ELECTRONIC MARKETPLACES

FOR TAILORED LOGISTICS

BY

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Dedication

To my parents and Dantong,

for their support and encouragement

Abstract

In the last two decades, the role of e-business as a fundamental element that links organisations of the supply chain into a unified and coordinated system has been increasingly recognised in the literature. Recent technological advances enable a proliferation of B2B e-business systems in supporting interorganisational e-business integration, but also create more complexities for organisations in determining what form of electronic linkage and relationship configurations should be forged with what kind of business partner(s). At the same time, as customers become more demanding, there is a trend towards providing tailored logistics provisions in order to satisfy different customers' needs. Consequently, careful design of information flows within and between the organizations is required.

In view of the aforementioned, there is need for a design of an overall e-business architecture which governs and specifies the different inter-organisation information coordinate and control (ICC) mechanisms for different logistics scenarios, referred to here as a B2B e-business reference architecture (ERA). Historically this research area has not received due attention from researchers or practitioners. Therefore, the primary aim of this thesis is to develop such an ERA and substantiate it through empirical research, focusing its application on an emerging e-business model termed an Electronic Logistics Marketplaces (ELM).

The first part of this research is analytical, developing the B2B ERA through the synthesis of literature and the use of secondary case examples. Four architectures are proposed with detailed characterisation: Centralised Market, Traditional Hierarchical Coordination, Modified Hierarchical Coordination, and Heterarchical Network. The second part of the research is empirical, since it validates the conceptual model developed through six case studies. It shows that one size does not fit all, and there should be different architectures for different logistics scenarios. The study also establishes a fundamental understanding of closed ELMs which have not been studied in-depth and systematically. Through analysis of three key elements, namely, technology, collaboration and process, the likely operational models and the relationship between ELMs and tailored logistics are established. Reasons for using closed ELMs are also identified through the exploration of motives, barriers, costs and benefits. A major case study is conducted to investigate the Heterarchical Network type of ELM, later after being termed as 'collaborative ELM'. Reasons for the formation of this type of ELM, and the impact it brings to the supply chain are examined in detail, providing significant insights considering its rarity and novelty in practice.

Finally the thesis summarises the research findings and their practical implications are discussed. Study limitations are acknowledged and possible future research directions are suggested.

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Thanks are due to industrial and governmental partners on McCLOSM and ELM projects, for providing funding, access and data for this research.

Finally, the author is greatly indebted to her parents and her husband Dantong. Without their full support, love and confidence in her, this PhD research would never have been accomplished. Thus this work is dedicated to them.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Description
3PL	Third party logistics: a third party logistics provider is a firm that provides outsourced logistics service to companies.
4PL	Fourth party logistics: a term coined by global consulting firm Accenture, "an integrator that assembles the resources, capabilities, and technology of its own organisation and other organisations" (for example, carriers) to provide comprehensive supply chain solutions.
AIP	Application integration provider: an agent or vendor who integrates a set of scattered enterprise computer applications by creating links among these applications in order to simplify and automate business processes.
ASP	Application service provider: an agent or vendor who assembles the functions needed by enterprises and packages them with outsourced development, operation, maintenance and other services.
B2B	Business to business: e-commerce model in which all of the participants are businesses or other organisations.
CIM-OSA	Computer Integrated Manufacturing Open System Architecture: It represents one of the most popular enterprise modelling architectures. It was developed for ESPRIT (European Strategic Programme for Research and Development in Information Technology) by AMICE (a consortium of 30 major European vendors and users of CIM systems (e.g. IBM, HP, DEC, Siemens, Fiat, and Daimler-Benz).
CNC	Computer numerical control: refers specifically to a computer 'controller' that reads G-code instructions and drives a machine tool, a powered mechanical device typically used to fabricate components by the selective remove of material.
CR	Continuous replenishment: a system used to reduce customer inventories and improve service usually to large customers.
CPFR	Collaborative planning forecast and replenishment: a concept whereby suppliers and retailers collaborate in their planning and demand forecasting to optimise the flow of materials along the supply chain.
CRM	Customer relationship management: a customer service approach that focuses on building long-term and sustainable customer relationships that add value both for the customer and the company.
DfT	Department for Transport: a government body with responsibility for all aspects of transport policy in the UK
DMS	Delivery monitoring system, an in-house software system owned by Shipper 1 in Case E.
DN	Delivery note, a standard document that is used to process a delivery of goods or services to a customer.
DOT	Delivery on time: a transportation performance measure evaluating the percentage of delivery on time vs total deliveries.
DRQ	Delivery request quotation, a distribution term used in Shipper 1's haulage load planning system
DSS	Decision support system: a computer-based information system that aids the process of decision-making.
EAI	Enterprise application integration: the integration of data between applications in a company.

Abbreviation	Description
ECR	Efficient consumer response: a concept which originated in the grocery sector, aiming for more responsiveness to customer demand and promoting the removal of unnecessary costs from the supply chain.
EDI	Electronic data interchange: the electronic transfer of specially formatted standard business documents such as bills, orders and confirmations, sent between business partners.
ELM	Electronic logistics marketplace, an online marketplace where shippers and carriers meet for either spot trading of transport services or for long-term collaboration.
EM	Electronic marketplace, an online marketplace where buyers and sellers meet to exchange goods, services, money, or information.
EPSRC	Engineering and Physical Sciences Research Council, a government supported funding body for universities in the UK.
ERA	E-business reference architecture: a high-level abstract framework for understanding significant components and the relationships between them and guiding implementations in general. Usually independent of their technical architecture and any implementation details.
ERP	Enterprise resource planning: an information technology term referring to a software system that serves all departments within an enterprise.
ERP II	Extended enterprise resource planning: the system extends beyond an enterprise boundary, linking with business partners like suppliers and customers.
ESIS	European stock information system: one of the case shipper's in-house stock management systems which monitors the overall stock status across its European operation units.
FMCG	Fast moving consumer goods
GERAM	Generalised Enterprise Reference Architecture and Methodology: is a tool-kit of concepts for designing and maintaining enterprises for their entire life-history. GERAM is not yet-another-proposal for an enterprise reference architecture, but is meant to organise existing enterprise integration knowledge. Generalised Enterprise Reference Architecture defines the generic concepts recommended for use in enterprise engineering and integration projects.
GPRS	General packet radio service: a method of transferring large amounts of mobile data at higher speed.
GPS	Global positioning system: a worldwide satellite-based tracking system that enables users to determine their position anywhere on the earth.
GSM	Global system for mobile communication: an open, non-proprietary standard for mobile voice and data transmission.
HLPS	Haulage load planning system: an in-house software system owned by Shipper 1 in Case E.
ICC	Information coordination and control: information connectivity mechanism for managing dependences between various parties
ICT	Information and communication technology
IOS	Interorganisational system: a communication system that allows routine transaction processing and information flow between two or more organisations.
IS	Information system, the means by which people and organisation utilising information technology gather, process, store, use and disseminate information.
JIT	Just-in-time: an inventory strategy implemented to improve the return on investment of a business by reducing in process inventories and their associated costs.

Abbreviation	Description
McCLOSM	Mass customised Collaborative Logistics for Sustainable Manufacturing: a 3-year flagship project conducted at Cardiff University innovative manufacturing research centre, of which the author is one of the three research associates.
MRP	Material requirement planning: a software system based production planning and inventory control system used to manage the manufacturing process.
MRP II	Manufacturing resource planning: a software system based method for the effective planning of all resources in a manufacturing company.
PAYG	Pay-as-you-go: a pricing model, customers use a software as a service and pay based on the transaction volume.
PERA	Purdue Enterprise Reference Architecture: a popular enterprise modelling architecture. It is composed of three main components: production facilities, people, and control and Information Systems.
PM	Packaging material
PO	Purchase order
POD	Proof of delivery: a written or digital document which is used as evidence of completed deliveries.
POS	Point of sales: the point at which the business transaction of the sale of goods or services to the customer occurs.
RBV	Resource based view: a management theory which studies how a firm's resources and capabilities can affect its performance.
RM	Raw material
RQ	Research question
SCM	Supply chain management: the process of managing upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole (definition by Christopher (1998)).
SCOR	Supply-Chain Operations Reference-model: is a process reference model that has been developed and endorsed by the Supply-Chain Council (US) as the cross-industry standard diagnostic tool for supply-chain management.
SME	Small and medium sized enterprise
SMS	Short message service: a service that supports the sending and receiving of short text messages on mobile phones.
TCA	Transaction cost analysis: a theory used to answer whether a transaction should occur within the hierarchy or the market.
TCE	Transaction cost economics: a theory used to answer whether a transaction should occur within the hierarchy or the market.
TMS	Transport management system: a software system that helps in managing transportation.
VAN	Value added network: private, third party managed networks that add communication services and security to existing common carriers; often used to implant traditional EDI systems.
VMI	Vendor managed inventory: the practice of retailers making suppliers responsible for determining when to order and how much to order.
WIP	Work in progress
WMS	Warehouse management system: a software system that helps in managing warehouse.
WTD	Work Time Directive: UK and European's regulations on working time
XML	Extensible Markup Language: a standard language used to improve compatibility between disparate systems of business partners by defining the measuring of data in business documents.

Chapter 1 Introduction

1.1 Chapter overview

In this chapter, background information pertaining to the research is given. Aim and research questions are presented, followed by a brief introduction to the research. Finally, an overview of the different chapters is included in order to acquaint the reader with the structure of the thesis.

1.2 Background

In the last two decades, the role of e-business as a fundamental element that links the organisations of the supply chain into a unified and coordinated system has been extensively discussed in the literature. It is argued that supply chain structures are now governed by the flow of information and decisions, rather than the physical flow of goods (Lewis and Talalayevsky, 2004). E-business in the literature is viewed as the backbone and nervous system of the supply chain business structure and an essential enabler of logistics activities (Gunasekaran and Ngai, 2004b). E-business here refers to the use and application of information and communication technologies to support a range of business processes. It includes all electronically mediated information exchanges within and between an organisation and its external stakeholders, through any computer-to-computer means, such as intranets, Electronic Data Interchange, and the Internet.

At the same time, as customers become more demanding, logistics solutions are becoming more customised to different customer segments (Bask, 2001). Torres and Miller (1998) also suggested that logistics operations should be aligned with customer segments to gain higher market penetration, greater customer loyalty, and profitable growth. This implies that organisations have to be both efficient and flexible in their logistics operations in order to fulfil different customers' unique needs. Consequently, the careful design of information flows within and between organisations is required. Since the internal use of e-business in logistics is now well advanced, with the wide adoption of Enterprise Resource Planning (ERP) systems and other applications like the transport management system (TMS) and warehouse management system (WMS), this research focuses on inter-organisation e-business connectivity, which is a relatively less mature area.

Facilitated by recent advances in Web-technologies, inter-organisational connectivity has become more efficient and less costly. There has been a proliferation of technology platforms, such as e-marketplaces, hubs, and portals, as well as tools such as enterprise application integration (EAI) for inter-organisation integration (Chou *et al.*, 2004). However, this also creates more complexities and difficulties for organisations in determining what form of electronic linkage and relationship configurations should be forged with what kind of business partners.

1.3 Aim and research questions

Based on the above discussion, there is a need for a design of an overall e-business architecture which governs and specifies the different inter-organisation information coordinate and control (ICC) mechanisms for different logistics scenarios, referred to as a B2B e-business reference architecture (ERA). Historically, this research area has not received due attention from researchers or practitioners (Christiaanse and Kumar, 2000; Gunasekaran and Ngai, 2004a). ***The primary aim of this thesis is therefore to develop such an ERA and substantiate it through empirical research, focusing its application on an emerging e-business model termed the Electronic Logistics Marketplace (ELM).*** An ELM can be defined as an electronic hub using Web-based systems that link shippers and carriers together for the purpose of collaboration or trading. There are two main types of ELM: open and closed. The former is used to facilitate long-term collaboration between shipper and carrier; the latter is for trading purposes either spot trading or strategic tendering. This research focuses on the closed ELM. It should also be noted that there is not a binary distinction between open and closed ELM, there is possibly a spectrum with differing degrees of openness and closure. More details are discussed later in this Chapter and Chapters 3 and 6.

Prior to the invention of web technologies in the late 1990s, e-business integration between organisations was usually achieved through building dedicated linkages, for example, using EDI, or sophisticated EAI techniques. Such connectivity involved large capital investment, long deployment time, and high switching costs. Usually only large companies could afford it. Once the system was set in place, a strong bond was created among the organisations (Gosain *et al.*, 2004). However as a result of increasing business dynamics, organisations need to build more robust and reconfigurable inter-organisational linkages to deal with changes in the business environment. Hence, when there is a need for structural partnering change, they will have the flexibility to configure or reconfigure their information linkages with their business partners. The traditional way of B2B integration has been seen as too rigid to meet such requirement (Edwards *et al.*, 2001).

It is the development of Web-based systems which makes the flexible B2B integration possible. Rather than the costly and complex point-to-point integration of separate systems, Web-based systems are designed for participants to share a single system. More recently, the rapid development of web technologies has also led to the emergency of a new concept, the so-called 'software-as-service', sometimes called 'on-demand' (O'Sullivan, 2007). Unlike traditional applications that are paid for with an up-front licence fee and installed on a company's own premises, on-demand systems are hosted by the vendor and typically paid for on a subscription basis. Offering greater flexibility for B2B collaboration, such systems also enable not only large companies but also small and medium sized companies to be able to use Web-based technologies. Such technological advances serve as an accelerator and boosted the development of a new e-business logistics model, the ELM. Emerging as recently as the late 1990s, the ELM is still at its infancy. However it is claimed to have potential advantages, namely, low cost inter-organization information connectivity, real time visibility, and flexible partnership configurations (Grieger, 2003; Kaplan and Sawhney, 2000). Because of these characteristics, the ELM has great potential in supporting the different logistics provisions. While there have been many studies of traditional e-business applications in the logistics field, study of ELMs are relatively few. Consequently, our understanding of this infancy business model is still very limited. There are therefore two benefits to be gained on the application of the developed B2B ERA typology in the ELM context:

1). Substantiation and validation of the conceptual model, and

2). Acquisition of a basic overall and enhanced understanding of ELMs.

In the UK, road haulage dominates the freight transport industry. The road haulage industry is characterised by a high degree of fragmentation with a high number of SMEs. The Department for Transport (DfT) reports that, in 2005/2006, 45% of vehicle operators had just one vehicle and only 0.3% had fleets of more than 100 vehicles (Keynote, 2007). It is also a highly competitive market, facing a number of challenges such as road congestion, reliance on spot haulage, low margins and environmental pressures (McKinnon, 2007). ELMs are therefore seen by the private sector and governmental organisations as one of the new ways of managing the movement of freight in a more efficient way.

Early ELMs were open platforms, such as www.teleroute.com, and hence had the same characteristics as the generic open electronic marketplace (EM). They adopted many-to-many transactions and utilised fixed and/or dynamic pricing (Gosain and Palmer, 2004). Despite the benefits of lower search and coordination costs, there is an increasing need for companies, mainly shippers, in ELMs to retain their linkages with preferred business partners (Dai and Kauffman, 2002). This has led to the recent development of closed ELMs, aiming not for a large volume of transactions, but based on relational lines emphasising extent of services. It is the closed ELM which is seen to have more strategic impact on the overall logistics performance, and has not been explored in depth. Hence, the focus of this empirical research is on closed ELMs.

In line with the research aim discussed above, four research questions are developed and addressed in this research:

1). RQ1. What are the supporting B2B e-business architectures for the provision of effective tailored logistics? This question considers the underlying B2B information coordination and control mechanisms and examines how they can support the provision of tailored logistics.

2). RQ2. Of the different architectures, how does the closed ELM, as an emerging business model, function and enable the provision of tailored logistics? Through this question, the emerging e-business model, i.e. the closed ELM, is investigated in detail, in particular through the examination of three key elements: technology, process and collaboration. How the closed ELM enables the provision of tailored logistics is also examined.

3). RQ3. What are the reasons for using a closed ELM within supply chains? This question builds on RQ2 and explores further the motives, barriers, costs and benefits in using closed ELM within supply chains, from both shippers' and carriers' perspective.

4). RQ4. What are the reasons for and impacts of introducing a novel type of ELM i.e. Heterarchical Network? This question attempts to understand Heterarchical Network type of ELM, later on termed as 'collaborative ELM', in depth through a 12-month major case study. This is particularly important given the novelty, rarity in practice and lack of research on this type of ELM.

It is important to point out that research questions are formulated not only from the literature review in Chapter 2 but are developed gradually as the research investigation progresses. RQ1 is developed in Chapter 2 after the review of the historical developments in both the e-business and logistics fields. RQs 2-4 are developed in Chapter 3, after the conceptual B2B ERA is proposed and its application in the ELM context is justified. How these RQs are developed is discussed in more detail in Section 1.5 below.

1.4 Research project

This research is part of a three-year flagship research project at the Cardiff University Innovative Manufacturing Centre which is sponsored by the Engineering and Physical Sciences Research Council (EPSRC). Known as Mass Customised Collaborative Logistics for Sustainable Manufacturing (McCLOSM), the project involves in total six industrial companies from three sectors: grocery, steel and transport. The whole project investigates how customised logistics solutions can be delivered in the most economic way. The author was one of three research associates participating in the flagship project, looking specifically into how information and communication technology facilitates both efficient and effective logistics provision.

This research is also funded by UK's Department for Transport (DfT), with a practical aim of producing a Freight Best Practice Guide for the government. This helped the author extend the research to a wider context to incorporate six ELM specific case examples from various industries. In total 12 companies are recruited including shippers, carriers and technology providers (see Chapter 4). This has provided a rich source of case study data. All the companies' names are withheld to ensure anonymity and confidentiality.

1.5 Thesis structure

As has already been seen, Chapter 1 provides background information on the research and presents research aim and questions. This helps to set the scene for the overall research.

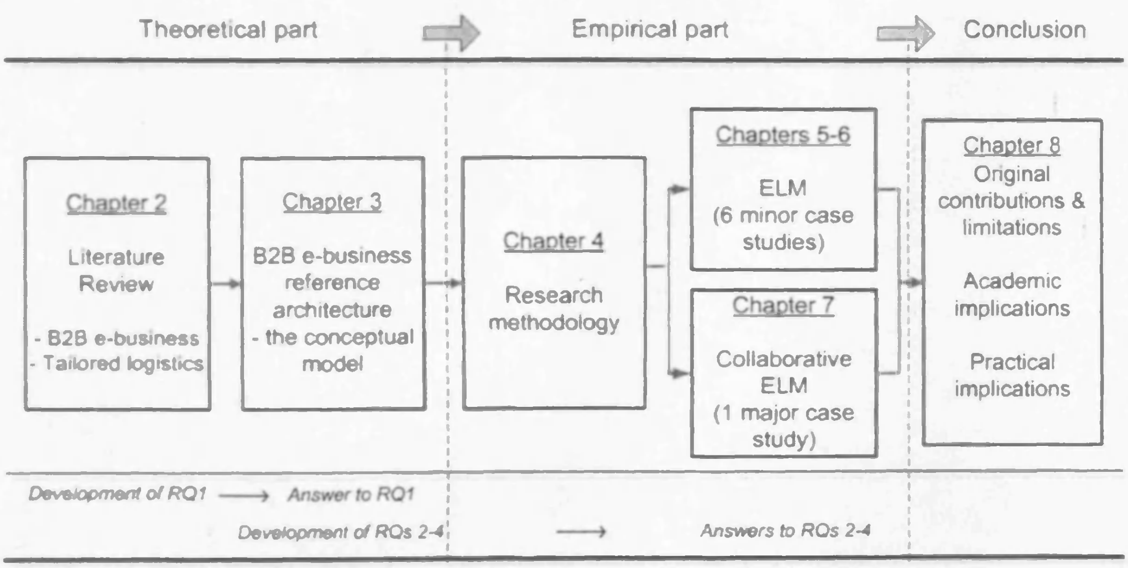


Figure 1.1 Overall thesis structure
(Source: Author)

The thesis consists of three parts as illustrated in Figure 1.1. The first part focuses on the theoretical aspects of the study and includes Chapters 2 to 3. The second part, Chapters 4 through to 7, presents the empirical evidence which validates the applied model being developed. The final part, Chapter 8, provides a summary of research findings, and a discussion of the research contributions and their implications. It concludes the research.

Chapter 2 presents a review of the evolutionary path in e-business technology, especially in the business-to-business (B2B) area, and the impact it has on logistics management. The historical developments of logistics paradigms are also detailed. Following this, the concept of customised logistics and its importance are discussed. The criticality of the proper design and alignment of e-business linkages in supporting different logistics provision is emphasised. This then leads to the development of RQ 1.

Chapter 3 develops a conceptual model, in the form of a B2B e-business reference architectures for tailored logistics from a synthesis of literature in the field of information architectures, including coordination theory and control architectures, and the use of secondary case examples. It answers RQ1 and at the same time develops RQs 2-4. This work has been published in the *International Journal of Services Operations and Informatics*, in its special issue *Intelligent Supply Chain Management*. A full reference is:

Wang, Y and Naim, M. M., (2007), "B2B e-business reference architecture for tailored logistics", International Journal of Services Operations and Informatics, Vol. 2 No. 3, pp. 253-266.

Chapter 4 describes the different methodological approaches in the study of logistics and operation management, and justifies the reason why a multiple case study approach is adopted in this research. The study and process is discussed in detail in order for the reader to comprehend how this helped to achieve the aim and objectives of the research.

Chapters 5 to 7 report the major case study findings. In Chapter 5, the operational models are established of three major closed ELM types, and the impact on tailored logistics provisions is examined. This answers RQ 2. This work is published in *Industrial Management and Data Systems*. A full reference is:

Wang, Y., Potter, A. and Naim, M. (2007), "Electronic marketplaces for tailored logistics", Industrial Management and Data Systems, Vol. 107 No.8, pp. 1170-1187.

Chapter 6 identifies the motivations, barriers, costs and benefits associated with the use of closed ELM and this provide answers to RQ3. This work was presented at the 12th Logistics Research Network Annual Conference in 2007. The full reference is as follows:

Wang, Y., Potter, A. and Naim, M. (2007), "Evaluating the reasons for using electronic logistics marketplaces within supply chains", Proceedings of 12th LRN conference, September 5-7, Hull, UK.

Chapter 7 presents the research findings derived from a major case study of a particular type of ELM, termed as a collaborative ELM. It is a new form of the closed ELM, and is seen to have most potential in enabling network optimisation. This provides the answer to RQ 4. This work was presented at the 9th Annual NOFOMA Conference in 2007. The full reference is:

Wang, Y., Potter, A. and Naim, M. (2007), "Assessing the impact of the electronic logistics marketplace – a case study", Proceedings of the 19th Annual NOFOMA Conference, June 7-8, Reykjavik, Iceland.

Finally, Chapter 8 discusses the overall research findings and the original contributions the research has made to the field. Academic and practical implications together with limitations and potentials for further research are also presented.

Figure 1.2 illustrates the evolutionary path of the whole research process, and demonstrates a 'zoom-in' approach as the research progresses.

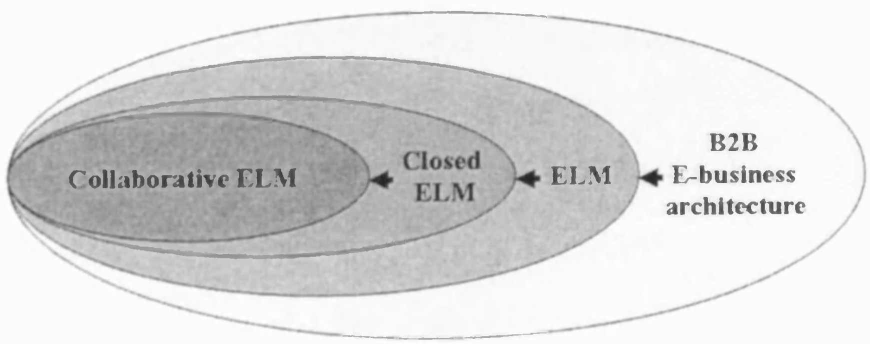


Figure 1.2 Research progression logic
(Source: Author)

1.6 Summary

This chapter has provided background information on the research initiative and research project, and presented the research aim and questions. An overview of the contents of thesis has also been provided in order to aid the reader's understanding of the research process and its progression.

Chapter 2 Literature Review

2.1 Chapter overview

This is the first chapter of the theoretical part as shown in Figure 2.1. First, important concepts in e-business are presented, along with a brief discussion of their impact on logistics management. Following this is a review of the evolutionary path of e-business technology, particularly with regard to the business-to-business (B2B) area. Second, the chapter looks at the development of logistics and supply chain management, and the relationship between the two. The concept of tailored logistics is then illustrated. Third, a discussion of the evolution of e-business technology and logistics development highlights the challenges complex and fragmented e-business systems present to both academics and practitioners in determining what form of electronic linkages and relationship configurations should be forged with their business partners. This leads to the development of Research Question 1.

> ***RQ1. What are the supporting B2B e-business architectures for the provision of effective tailored logistics?***

A review of related studies in the literature and their limitations are subsequently presented. It needs to be pointed out here that background information on ELMs as well as the lack of research on closed ELMs will be discussed in Chapter 3, which is also part of the literature review.

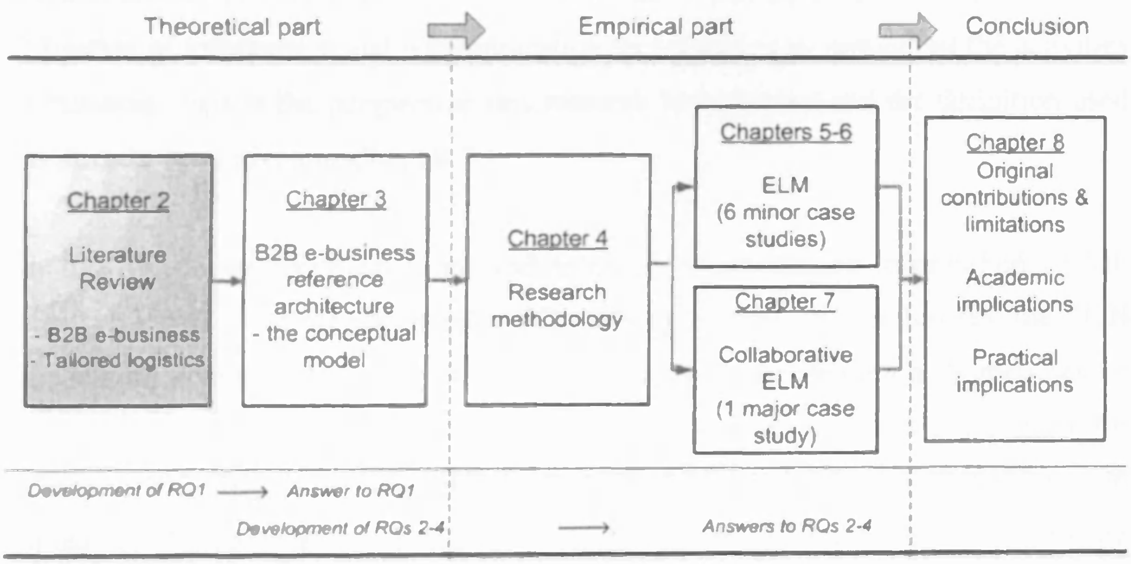


Figure 2.1 Thesis structure- literature review
(Source: Author)

2.2 Business-to-Business (B2B) E-business

Definitions of E-business, E-commerce and Interorganisational Systems (IOSs)

Although the importance of e-business in the overall supply chain performance has been widely discussed in the literature, there is still no common definition of e-business. Other interchangeable terms like e-commerce and IOSs create even more confusion.

The fast emerging ICT in the 1990s dramatically transformed the way companies used their supply chain operations to achieve competitive advantages. This led to the emergence of the 'e-business' concept. The term 'e-business' was coined by Lou Gerstner, CEO of IBM. It refers to the transformation of key business processes through the use of Internet technologies (Anonymous 1997). There are a number of different viewpoints of the relationship between e-business and e-commerce. Some consider e-business and e-commerce to be synonymous (Rayport and Jaworski, 2001). Others believe e-commerce has some degree of overlap with e-business (Award, 2004; Laudon and Traver, 2007). But the most popular and most realistic perception is that e-commerce is a subset of e-business (Chaffey, 2004). For example, Turban *et al.*, (2006) point out that e-business is a broader concept of e-commerce, not just the buying and selling of goods and services, but also servicing customers, collaborating with business partners, and conducting electronic transactions within an organisation. Beynon-Davies (2004) holds a similar view that e-business can be defined as the utilisation of information and communication technologies to support all the activities of business. This is the perspective this research has adopted and the definition used has already been given in Chapter 1.

An IOS is a more technical term, and refers to an automated information system shared by two or more companies (Choudhury, 1997). It emphasises the B2B information connectivity, rather than the internal system integration. Sometimes an IOS is also referred to as a collaborative SCM system, addressing the need for information sharing and collaborative management of supply chain activities between companies (McLaren *et al.*, 2002). The terms IOS and B2B e-business systems are hereafter used interchangeably.

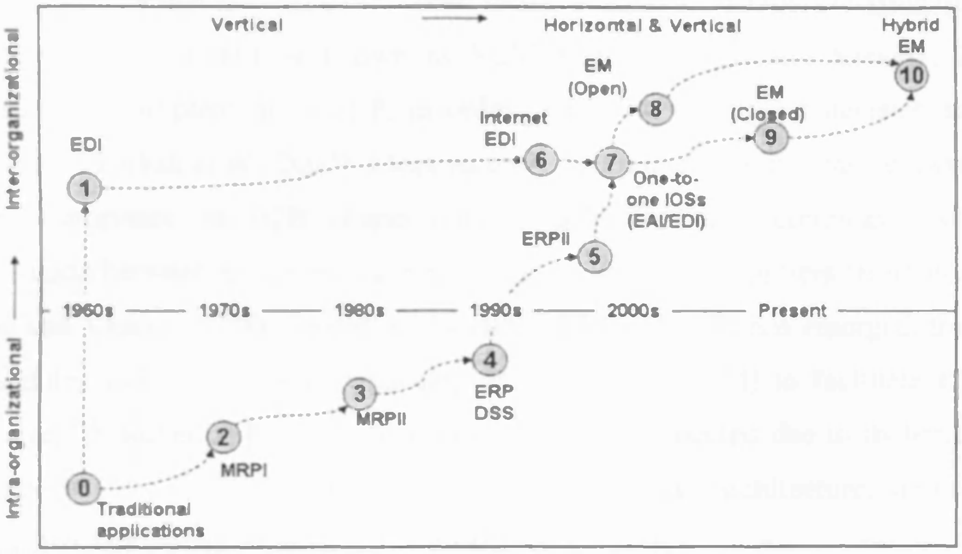
The impact of e-business technologies on logistics

In a highly competitive environment, the importance of fast developing e-business for ultimate success, and in some cases, even the survival of any logistics operation and initiatives, has been well recognised (Bowersox and Daugherty, 1995; Closs and Swink, 2005; Edwards *et al.*, 2001; Helo and Szekely, 2005; Kärkkäinen *et al.*, 2007; Lewis, 2001). Many advanced business concepts would not have been successfully implemented without the aid of e-business technology, for instance just-in-time (JIT), time compression, collaborative planning forecasting and replenishment (CPFR), vendor managed inventory (VMI), and cross docking. National Bicycle's postponement strategy and Dell Computer's mass-customised direct marketing model are well known examples of utilising e-business technologies to manage their supply chains. E-business has had a significant impact on supply chain structures, and inter-organisational coordination and relationship configurations (Croom, 2005). It supports business operations, facilitates decision-making, and brings competitive advantage (Lewis, 2001).

It is claimed that there are multiple benefits from using information and electronic business concepts in the supply chain. E-business can make the flow of goods transparent, allow for the integrated management of a physically dis-integrated unit, and decentralisation and centralisation within one operating system (Bowersox and Daugherty, 1995; van Hoek, 2001). Improvement on customer service, operation efficiency, information quality and support of collaborative planning and execution as well as improved responsiveness are well cited benefits in the literature (Auramo *et al.*, 2005; Bharadwaj, 2000; Mondragon *et al.*, 2004; Pokharel, 2005). More specifically, e-business can facilitate the effective information change and removal of unnecessary players in the supply chain, for example, by helping in minimising one of the well documented problems, the 'bullwhip effect' (Holweg *et al.*, 2005; Chatfield *et al.*, 2004; Lee *et al.*, 1997). Creating better information flows between organisations can also help to reduce the uncertainties in demand or supply, and the need to build expensive inventory buffers (Premkumar *et al.*, 2005).

The development of e-business systems in logistics

To better appreciate the impact of e-business technology on logistics, it is advisable to take a look at the evolution of logistics information systems over the last four decades, which is summarised in Figure 2.2. Figure 2.2 does not attempt to provide a comprehensive summary, rather it highlights the major developments along a time line.



MRPI: Material Requirement planning; MRPII: Manufacturing Resource Planning; ERP: Enterprise Resource Planning; DSS: Decision Support System; EM: Electronic Marketplace

Figure 2.2 The evolutionary path of e-business systems in logistics
(Source: Author, based on various sources)

Historically, the use of e-business systems in logistics and supply chain management originated in the 1960s. Typical examples are inventory management systems, scheduling and billing systems. These systems are usually function-based and thus are independent of each other. Material Requirements Planning (MRP) later evolved in the 1970s in order to integrate production, purchasing and inventory management functions. In the 1980s, companies realised the limitations of MRP in incorporating financial and labour into the planning. This resulted in an enhanced MRP methodology and software termed Manufacturing Resource Planning (MRP II), which adds labour and financial requirements to the system. The integration expanded further in the 1990s and tries to integrate all the transaction processing activities of all functional areas in the entire enterprise. This is termed Enterprise Resource Planning (ERP).

Although it is widely accepted that ERP systems can bring about greater integration within an enterprise and have been widely adopted, it is impossible for one single system to provide a one-stop solution for all the logistics activities within a company. Therefore, many companies still need, or sometimes prefer to adopt best-of-breed systems for certain logistics activities. For example, TMS and WMS are typical stand alone packages which are still widely used today. During the 1990s, Decision Support Systems (DSSs), sometimes known as SCM systems (Helo and Szekely, 2005), emerged as a complement to ERP, in order to provide intelligent decision support capabilities (Turban *et al.*, 2002). More recently, there has been increasing awareness of the importance of B2B connectivity to achieve better communication and collaboration between an organisation and its customers and suppliers (Horvath, 2001; Wilson and Vlosky, 1998). Therefore, extended ERP (ERP II) has emerged, trying to add modules like Customer Relationship Management (CRM) to facilitate external integration. However, it has been less successful than expected due to its limitations in respect of its design issues, implementation issues, architecture, access and availability (Akkermans *et al.*, 2003; Edwards *et al.*, 2001).

The development of IOSs has paralleled the development of enterprise systems discussed above. EDI is one of the earliest IOSs developed to streamline business processes like order transmission, delivery note communication, and financial settlements. Although EDI has been in practice since the 1960s, a major step in its adoption only occurred in 1982 when General Motors and Ford mandated EDI for their suppliers (Award, 2004). The main problems with EDI are that it is relatively expensive and inflexible, and so is unaffordable for small and medium sized companies. In many cases, therefore, it has been used by large organisations as a tool to 'lock in' their key business partners (Gosain *et al.*, 2004).

When the Internet commercialised and users began flocking to participate in the World Wide Web in the early 1990s, EDI transmission migrated from the use of private networks or value-added networks (VANs) to Internet based open communication platforms (Zhu *et al.*, 2006). Internet EDI provides a number of advantages over traditional EDI, for example, near real time transmission, and a significant reduction of set up and transaction costs (Lankford, 2000). Though it seems that Internet based EDI presents a cost effective transmission medium, many organisations will still need an EDI translation software to provide interface between internal systems and the EDI format sent/received. Similar to EDI systems, EAI based systems also use either point-to-point connections or middleware-based integration, therefore they also utilise rigid and complex interfaces and are costly to deploy (Badii and Sharif, 2003). These systems are categorised as one-to-one IOSs, sometimes known as proprietary IOSs.

While EDI/EAI systems are still widely used in industries, Internet-based IOSs have gained significant growth since the late 1990s, facilitated by rapid ICT developments. Rather than the costly and complex point-to-point integration of separate systems, Web-based systems are designed for participants to share a single system. Because of the relative immature nature of Internet-based IOSs, many studies have attempted to provide classifications of various IOSs for better understanding of their implications. A notable work is that of McLaren *et al.*, (2002) who classified different IOSs according to the degree of supply chain coordination and collaboration they support, as shown in Figure 2.3.

Such technological advances serve as an accelerator and boosted the development of a new e-business model, the electronic marketplace (EM). It is argued that due to the use of open technologies like web/XML based applications, asset-specific investment for B2B e-business integration will largely decrease and adoption of EMs will be higher and more rapid (Christiaanse *et al.*, 2004). The early EMs tend to be open systems, and based solely on aiding procurement for both buyers and suppliers (Daniel *et al.*, 2004).

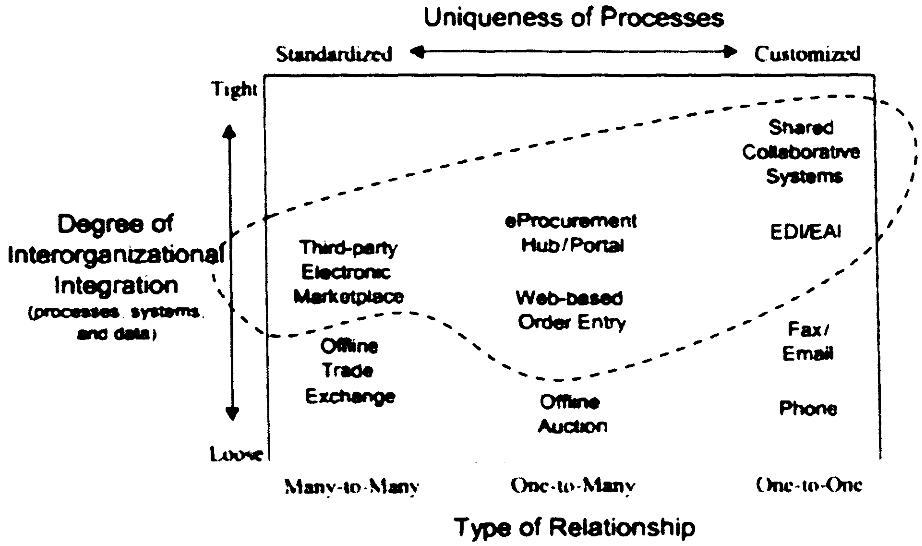


Figure 2.3 Collaborative supply chain systems
(Source: McLaren *et al.*, 2002)

A new business model termed closed EMs, sometimes simply known as network, emerged in early 2000s. It has not been explicitly incorporated into McLarent *et al.*'s classification and little research has been done in this area. The study of closed EMs from a logistics perspective has been even scarcer (Grieger, 2003). The lack of logistics focused studies on closed EMs will be discussed in detail in Chapter 3, Section 3.6, which will then lead to the development of RQs 2-4. The major difference between a closed EM and a third party EM (known as open EM) is that the former mainly uses a Web-based platform for strategic alignment, while the latter normally uses a Web-based platform for spot trading and strategic tendering. To some extent, closed EMs have similarities with 'shared collaborative systems' as defined by McLaren *et al.*, (2002), as they both attempt to share one single system rather than integrate different systems. But 'shared collaborative systems' are limited to either jointly owned SCM systems or SCM modules from ERP packages which are made accessible for partner access and collaboration. Shared collaborative systems still emphasise the one-to-one connection, while the closed EM allows multiple participants and provides uniform visibility to all. Finally, it is predicted that closed and open EMs can merge in the near future as a result of further advances in technology (Grieger, 2004).

More recently, the rapid development of web technologies has also triggered the emergency of a new concept, called 'software-as-service' or sometimes named as 'on-demand' (O'Sullivan, 2007). On-demand systems are hosted by a third party and user companies just 'plug in and play'. Offering greater flexibility, on-demand systems also enable not only large companies but also small and medium sized companies to be able to use the system (Gulledge, 2002). Although widely considered as the next-generation technical advance in practice (Lynch, 2005; O'Sullivan, 2007; Dubey and Wagle, 2007; Viswanathan *et al.*, 2007), our understanding of these new business models and concepts from an academic perspective is very limited.

To summarise, the above discussion clearly demonstrates that while the development of enterprise systems is relatively mature with the dominant use of ERP systems (Akkermans *et al.*, 2003; Botta-Genoulaz *et al.*, 2005), there is a variety of emerging and co-existing IOSs in logistics practice. On the one hand, these technical advances have made B2B e-business connectivity more flexible and less costly, for example, many IOSs have become more reliable and adaptable, and can now be more easily modified, extended or reconfigured. On the other hand, this also creates complexities and difficulties for organisations in determining what form of electronic linkage and relationship configuration should be forged with what kind of business partner(s). Typical issues include fragmented development of different software applications and standards, interoperability between different systems, and time and cost of deployment (Jardim-Goncalves *et al.*, 2006; Kosanke, 2005; Love *et al.*, 2004).

At the same time, as customers become more demanding, logistics solutions are becoming more tailored to different customer segments. This requires the careful design of an information control and coordination (ICC) mechanism between organisations in order to achieve effective and efficient logistics provisions. The following sections will examine in more detail the concept of tailored logistics. Prior to this, a brief overview of logistics and supply chain management is provided. This will then lead to a discussion as to why it is critical to have an overall e-business architecture to govern and specify the different ICC mechanisms for different logistics scenarios.

2.3 Logistics and supply chain management

History and definitions

The academic study of logistics management dates back to the 1850s when Henry Adams, an economist and president of Yale University, offered a course in the Economics of Transportation (Farris, 1997). In the 1960s, it was argued that logistics was unexplored and had been left behind as a "dark continent" (Drucker, 1962). Growing realisation of the importance of logistics occurred in the late 1970s and 1980s (Bartels, 1976; Heskett, 1973; Shapiro, 1984; Sharman, 1984). During the last ten years, logistics developments have exerted significant influence on organisations in many industries, for example, in the automobile and retail sectors. In fact, it is widely accepted now that logistics can bring competitive advantages by creating value for customers, and acting as an important source of cost savings and as a critical link between production and marketing (Fuller *et al.*, 1993).

There are a number of definitions of logistics. Christopher (1992) nevertheless argued that although there are many ways of defining logistics, logistics is fundamentally "the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organisation and its marketing channels in such a way that current and future profitability are maximised through the cost-effective fulfilment of orders".

Another popular definition is that offered by the Council of Logistics Management in the United States which defines logistics as "the process of planning, implementing, and controlling the efficient and effective flow and storage of goods, services, related information from point of origin to point of consumption for the purpose of conforming to customer requirements" (Council of Logistics, 2006).

More recently, logistics has evolved into a broader management philosophy known as supply chain management (SCM). The development of the idea of the supply chain owes to the emergence from the 1950s onwards of systems theory, and the associated notion of holism (New, 1997), as a result of the observation that the behaviour of a complex system cannot be understood completely by the segregated analysis of its constituent parts (Boulding, 1956; Burbidge, 1961).

The distinction between SCM and logistics is unclear in the literature. According to Larson and Halldorsson (2004), there are four distinct perceptions of the relationship between SCM and logistics as shown in Figure 2.4. The traditionalist positions SCM within logistics and sees SCM as external logistics activities between companies. The interventionist's perspective believes logistics and SCM overlap, and logistics evolves into 'integrated logistics', which is often called SCM. The re-labelling perspective views the concept of SCM and logistics as synonymous. Finally the unionist argues that SCM is a wider concept, which includes all business functions such as new product development, finance, marketing and human resource management, which are not typically within the scope of logistics. This unionist approach is adopted by the author in defining the boundary and relationship between the two concepts, as the research focuses mainly on the order-to-delivery process and related functions, rather than supportive activities like finance, marketing and human resource management. This is also supported by Stock and Lambert (2000) and Lummus *et al.*, (2001), who claimed that logistics usually includes the following business processes: customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, sourcing, new product introduction, and returns.

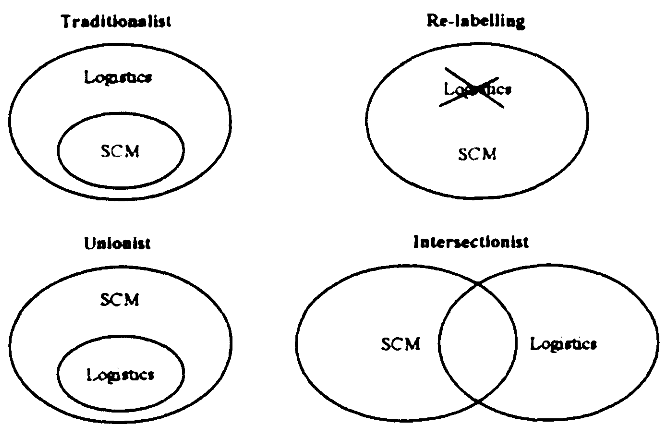


Figure 2.4 Perspectives on logistics vs supply chain management
(Source: Larson, 2004)

Tailored logistics

It is argued that companies should tailor their supply chains to specific customer requirements to remain competitive in today's turbulent markets (Fisher, 1997).

Specifically, Fisher differentiates between physically efficient and responsive supply chains. The former is aimed at what he calls functional products; those products that are marketed according to price and have little if any degree of customisation. Responsive supply chains are created to support 'innovative' products, which are fashion items with a high degree of customisation and short life cycles. This concurs with research by Fuller *et al.*, (1993), who suggested that supply chains should be tailored to specific market priorities. Fuller et al. also pointed out that logistics is seen as an essential service like 'an envelope around physical products'. Tailored logistics means that different logistics pipelines should be organised according to different customers' needs, which include the appropriate provisions of the channels of transport, warehousing, handling and control. Such suggestion thus implies that different logistics processes have distinct goals and priorities (Torres and Miller, 1998). In fact, it has been suggested that aligning logistics segments could lead to higher market penetration and greater customer loyalty (Narus, 1996).

Supply chains that try to satisfy all marketing priorities are vulnerable to developing standard or 'average' offerings to their customers that lead to increased costs and poor customer service when specific customisation is required. Christopher (1992) also indicates that a service-oriented logistics system should be designed, in order to establish the relative importance of customer service for different customers. He claims that it is wrong to purely focus on internal requirements such as cost reduction. A global survey of 208 companies conducted by Panayides (2004) confirmed that service differentiation does exert a positive impact on various measures of company performance. According to Lee (1998), logistics postponement can also be used for alternative customisation to satisfy customer demands. Recently a contingency based approach to supply chain management has become popular in much of the literature that attempts to consolidate differences between lean and agile product delivery (Naylor *et al.*, 1999; Christopher and Towill, 2002; Aitken *et al.*, 2005). According to Naylor et al. (1999)

> "Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile marketplace. Leanness means developing a value stream to eliminate all waste, including time, and to enable a level schedule".

It is suggested that whereas both lean and agile delivery streams have 'quality' and 'reliability' as their market qualifiers, the former focuses on 'price' as order winner and the latter on 'lead time'. The different strategies are determined by the relative importance attached by potential customers to these criteria.

Having realised that the traditional way of using general services to deal with all customers has its limitations, tight process integration and collaborative partnership between suppliers and customers are now well-cited strategies to achieve better logistics efficiency and effectiveness (Holweg *et al.*, 2005; Stevens, 1989; Bowersox, 1990; Sundaram and Mehta, 2002). For example, Stevens (1989) presents a four-step evolutionary model for supply chain integration; moving from functional silos, towards fully external integration with suppliers and customers. Folinas *et al.*, (2004) used Steven's four-step evolutionary model to examine the evolution of an electronic supply chain. They also argued that the more integrated the supply chain, the better the supply chain performance. However one should be noted that many companies cannot afford to build tight integrated process linkages and relationships with all their customers and also do not need to build them (Gosain *et al.*, 2004; Zhang *et al.*, 2005). Rather, organisations need to build their logistics flexibilities to cope with the divergence of delivery processes (Closs and Swink, 2005; Zhang *et al.*, 2005; Naim *et al.*, 2006). There is a trade-off between tight integration and adaptability (Jahre and Fabbe-Costes, 2005). Too much integration can lead to less adaptability and loose coupling is necessary when there is a need for organisations to be more responsive to uncertainties in a dynamic business environment (Orton and Weick, 1990; Dubois and Gadde, 2002; Wang and Lalwani 2007).

Role of transport in tailored logistics

In the provision of effective tailored logistics services, the role of transportation is critical. It serves as a bridge over the buyer-seller gap and is the physical thread connecting a company's geographically dispersed operations (Coyle *et al.*, 2003). It also adds value to the company by creating time and place utility. As supply chains become lengthier under globalisation, transport becomes increasingly important in determining the overall efficiency and effectiveness of logistics process. At the same time, there is also a growing trend towards outsourcing logistics activities as companies put increased focus on core business processes and face pressures to reduce overall distribution cost (Selviaridis and Spring, 2007; Sheffi, 1990; Razzaque and Sheng, 1998; Bolumole, 2001). This has led to a growing interest in third party logistics (3PL) providers. Various terms have been used to describe the organisational practice of contracting out part or all of logistics activities, for example, '3PL', 'contract logistics' and 'carriers'. These terms are often used interchangeably. 3PL is usually associated with the offering of multiple services and are usually based on formal contractual relationships (Razzaque and Sheng, 1998; Stefansson, 2006).

In this research, outsourcing is considered to incorporate a wide spectrum of activities. Its scope can range from outsourcing only one type of service (e.g. warehouse or transport) or the complete logistics operations (e.g. multi-mode transport, warehouse, labelling and packing, and other value added activities). It does not necessarily involve formal contractual relationships like 3PL, for instance, spot trading of a road transport service in an open marketplace. The term 'carrier' is therefore adopted to denote external suppliers that perform all or part of a company's logistics function. The role of carrier in facilitating the provision of logistics services is depicted in the work of Fung and Wong (1998) as shown in Figure 2.5. This figure indicates that shippers and carriers should work together in delivering tailored logistics services. The various customisations required by customers, in turn, determine the required relationship configuration and process integration between a shipper and its carrier(s).

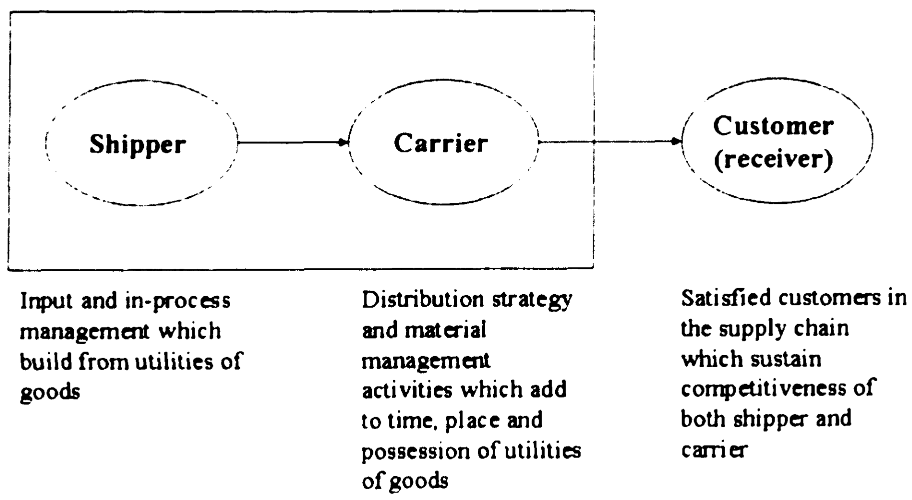


Figure 2.5 The role of carrier in facilitating the provision of logistics services
(Source: Fung and Wong 2000)

Logistics processes as a service are difficult to categorise because of their abstract nature, compared with more concrete manufacturing processes (Kallio *et al.*, 2000). Various classifications of logistics service provision have been proposed to highlight the differentiation of delivery processes. These are summarised in Table 2.1.

Author(s)	*Proposed classification of logistics service provisions*
Berglund *et al.*, (1999)	• *Basic logistics services*: provide a few standard services at low cost for many customers • *Value-added logistics services*: offer additional value added services to few large customers; customised comprehensive offers
Kallio *et al.*, (2000)	• *Routine services*: a streamline process for fast standard orders; only provide a few options for the customer to choose from • *Normal services*: provide customers with several options and represent the traditional way orders are managed in most companies • *Custom services*: adaptive delivery according to specific customer requirements; usually involves extensive communications and close partnership
Skjoett-Larsen (2000)	• *Single and repeated transactions*: short-term and arm-length relationship with customer with price being the main leverage • *Strategic alliances*: o Partnership: providing standard solutions, and largely maintained independence in terms of commitment; o Third party agreement: services are mainly tailored to the requirement of a specific customer. Cooperation is based on mutual trust and free information exchange. o Integrated logistics service: fully tailored to customers' requirement with a number of value added services; partial integration of information systems for better communication.
Bask (2001)	• *Routine services*: the provision of services that does not contain any specific arrangements, with a rationale for pursuing economy of scale. • *Standard services*: contain some easy customised types of operations with a rationale of pursuing economy of scale and scope. • *Customised services*: increasing customisation provided for only a few key customers with close partnership in place; pursuing economy of scope
Andersson and Norrman (2002)	• *Basic logistics services*: single services, and focus on handling and executing activities • *Advanced logistics services*: multiple and bundled services; focus on value added activities; development and reengineering of solution
Delfmann *et al.*, (2002)	• *Standardising services*: optimisation and offering of singular logistics services, resulting in highly interchangeable services. • *Bundling services*: combination of isolated services and optimisation of bundled logistics services, for instance, transportation combined with simply assembly and quality control activities; these bundles are offered undifferentiated for all potential customers • *Customising services*: individual, complete logistics solutions for specific customers; also offering management support services or tools configured specially for one or a few key customers
Kemppainen and Vepsalainen (2007)	• *Transaction based services*: use marketplace where customers are relying on self-service • *General services*: use service personnel or agents based on standard contracts • *Partnership-based service*: mainly used for principal customers, in which case customised delivery is provided and contingent relationships are forged. Service may be procured in house.

Table 2.1 Proposed classifications of logistics service provisions in previous studies
(Source: Author)

In Table 2.1, one can observe that large similarities exist among the classifications, most emphasise that the complexity of service provided and the level of customer relationship determine the level of customisation required. This logic is best presented by Bask (2001)'s framework shown in Figure 2.6. Bask (2001), which is based on the research of Fisher (1997), that suggests that logistics operations should be tailored to match the demands of the supply chain they are contained within, thereby providing flexibility in certain circumstances and efficient solutions in others. Another advantage of Bask (2001)'s framework is that it emphasises the importance of integrating carriers into the supply chain, and explicitly explores the correlation between the complexity of the logistics service provision and the type of relationship required to support it. Other classifications in Table 2.1 have failed to address these points.

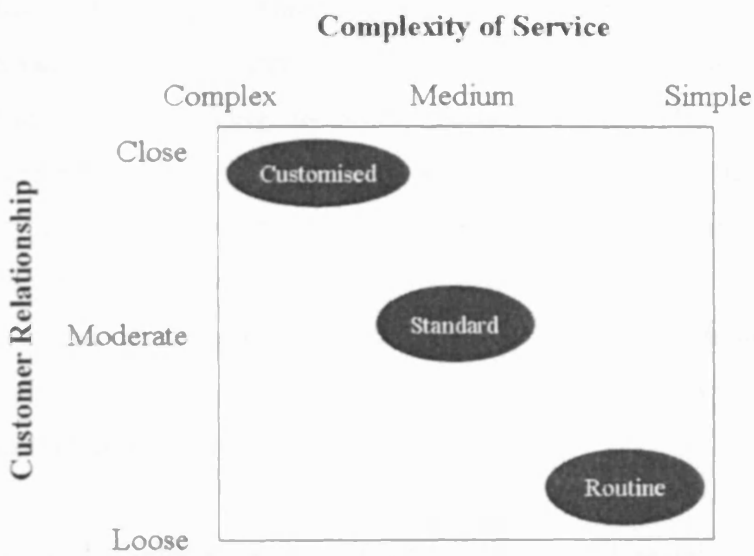


Figure 2.6 Logistics types
(Source: Bask, 2001)

The characteristics of the three service types (routine, standard and customised) are;

Routine – This simply involves the transportation of goods, using a single mode of transport, without any other additional services. The procurement of the service is based on volume provision and is selected primarily on price. The provision of the transport may be at short notice or be provided over a period of time. Notwithstanding, the logistics provider has to ensure reliability of service and that delivery time slots are met. This type of service does not require any close relationship between user and provider. The service may be procured via an electronic data exchange. Hence a user may select from a very wide range of providers.

Standard – This type of service may provide a degree of customisation. This may include the provision of different specialist transportation in terms of vehicle types or mode of transport. In order to determine the most suitable type of transportation, and ascertain where and when it is required, the service provider will have to have relatively closer co-ordination and co-operation with the service user.

Customised – This type of service provides a fully-customised offering. As well as some of the routine and standard features mentioned above, various other services may be provided, such as, warehouse provision and its management, inventory control and ordering, product tracking, and value-adding activities. The service provider aims to deliver greater logistics flexibility (Bask, 2001). Users may establish a relationship with a very few or just a single provider. Partnering arrangements are established between the provider and user, ensuring effective flow of information and co-ordination of activities, facilitated by a shared information technology infrastructure (White *et al.*, 2005). It is, however, likely that transaction costs will be higher than routine and standard service provision.

To summarise, in order to cope with key customers' demand, a logistics company needs to forge highly specific and efficient process linkages and information exchange mechanisms with selected partners. Thus, a 'customised' logistics service can be delivered to these customers and a long-term close relationship can be built up. To handle unpredictable, sporadic orders from non-key customers, a company needs to effectively and quickly reconfigure its business processes and build loose and standard interfaces with partners, in order to provide the service desired. This means a 'routine' logistics service applies. Between 'routine' and 'customised' is the 'standard' service which varies between the two extremes. One should note that it would be a mis-match if a 'simple' service were to be coupled with a 'close' relationship or a 'complex' service were to be coupled with a 'loose' relationship. The former implies unnecessary resource commitment while the latter means high transaction costs and potential delivery problems (Bask, 2001; Kallio *et al.*, 2000).

Based on the above discussions, the attributes of each of the three service types are summarised in Table 2. 2. The three different types of services have different focus on the value offered to customers. The logistics value is defined by four criteria: cost, lead time, service and quality, widely acknowledged in previous studies (Kallio *et al.*, 2000; Naylor *et al.*, 1999; Aitken *et al.*, 2005; Fawcett and Cooper, 1998; Lambert and Burduroglu, 2000; Rutner and Langley, 2000; Christopher and Towill, 2001; Childerhouse *et al.*, 2002). These criteria are derived from Johansson *et al.*, (1993), who state that they should be combined to give a measure of total value from the customer's perspective. Because the studies mentioned have slightly different definitions for these criteria, in the context of this research, the four criteria are defined as follows:

- Quality – removing variability from the logistics process, particularly in terms of uncertainty in delivery processes.
- Service – delivering the correct products at the planned time and flexibility to meet customer demands/market changes.
- Cost – influencing the total cost of the order delivery process from shippers to customers including distribution, administration and inventory costs.
- Lead time – controlling the time taken from order receipt to making a delivery to customers.

Type of services / *Attributes*	***Routine***	***Standard***	***Customised***
Value focused	Cost-driven, with Competitive service and lead time; little concern with supply chain variability	Standardised offering sitting between routine and customised	Service-driven with competitive cost and lead time; emphasising removal of supply chain variability
Logistics process scope	A few basic standard services, e.g. road transport from point A to B	Bundling of some easy customised services e.g. transportation with simple assembly or quality control	Highly customised services with value added activities e.g. return goods handling, tracking and tracing, scheduling and route optimisation
Shipper and carrier relationship	• Arm-length relationship • Limited trust and transparency • Fire fighting approach when problem occurs	• Limited collaboration • Increased level of trust and transparency • Largely based on standard contracts • Reactive approach	• Broad-based collaboration • High level of trust and transparency • Sharing of risks and rewards as well as resources • Proactive approach
Use of e-business technology	• Open EMs • Independent information systems • Transactional data processing such as basic order details	• EDI for order and invoicing • EAI integration for point to point connection • Operational data processing including order details, estimated lane annum volume and customer profiles	• Integrated e-business solutions e.g. use same Web-based systems for communication • Advanced technologies adopted e.g. real time tracing and tracking; • Strategic data processing such as sales and demand forecasting, promotion plans, complete customer portfolios
Information sharing/ decision making between shippers and carriers	• Limited information visibility • Price-driven independent decision-making	• Extended information visibility • Coordinated decision making via authority and other procedures and largely influenced by the party who has more power	• Full visibility • High level of information sharing • Joint decision-making based on aligned interests

Table 2.2 Attributes of three types of logistics service provisions
(Source: Author)

As 'routine' logistics is largely price-driven, value is focused on 'cost' with relatively less attention given to service and lead time. Little effort is put into reducing supply chain variability. This is because the reduction of uncertainties and variability requires active collaboration between supply chain players (Holweg *et al.*, 2005), whereas collaboration under 'routine' logistics is at a low level. For 'customised' logistics, service and lead time are priorities in order to meet the more complex customer requirements. Greater efforts are put into removing variability from the supply chain through various collaborative activities in order to achieve competitive advantages. In line with this, the scope of process extends from a basic transportation service for the 'routine' stream towards more tailored deliveries for the 'customised' stream. In return, the relational configuration between shipper and carrier goes from arm-length to close partnership. In the meantime, there will be increasing use of e-business technology for B2B linkages which will lead to improved information visibility. Decision making under 'routine' logistics is largely independent between shipper and carrier, while more coordination occurs under 'standard' and 'customised' logistics streams.

Under these three different service streams, there are distinct requirements for different inter-organisation ICC mechanisms. Although providing useful insights, most publications in the tailored logistics area and in outsourcing in general, have devoted little attention to the potential effect of e-business technology in supporting the provision of different logistics services. In particular, no work has systematically investigated what inter-organisation ICC mechanisms are appropriate for routine, standard and customised logistics. This gap is highlighted by the two recent extensive literature surveys on outsourcing and third party logistics conducted by Razzaque and Sheng (1998) and Selviaridis and Spring (2007). Both surveys have shown that most researchers have focused on the benefits and risks of outsourcing, the relationship between shippers and carriers, and service offering and usage, while efforts to explore the underlying ICC mechanisms in supporting tailored logistics provisions have been somewhat lacking.

Despite this, lack of use of ICT is well explored in the shipper-customer context, although its use in the shipper-carrier context is limited to information exchange effect only (Sauvage, 2003; Stank *et al.*, 1996; Gentry, 1996; Lewis and Talalayersky, 2000). This research therefore attempts to fill the gap by building up the link between the three different logistics steams and their underlying supporting ICC mechanisms. Many previous studies have argued that the ability of e-business to reduce coordination and transaction costs will lead towards more tightly coupled relationships and information integration (Clemons and Row, 1992; Bagchi and Skjoett-Larsen, 2005; Fawcett and Magnan, 2002; Kim and Narasimhan, 2002). But taking into account the distinct nature of different delivery streams and the trade-off between tight integration and adaptability discussed above, this research contends that a one-size-fits-all approach is unlikely to work and there should be different information architectures for different logistics scenarios.

2.4 The development of Research Question 1

From the discussion in Sections 2.2 and 2.3, two parallel streams are observed, which are summarised in Figure 2.7:

- Under e-business development, there has been a proliferation of B2B e-business systems in supporting B2B e-business integration. The technical advancements, in particular Web-based technologies, have made different ICC mechanisms available for flexible inter-organisational connectivity. But this also poses challenges due to the complexities and difficulties involved.
- Under logistics development, there is a trend towards providing tailored logistics provisions to satisfy different customers' needs. This requires a careful design of information flow within and, in particular, between companies.

Accordingly it is critical to have an overall e-business architecture which can govern and specify the different ICC mechanisms for different logistics scenarios. Consequently, a fundamental question is raised:

Research Question 1: What are the supporting B2B e-business architectures for the provision of effective tailored logistics?

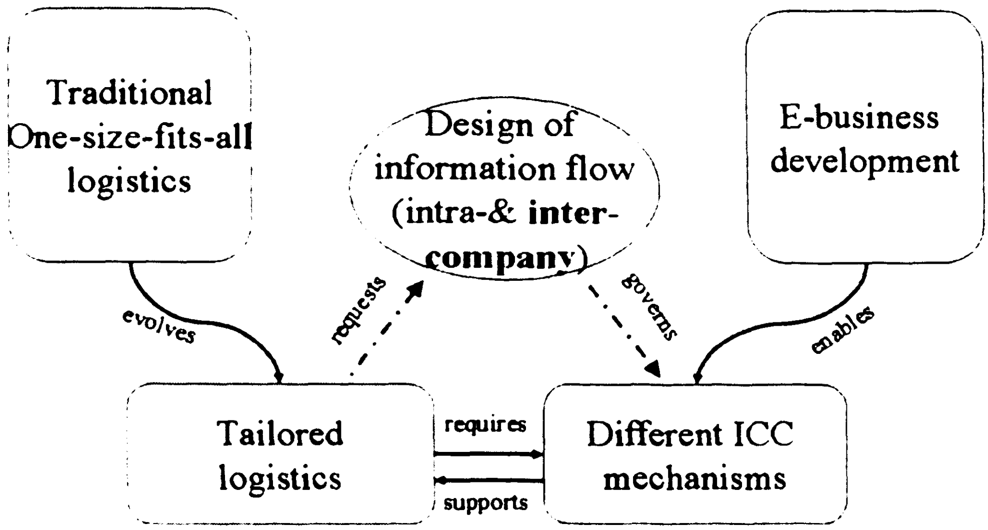


Figure 2.7 Alignment of e-business and logistics developments
(Source: Author)

The architecture is termed a B2B E-business Reference Architecture (ERA) as mentioned previously in Chapter 1. It should be noted that reference architectures are different from technical architectures, a term often used in the software engineering discipline. Whereas the latter focuses on the internal structure design of a program or system, for example, event-driven architecture, reference architectures are independent of their technical architecture and any implementation details. An ERA is generally not specific enough to govern the implementation of any individual software system implementation. Rather, it is a high-level abstract framework for understanding significant components and the relationships between them and guiding implementations in general (Bernus and Nemes, 1996). The aim of developing an ERA in this research is to outline the structural arrangement between organisations in order to achieve effective and efficient logistics provisions.

Historically there have been many discussions concerning the use of B2B e-business systems in the supply chain, but no systematic framework has been developed to bring the two streams together and answer RQ1. Moreover, according to Kärkkäinen *et al.*, (2007), the study of B2B e-business systems in the supply chain management can be categorised into three approaches: analytical and modelling, empirical studies, and conceptual classification. The main contributions and shortcomings of the three approaches, in relation to B2B information coordination and control for tailored logistics, are discussed below in order to highlight the voids in the literature.

Analytical and modelling approach

Much of the research under this stream focuses on information sharing and related costs and benefits (Sahin and Robinson, 2002; Samaddar *et al.*, 2006; Fiala, 2005). Sahin and Robinson (2002) extensively reviewed over 100 publications in this field and categorised them in terms of information sharing and flow coordination. They pointed out that a substantial number of publications had addressed the bullwhip effect, including its definition, causes, effects and countermeasures and procedures for quantifying the effect. In addition, partial and full information sharing had also been studied, with the focus on Point of Sales (POS) data sharing and VMI practices (Dejonckheere *et al.*, 2004; Disney *et al.*, 2003; Kaipia and Tanskanen, 2003; Wilson, 2007). However, while numerous studies have explored demand variability and inventory planning and control as well as information sharing, they do not provide insights on how interorganisational systems should be designed and integrated to facilitate appropriate information sharing and flow coordination, although it is clear that information sharing is one of the benefits which B2B e-business systems can bring to supply chain players. Accordingly, while the studies are relevant, they do not directly explore the underlying ICC mechanisms.

Empirical studies

Transaction-cost based theory, sometimes known as transaction cost economics (TCE) or transaction cost analysis (TCA), and the resource-based theory/view (RBV) are well established paradigms in the strategic management, marketing and organisational economic literature (Skjoett-Larsen, 1999). TCE explicitly views the firm as a governance structure and the governance structure chosen is mainly determined by the extent of asset specificity involved in the transactions concerned (Rindfleisch and Heide, 1997). The more highly specific the assets are, the more the choice will lean towards hierarchy, leading to more research focused on make-or-buy decisions (Tsang, 2000). TCA posits that organisations insource when the costs of using market are higher than internal governance costs (Watjatrakul, 2005). TCE is based on two key assumptions of human behaviour, i.e. bounded rationality and opportunism, and two key dimensions of transactions, i.e. asset specificity and uncertainty. It focuses on how trading partners protect themselves from the hazards associated with exchange relationships (Shelanski and Klein, 1995). Originating from the Economics discipline (Coase, 1937; Williamson, 1975), the theory has been increasingly used in the study of IOS adoption and impact. For example, Rasheed and Geiger (2001) conducted a survey of 113 companies and found a number of determinants of governance structure for the use of online intermediaries. Subramani (2004) examined the benefits for suppliers of the use of IOSs via an analysis of data obtained from 131 suppliers. He found that IT deployments in supply chains lead to closer buyer-supplier relationships. Ang (2007) investigated the effect of partner alignment on the choice of using equity (the creation of a separate new entity) and non-equity alliance (market-based contractual arrangement) governance mode in IT software alliances, using a sample of 485 IT alliances. The study partially supported the behavioural uncertainty arguments in TCE theory. He found that as behavioural uncertainty increases in an alliance, the likelihood to adopt the equity mode increases. Interestingly this study also found that specifically in IT sector, partner alignment coupled with the need for flexibility within this sector, requires a less hierarchical model of alliance governance.

RBV studies have shown how a firm's resources and capabilities can affect its performance (Barney, 1991). Within the e-business field, it has been adopted to identify various IT related resources that serve as potential sources of competitive advantages (Mata *et al.*, 1995; Grover and Albert, 2003; Thomas, 2003). For example, through an empirical study, Bharadwaj (2000) found that IT capability is rent (economic profit) generating resource that is not easily imitated or substituted. He also indicated that isolating mechanisms such as connectedness of resources, and social complexity allow firms with high IT capability to achieve and sustain superior performance. The study carried out by Chatfield and Bjorn-Andersen (1997) showed how an airline company can use IOS systems to achieve time-based competitiveness. Among the few researchers to combine resource-based theory with logistics strategy, Olavarrieta and Ellinger (1997) indicated that a distinctive logistics capability, for example, Wal-Mart's complex logistical system which is valuable, scarce and both difficult and costly to imitate, is a source of sustainable competitive advantage and superior performance.

Though providing an important foundation for the development of the conceptual model in this study, TCE and RBV theories have their limitations in explaining the emerging Web-based B2B systems. Christiaanse *et al.*, (2004) claimed that simply classifying supply chain structure into either hierarchy or market is no longer valid, as there are many intermediate forms of governance available, for instance, the network. A major weakness, according to Zajac and Olsen (1993), is that TCE over-emphasises the cost minimization and neglects the value creation aspect of a transaction. It is often criticised for focusing solely on economic issues, failing to include personal, social and technological elements (Skjoett-Larsen, 1999). TCE-based antecedents, like assets-specific investments, transaction frequency, and performance ambiguity, are also too limited to help us to understand the complex relationship configurations and economic and political consequences (Christiaanse *et al.*, 2004; Tsang, 2000). As the range of ICT systems expands and standards become increasingly open, asset specific investment will become less necessary, thus the study of B2B e-business integration is likely to focus upon less on the 'lock-in', switching cost and hold-up threats and more on functions and process interdependence (Wareham, 2003). One major limitation of RBV is that it concentrates mainly on an internal perspective of an organisation's resources and capabilities (Skjoett-Larsen, 1999). Moreover, TCE and RBV theories do not consider explicitly the underlying information linkage between organisations.

As regards the study of specific technology application, there is a wide body of literature on EDI adoption and its related costs and benefits (Angeles and Nath, 2007; Craighead *et al.*, 2006; Damsgaard and Lyytinen, 2001; Larson, 1998; Lee and Lim, 2003; Leonard and Davis, 2006; Martinez Sanchez and Perez Perez, 2005; Ramamurthy *et al.*, 1999; Reimers, 2001). There is also a growing number of studies on Internet related applications, such as XML-based integration, electronic marketplaces/hubs, portals, mobile commerce and tracking and tracing (Anand, 2005; Anton *et al.*, 2005; Grey *et al.*, 2005; Kaplan and Sawhney, 2000; Lau *et al.*, 2006, Murtaza *et al.*, 2004; Rabinovich and Knemeyer, 2006). Although such studies contribute to the understanding of various issues associated with the adoption and use of IOSs in the supply chain, they do not explore the underlying connectivity principles and, in particular, they do not investigate how different systems should be connected to support tailored logistics.

Conceptual classification

Given that Internet fosters the integration of business processes and provides efficient platforms for coordination, a number of studies have attempted to develop conceptual models and to categorise e-business enabled inter-organisation coordination mechanisms. According to García-Dastugue and Lambert (2003), Internet-based mechanisms can be classified into market mechanisms and coordination flows. The former are used to foster price competition and the latter means purchasing decisions have been made between buyer and supplier, and information is shared in a seamless fashion to coordinate the flow of products. Applying this concept to the construction industry, Xue *et al.*, (2007) identified different forms under each mechanism. The market mechanism includes auctioning and contracting, while coordination flows include information hubs and electronic marketplaces. Li and Wang (2007) proposed a framework based on supply chain decision structure and nature of demand. However, their framework was limited to two extreme types; centralised and decentralised systems. Overall, it can be seen that the aforementioned studies are still rooted in TCE, and do not cover the other intermediary forms as proposed in the conceptual model developed in Figure 3.3, Chapter 3. Extending slightly further and using network theory, Jarillo (1988) broke down 'hierarchies' into two different categories: 'bureaucracies (with strict supervision)' and 'clans (with higher autonomy)', and 'market' into 'classic market (for spot trading)' and 'strategic network (for long-term value creation)'.

Although providing useful insights, network theory emphasizes mainly the long-term cooperative *relationship* between companies (Harland, 1996), and consequently neglects the critical aspects of process and information linkages. Choudhury (1997) and Samaddar *et al.*, (2006) proposed further categorisation of B2B e-business configuration; i.e. dyadic, multiple dyadic and many-to-many networks. However the above configurations do not cover some emerging forms in the e-business domain, for example consortia-based alliances. Xu and Beamon (2006) identified four key components of coordination mechanisms; resource sharing structure (no sharing, operational, tactical and strategic), level of control (low, medium and high), risk/award sharing (fair and unfair) and decision styles (centralised and decentralised). Building on this, they identified three coordination mechanisms: price coordination, non-price coordination and flow coordination which are also supported by Fugate *et al.*, (2006). Xu and Beamon (2006) contended that there should be different mechanisms for different logistics practices like Quick Response, spot sourcing, VMI, and strategic alliances. Although partly supporting the author's one-size-does-not-fit-all argument, Xu and Beamon (2006) and Fugate *et al.*, (2006) did not focus on B2B e-business connectivity.

In addition to the generic frameworks being developed, there is also a rich body of literature defining a specific type of IOSs, i.e. the electronic marketplace (Dai and Kauffman, 2002; Kaplan and Sawhney, 2000; Lenz *et al.*, 2002; Rask and Kragh, 2004; Rudberg *et al.*, 2002; Stockdale and Standing, 2004). These criteria include industry focus (vertical, horizontal and mega exchange), type of product (direct or operating input), type of transaction (sport or systematic), and ownership structure (third party, private or consortia-led) (Howard *et al.*, 2006; Kaplan and Sawhney, 2000; Rudberg *et al.*, 2002). However, while many researchers have focused on classifying the different Web-based IOSs using different frameworks, in-depth studies are rare in terms of why, what and how these systems should be adopted, and for what logistics conditions. Understanding their impacts and benefits is another relatively unexplored area (Sahin and Robinson, 2002).

2.5 Summary

In this chapter, major developments in e-business and the logistics fields have been presented. It has been shown that the traditional one-size-fits-all approach in logistics has evolved into tailored logistics in order to satisfy different customers' needs. Such evolution requires a careful design and development of ICC mechanisms between a company and its different partners. Rapid advances in e-business, especially Web-based technologies, can facilitate this process but also pose the challenges due to the complexities of system and process integration, and relationship configurations.

Accordingly there is a need to develop a B2B ERA to guide and govern the ICC between organisations for effective logistics provisions. Research Question 1 is therefore developed to examine supporting B2B e-business architectures for effective tailored logistics provision. The related literature has been reviewed and gaps in previous studies highlighted.

The next chapter focuses on development of a B2B ERA. The next step after development of the B2B ERA is to validate it through empirical investigation of its application to an emerging e-business model, the Electronic Logistics Marketplace (ELM). Reasons for the application within this context are explained in detail in the following chapter. Background information on ELMs will also be provided in Chapter 3, which is part of the literature view.

Chapter 3 B2B E-business Reference Architecture (ERA)

3.1 Chapter overview

Following RQ1's development in Chapter 2, this chapter develops a B2B ERA typology for different logistics scenarios in order to answer RQ1 (see Figure 3.1):

> ***RQ1. What are the supporting B2B e-business architectures for the provision of effective tailored logistics?***

This then leads to the choice of model validation through a study of closed ELMs and the development of Research Questions 2-4.

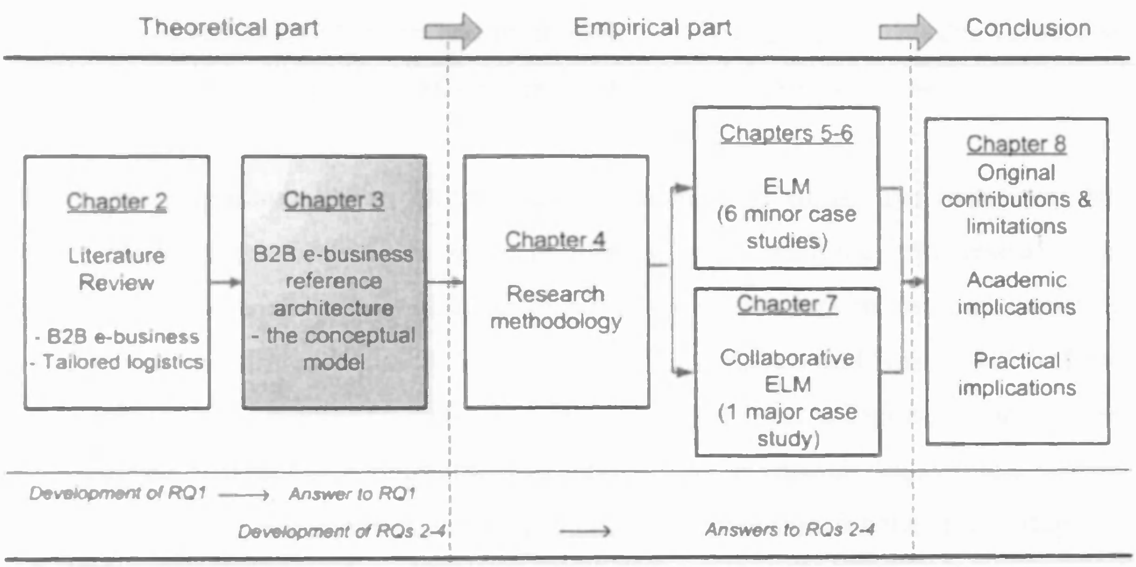


Figure 3.1 Thesis structure – The development of B2B ERA
(Source: Author)

3.2 B2B e-business systems and information architecture

E-business is a wide ranging concept that embraces all aspects of the use of information technology in business. As discussed in Chapter 2, B2B e-business development in logistics is evolving from traditional electronic data interchange for automated order and invoice processing to web-enabled shared collaborative systems or platforms for either trading or collaboration purposes (McLaren *et al.*, 2002).

As well as the limitations of various studies on B2B e-business systems in supply chain management discussed in Chapter 2, studies on information architecture also have limitations. Most largely focus on the technical perspective of e-business, and at the intra-organisation level (Abdmouleh *et al.*, 2004; Channabasavaiah *et al.*, 2004). As a result, for example, Niederman *et al.* (1991) indicated that an information architecture is a high-level map of the information requirements of an organisation, and showed how major classes of information are related to major functions of the organisation. In a similar vein, Evernden and Everden (2003) contended that an information architecture is a high level overview of interrelated components, and is used to organise information about a topic in order to manage it in a structured way. The aforementioned definitions are also supported by Pai and Lee (2005), and Chaffey and Wood (2005). Examples of well-known technical architectures include computer integrated manufacturing-open system architecture (CIM-OSA), generic enterprise reference architecture and methodology (GERAM), and Perdue Enterprise Reference Architecture (PERA) (Cummins, 2002; Aguilar-Saven, 2004).

Despite the importance of an information architecture in aiding and instructing the design of information linkages between different organisations, little research has been done on the inter-organisation perspective, and there is even less understanding in the context of tailored logistics. For example, Gunasekaran and Ngai (2004) refined the Supply Chain Operations Reference (SCOR) model for e-logistics management and specified different e-business models/applications in various stages (plan, source, make and deliver), for instance, network planning application for the 'plan' stage, e-procurement for the 'source' stage, MRPII and ERP adopted in the 'make' process, and EDI and e-logistics systems used at the 'delivery' stage. Unfortunately, their e-logistics SCOR model does not address the different information structures embedded in different logistics streams, and therefore do not provide appropriate guidance in the context of tailored logistics. Based on the e-SCOR simulator (an industrial simulation software developed by Gensym), Tang *et al.*, (2004) proposed a holistic approach in designing and optimising e-supply chains. However, this approach again does not explicitly consider B2B connectivity in the tailored logistics context. Using a simulation study, Janssen and Verbraeck (2005) examined an electronic intermediary's influence on interorganisational information architecture. Yet their study was limited to information, matching and trusted roles of the electronic intermediary. Issues such as how the information architecture was constructed were not explored.

The underlying logic adopted in this thesis is based on Kim and Lee (1996) and Galal-Edeen (2003) that an ERA should be independent of its technical architecture and any particular implementation details. The need for independence is because although fast changing business environments and information technology demand constantly updated or modified information systems, the principles of inter-organisational information connectivity are relatively stable over time (Brancheau, 1989). As mentioned in Chapter 2, an ERA is a high-level abstract framework which captures these principles, and specifies significant components and the relationships between them, and guides implementations in general. It can also be used as guidance for future changes where business system (re)engineering will occur and a new technical architecture may be needed (Pai and Lee, 2005). According to Galal-Edeen (2003), a good architecture is stable but also allows "the system it contains to evolve gracefully in tune with evolving business and organisational needs".

A technical architecture translates and applies the prescribed needs identified by a reference architecture into an individual specific B2B system integration project (Poirier, 2003). Any individual B2B system linkage will have its specific requirements of computers, data, communication facilities and software, and the implementation process will also vary depending on the scale and objectives of each project. Accordingly, these details should be reviewed on a case by case basis, and not to be included in an ERA. Otherwise an ERA will lose its usefulness as a guiding framework. A reference architecture is also a common denominator for comparing and evaluating different specific instantiations, and it allows one the choice of the technical architecture that is best suited to a particular organisation (Basili *et al.*, 1992).

To develop such an B2B ERA, one needs to address the information coordination structure between organisations, as "logistics activities can actually be described as integrated systems of coordination structures governing the flow of physical goods, and associated information flow within and between organisations" (Lewis and

Talalayevsky, 2004). Janssen and Verbraeck (2005) pointed out that an architecture determines the way mutually dependent activities of two organisations are coordinated. By definition, coordination means 'managing dependencies (Malone and Crowston, 1994)'. If there is no interdependence, there is no need to coordinate. Interdependence implies that the success of each firm in a relationship depends on the actions of the other firms within that relationship (Clemons and Row, 1992; Heide and John, 1992). Coordination theory is a multi-disciplinary area which incorporates organisation theory, operations research, economics, and information technology. A comprehensive overview is provided by Malone & Crowston (1994). In the logistics discipline, Stock *et al.*, (2000) applied three governance forms developed from coordination theory to categorise supply chain governance structures: networks, hierarchies and markets. In a market configuration, links between suppliers and customers are weak and vertical integration is low. In a hierarchy, both vertical integration and the nature of the relationship (also known as supply chain linkage) between suppliers and customers are high. The network governance form is an intermediate form of governance characterised by low vertical integration and high linkages. However, Stock *et al.*'s (2000) discussion did not present detailed e-business attributes of each form.

Kumar and Dissel (1996) proposed a three-part independence-based typology to examine the relationship between technology and organisational structure variables, but with a focus mainly on potential conflicts and risks. Other typical approaches include using transaction cost economics to discuss or compare different inter-organisational structures in practice (Goldsby and Eckert, 2003), or to classify different e-business models in terms of function and salient features (Kim and Shunk, 2004; Pant and Ravichandran, 2001). These have been discussed in detail in Section 2.4 of Chapter 2. However, the coordination mechanism in supporting tailored logistics services has not yet been fully addressed in the aforementioned studies.

Complementary to the 'coordination' perspective, the control mechanism is another important element of an information architecture. Control elements in a system directly influence the flow of information and interactions between different functions. They embody decision-making responsibilities within and between companies. The control architecture determines the interrelationships between the control components, thereby establishing the mechanism for coordinating the execution of the various decisions (Martinez *et al.*, 2001; Dilts *et al.*, 1991; Lee *et al.*, 2004). Two distinguishing works in this field are Allen and Boynton (1991) and Dilts *et al.*, (1991). Their work is discussed below:

- Allen and Boynton (1991) clarified two control approaches; the low road (decentralisation) and the high road (centralisation). Under the low road, IS technology and its management and control are dispersed widely throughout the firm. This approach appears to be appropriate for organisations in need of rapid and drastic change to the total operations. Despite the benefits of speed and responsiveness, one of the major problems associated with this approach is integration; complex efforts are needed to link different systems together. Under the high road, the core IS activities and management control are centralised. Opposite to the low road, the high road has advantages in terms of integration and efficiency. Standardised data and rules and, quick centralised decision-making bring higher efficiency. However, one of the drawbacks of the high road approach is its rigidity, i.e. it cannot adapt to the needs of a changing organisation quickly. Notwithstanding, the dichotomy between low and high roads is not as sharp as it may seem. In practice, there are often mixed approaches in order to achieve both efficiency and flexibility simultaneously.

- Dilts *et al.*, (1991) defined four basic control architectures observed in the evolution of automated manufacturing system development as shown in Figure 3.2: centralised, proper hierarchical, modified hierarchical, and heterarchical forms. The centralised form is characterised by a mainframe computer performing all planning and information processing functions and maintaining global databases to record the activities of the whole cellular system. In an attempt to overcome some of the shortcomings in centralised form such as low fault-tolerance and limited modifiability, the proper hierarchical form has been developed. It represents "a philosophy of levels of control and contain several control modules arranged in a pyramidal structure (Dilts *et al.*, 1991)". The control decisions are operated by a means of a top-down approach with information being fed back in a bottom-up manner. This proper hierarchical form has further evolved into the modified hierarchical form, as there is a need for increased autonomy of and coordination between subordinates. The heterarchical form aims to pursue full local autonomy and a cooperative approach to global decision making. The cooperation between entities is arranged via "a negotiation procedure". Though the four models proposed are limited in an intra-organisation environment, Dilts *et al.*'s (1991) work has been a significant input to the design of information architectures from a technical aspect.

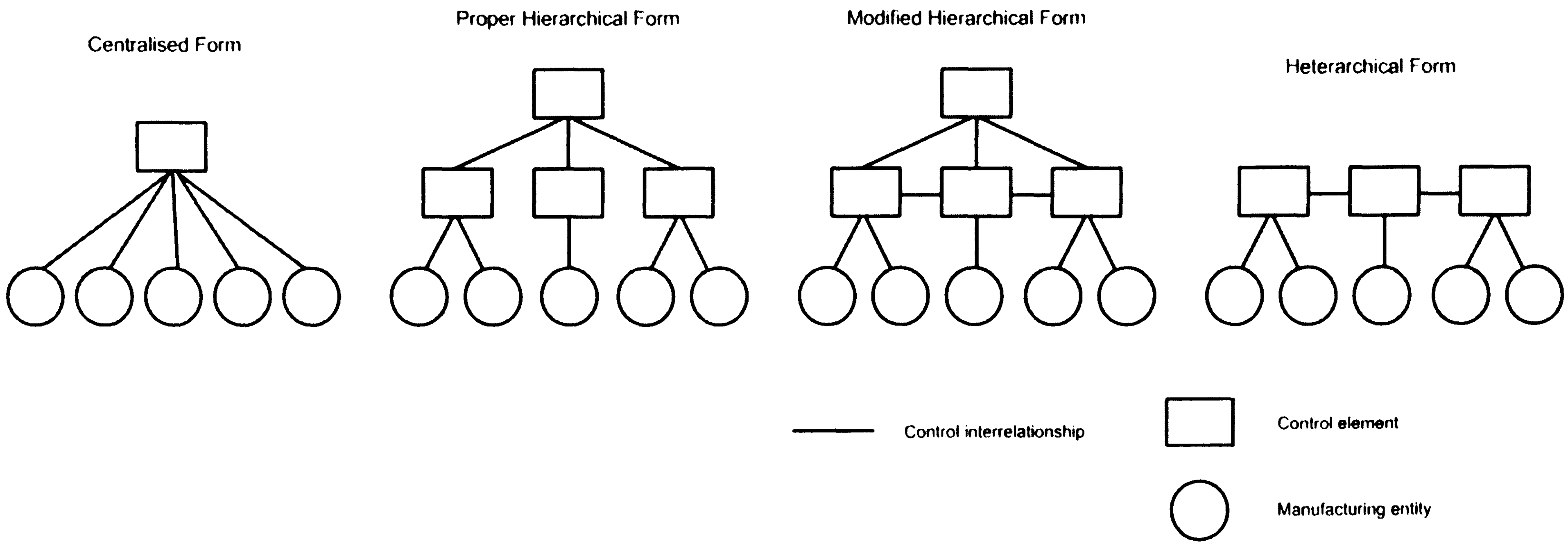


Figure 3.2 Control architectures – the four base forms
(Source: Dilts *et al.*, 1991)

Later studies in control architecture largely build on Dilts *et al.* and Allen and Boynton's work, and extend it further. For example, Cantamessa (1997) explored hierarchical and heterarchical behaviour in agent-based manufacturing systems. Leitao and Restivo (2006) developed a holonic architecture for shop floor level management, and introduced an adaptive control that balances dynamically between a more centralised structure and a more decentralised one. Saint Germain *et al.*, (2007) applied the holonic manufacturing control paradigm[1] to inter and intra-enterprise logistics issues, attempting to preserve the stability of hierarchy while providing the dynamic flexibility of heterarchies.

Overall, one can see that the control mechanisms proposed by Allen and Boynton (1991) and Dilts *et al.*, (1991) are analogous to the three forms defined by Stock *et al.*, (2000), although Allen and Boynton (1991) focus on intra-organisational e-business systems while Dilts *et al.*, (1991) emphasise the inter-organisational aspects. However, a combination of both coordination and control mechanisms serves as a foundation in defining the typology of the ERA proposed in the next section.

3.3 B2B e-business reference architecture

Via a synthesis of the literature discussed above and that reviewed in Chapter 2, a conceptual model is developed, as shown in Figure 3.3, which traces and categorises four different inter-organisation ICC mechanisms observed in the logistics domain. The developed model is based upon the intra-organisational control architectures proposed by Dilts *et al.*, (1991) and is applied from an inter-organisation perspective. The model also utilises the concept of coordination structures developed in the area of coordination theory to characterise the four basic ERA forms. It then aligns Bask's (2001) three different logistics streams with each form.

The control architectures proposed by Dilts *et al.*, (1991) are in the context of production processes within an organisation. They decomposed the general control

[1] Holonic manufacturing is a highly distributed control paradigm based on autonomous and cooperative entities. It claims to be able to guarantee performance stability, predictability and global optimization of hierarchical control, and provide flexibility and adaptability of heterarchical control (Leitao and Restivo 2006).

responsibilities into shop-level, cell-level, and machine level groups. While this research directly incorporates Dilts *et al.*'s proposed control architectures into the conceptual B2B ERA model, the definition of entities is significantly different, as it is translated into an inter-organisation form. These differences are summarised in Table 3.1. The control elements change from production systems into enterprises. The circles, previously representing entities, such as robots and automatically guided vehicles, now correspond to e-business applications, such as transport management systems and warehouse management systems. The author has also renamed the four architectures in order to incorporate the changes.

	Dilts et al.'s original model	***Conceptual model in this research***
Application environment	Automated manufacturing	Generic B2B information linkage and processing
Strategic objective	To aid the design of the automated manufacturing process	To aid the design of B2B e-business linkages
Enterprise boundary	Intra-organisation Only considers information flows within one single company at shop, or cell or machine level.	Inter-organisation Considers process, information and collaborative arrangements between organisations
Symbols		
□ Boxes	Control components (production system, shop floor scheduling system, machine controller, etc.)	Control components (enterprises: supply chain players e.g. shippers, carriers; or a consortium of a few enterprises)
O Circles	Manufacturing entities (robots, automated guided vehicles, CNC machines, etc.)	E-business applications (transport management system, warehouse management system, ERP, etc.)
— Connection lines	Control interrelationships	Coordination and control interrelationships

Table 3.1 Differences between Dilts at al.'s model and this research's conceptual model
(Source: Author)

The characteristics, disadvantages and advantages of each form are detailed in Table 3.2 and supported by case studies observed from the literature as presented in Section 3.4. The following discussion attempts to align the four architectures with the three logistics streams (i.e. routine, standard and customised) discussed in Chapter 2. This is done through the alignment of attributes of the ERA defined in Table 3.2, and the attributes of tailored logistics streams summarised in Table 2.2, Chapter 2.

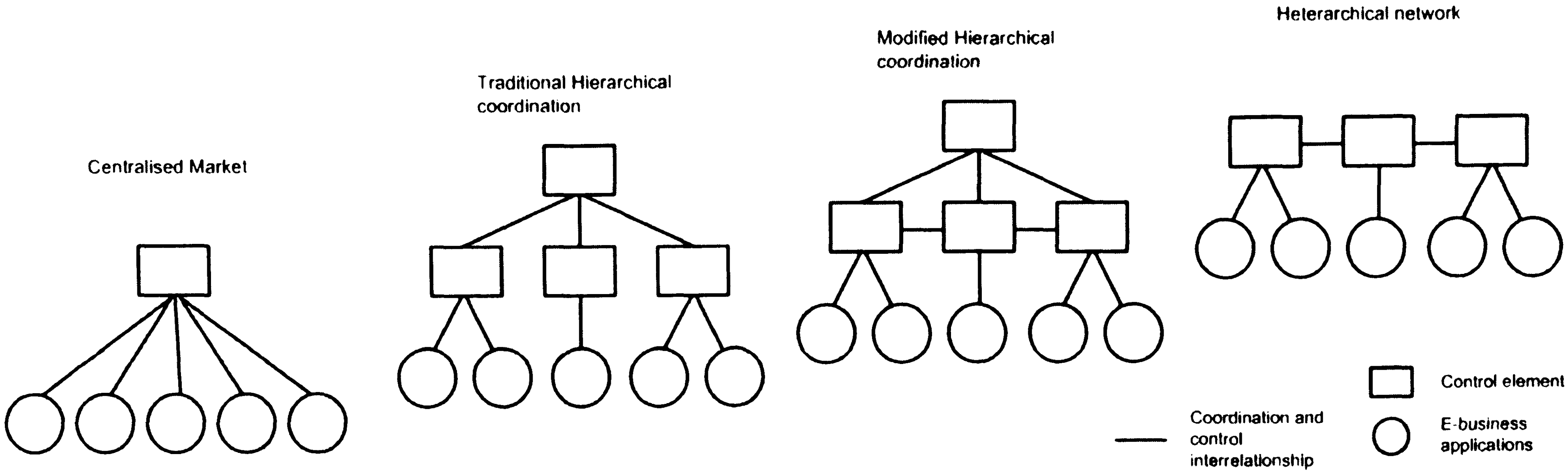


Figure 3.3 Four basic forms of ERA
(Source: adapted from Dilts, *et al.*, 1991)

Under a Centralised Market structure, organisations are coordinated by the market via bidding and pricing systems. All organisations are fully autonomous and make decisions independently. An e-marketplace is viewed as the typical platform of this type. Companies use it for spot purchasing of commodity-like materials or services, for example, the provision of third party logistics to cope with fluctuations in transport volumes. Such transaction based activities imply that only a single agreement between companies is in place and once the transaction is complete, the relationship dissolves. This model is thus appropriate for dealing with 'routine' logistics which does not require any close relationship with business partners, and few value added services are provided as shown in Table 2.2, Chapter 2.

Traditional Hierarchical Coordination uses authority and other procedural coordination processes, instead of a pricing mechanism. Normally, a dominant player in the supply chain will create such a mechanism in order to achieve high efficiency and vertical integration between organisations. E-business executional applications, such as EDI for automated ordering, are adopted. The more integrated inter-organisational systems provide increased information visibility that enables a wider scope of activities to be conducted, for instance, order planning and communication, delivery tracking and automatic invoicing. Referring back to Table 2.2 in Chapter 2, one can observe that this model can be applied to 'standardised' logistics operations where some degree of customisation is provided and a moderate partnership is in place. Dell Computer's direct business model is a good illustration of such a mechanism.

In the Modified Hierarchical Coordination model, the master-slave relationship is loose and peer-to-peer communication at the subordinate level is introduced for more effective information management. Berry and Naim (1996) presented a personal computer supply chain case study where interplant planning and logistics integration were achieved between the component plant, the sub-assembly plant and the box plant through dedicated inter-organisation system connection. Peer-to-peer integration implies higher information sharing, and supports a broader range of collaborative activities, for example, in a make-to-order environment, joint design and delivery between subordinates via the utilisation of each subordinate's complementary competencies and resources. As more value-added elements are incorporated, this model can be used for the 'customised' logistics stream which normally means complex inter-organisational systems being in place. It is termed a Type I system here in order to differentiate it from the next description.

Hierarchical Coordination (both Traditional and Modified) suggests that organisations might be frozen into a fixed structure, decision-making process, and pattern of relationships and operations. Hence, organisations are highly bonded into the current electronic linkage and switching costs are consequently high. This, in turn, reduces supply chain flexibility and the ability to respond to the changing business environment. In this case, the hierarchical mechanisms are merely appropriate for a company to engage with a large number of customers, suppliers or 3PLs, but only with selected key partners where demand is relatively stable and relationships are long-term. This leads to the 'standardised' or 'customised' logistics solutions designed and delivered to a unique segment of customers.

Since the late 1990s, Web-technology advances, a new type of coordination model has emerged, termed the Heterarchical Network. Rather than building in-house complex e-business systems connected to different partners, organisations can now collaborate in a more flexible and portable way with different partners using a single platform, such as an electronic network or e-hub. This, to some degree, reduces the negative effects of the interoperability of different legacy systems and the cost of investment which often occur in hierarchical structures. On the one hand, organisations have greater flexibility for (re)configuration thanks to 'plug-and-play' technology, while, on the other hand, highly customised logistics services can be achieved in a more cost-effective way due to the increased information visibility, processing capacity and standardised interconnection. There is also the advantage of lower relationship-specific investment. A detailed example may be found in Goldsby and Eckert (2003). The shared use of one single system means high information visibility across companies. It is supported by the use of a single database and high level of trust and collaboration. Decisions are jointly made based on common interests. Activities are usually at the operational and strategic level, for instance, such a system can provide network optimisation opportunities across companies. The network is designed and highly customised to serve the specific needs of participating companies. Hence it facilitates "customised" logistics, termed Type II system.

The differences between Type I and Type II systems are determined more by their underlying ICC mechanisms rather than the output of the system, though the output does differ too. The output, in this case, is the provision of 'customised' logistics services. The major differences are as follows:

- In terms of output, Type II can enable more customised elements to be designed in the system. Companies using type II generally pursue more strategic benefits as has been discussed above than Type I. Type II is also more flexible and responsive to customer requirement changes. While Type I, limited by its hierarchical nature, will be less modifiable to incorporate changing needs.
- In terms of ownership, Type II is usually owned by a consortia group of totally independent companies, while Type I is mostly shared by a parent company and its subsidiary companies, or between sibling companies.
- In terms of input, Type II requires a higher level of horizontal collaboration between companies, while Type I still largely focuses on vertical integration with limited horizontal collaborative arrangements. There is a more rigid data transfer standard requirement in Type II as well.

Type/characteristics	*Advantages*	*Disadvantages*	*Examples*
Centralised Market [Routine logistics] • Single price-based neutral trading platform as supervisor control component • Independent data warehouses with applications directly or indirectly connecting to the e-marketplace but no direct peer-to-peer interaction • Many-to-many open system • Basic online services and transactions • Commodity purchase of products and services, simple tasks	• Global reach with parallelism • Cost reduction of non-strategic sourcing • Quick and flexible match of demand and supply	• Little value added services • Less attractive to large players	Public marketplaces are owned and operated by one or more independent parties. E2Open.com Isteelasia.com
Traditional Hierarchical Coordination [Standardised logistics] • Dominant player in the supply chain as supervisor control component • Rigid master/slave relationships between decision making levels • Aggregated database at each company • Multiple, and different systems of subordinate control components have to directly integrate with supervisor's system (e.g. via EDI) yet no direct peer-to-peer interaction • High dependence: supervisor control component coordinates all activities of subordinates, that is, if it fails to execute a process in the e-business application category, all subordinates will fail • Long-lasting one-to-one relationship between supervisor and subordinate with fixed rules of behaviour and clear authority • Vertical integration	• Fast response time due to centralised point of control • Human errors reduced due to machine-to-machine interaction • Incremental addition of control possible: additional company can be added without disrupting control logic • Master-slave control introduced hence adaptive behaviours	• Need heavy in-house investment for inter-organisation system integration • Highly bonded in the supply chain, i.e. high switching cost • Less flexibility in system modification and reconfiguration	Dell's direct model or a traditional food manufacturer may have two separate hierarchical substructures for upstream and downstream integration via some intermediaries (Lewis and Talalayevsky, 2004)

Modified Hierarchical Coordination **[Customised logistics type I]** • Dominant player in the supply chain as supervisor control component • Multiple and different systems from subordinate control components directly integrate with supervisor's systems while also maintaining peer-to-peer interaction enabled by EAI technology • Loose master/slave relationships between decision-making levels • Subordinates cooperate to complete sequence • Both vertical and horizontal collaboration	• All the advantages of the Traditional Hierarchical Coordination form • Subordinate control components have more local autonomy	• Most of the disadvantages of the Traditional Hierarchical Coordination form • Complexity generated from combination of peer-to-peer & master-slave interaction • Connectivity problem due to existing legacy systems • Increased difficulty of control system design	Phases 2 & 3 in a PC supply chain redesign example (Berry and Naim, 1996)
Heterarchical Network **[Customised logistics type II]** • Single knowledge network-based platform as supervisor control component • No master-slave relationships • Full local autonomy • Flexible route to the provision and maintenance of the information connectivity enabled by plug-and-play technology from ASPs, AIPs, etc. • Multiple and different systems from different control components with standardised interface are connected via e-hub • Closed system • Complex tasks with a lot of value added services • More focus on horizontal collaboration with certain level of vertical integration	• Full local autonomy • Reduced software complexity • Implicit fault-tolerance • Ease of reconfigurability and adaptability • Fast diffusion of information • Process automation/transaction cost reduction by using common platform • Real time information visibility, including tracking and tracing • Supply chain synchronisation	• No open standards for communications, protocols or operating systems • Requires a high network capacity • High likelihood of local optimisation • Data transaction security issue	E-hubs, focus more on collaboration via systems connectivity and integration For example: collaborative transportation model between Buyer, Supplier and Haulier. (www.agora-europe.com)

Note: EAI= enterprise application integration; ASP=application service provider; AIP = application integration provider

Table 3.2 Characteristics, advantages and disadvantages of four basic ERA forms
(Source:Author)

3.4 Case examples

The above discussion highlights the fact that, with an increased awareness of the importance of customisation in logistics processes, inter-company information architecture may also develop into different forms. Overall, the adoption of different ICC mechanisms is not moving in one direction. Firms are using different mechanisms to meet different logistics needs. In this section, a number of examples from the literature have been selected to showcase the various architectures detailed in Table 3.2.

Centralised market

One of the earliest examples of the 'Centralised Market' is www.E2Open.com, established by a consortium of leading organisations in the electronics industry. The basic function of such B2B e-markets is to act as intermediaries that aggregate and match supply with demand. They provide facilitation services to help firms secure interfirm transactions (Dai and Kauffman, 2002). Unlike a traditional one-to-one IOS, E2Open is built on open network infrastructures and based upon a 'software-as-a-service' model. It can be accessed by a browser or can be integrated into an organisation's existing back-end systems. It operates a single platform supporting 'many-to-many' trading, where organisations in the electronics industry can connect to a large base of customers and suppliers.

According to the study of White *et al.*, (2005), using E2Open enables IBM to significantly reduce the time in the 'order-to-pay' process by removing human interactions and eliminating batch processes. It also allows IBM, and other participants, to have the flexibility they need, to "easily form electronic linkages with their trading partners and to reconfigure these when market conditions require" (White *et al.*, 2005). As price is normally the main driver, many trading e-market operators only provide very basic online services and transactions. Hence companies usually utilise such e-marketplaces to deal with most of their 'routine' logistics operations.

Traditional hierarchical coordination

Currently, Traditional Hierarchical Coordination seems to be the most common form of architecture. Many one-to-one IOSs fall into this category. Interfirm system integration is highly partner-specific. In EDI implementations, for instance, it has been found that prominent manufacturers use EDI as a way of inhibiting their suppliers' relationship with others because of increased transaction specificity and switching costs (Gosain *et al.*, 2004). Hence, dominant players in the supply chain normally choose to forge such highly specific and efficient information linkages with selected partners, in order to maintain a long-term partnership and 'lock in' their key suppliers or customers or logistics service providers. Lewis and Talalayevsky (2004) provide a useful case where a traditional goods producer has two hierarchical substructures as shown in Figure 3.4. There is first the parts substructure which gathers raw materials (RM) and packaging materials (PM), and channels them through a set of intermediaries towards the producer. Then there is the distribution substructure which distributes the finished products to consumers via intermediary layers.

Under this structure, the high automation of data transmission and processing leads to less human errors and faster response time. However, one of the disadvantages is that hierarchical coordination tends to be rigid and fixed once it is formed. The failure of one node or link might lead to the entire structure breaking down. Because relationship-specific investment is required to build up the IT infrastructures, there are more customised elements in the operation compared with 'routine' logistics, termed here 'standardised' logistics.

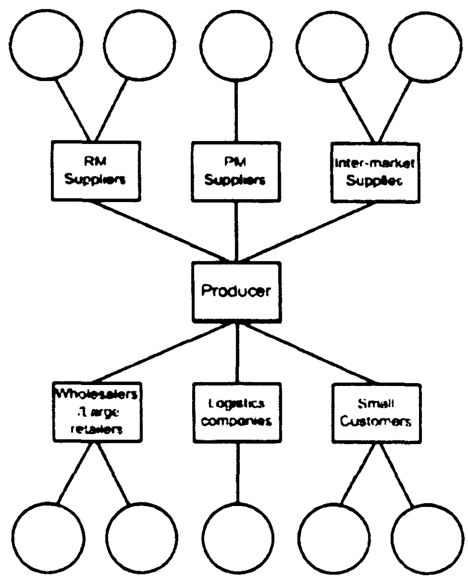


Figure 3.4 Example of traditional hierarchical coordination structure
(Source: Lewis and Talalayevsky, 2004)

Modified hierarchical coordination

The main distinction between Traditional Hierarchical Coordination and Modified Hierarchical Coordination is to some degree due to horizontal connections and autonomy among subordinates when carrying out a sequence of activities initiated by the system at the supervisory level. An example of the application of a Modified Hierarchical Coordination structure is given by Berry and Naim (1996). In a PC supply chain, materials are 'pulled' via EDI from the end of production lines in each plant. At the same time, a global material planning system monitors three plants' production, taking into account of total market demand, stocks and Work-in-Progress (WIP) in individual plants, as shown in Figure 3.5. All the requirements are then transmitted simultaneously direct to all three plants using EDI. "[A]ltering the flow of demand from serial to parallel mode has brought a reduction in information flow delays through the chain of more than 75%" (Berry and Naim, 1996). As a result of the introduction of horizontal communication between companies at the subordinate level, this structure can facilitate a more responsive reaction to local market conditions. Further, fault-tolerance through greater subordinate autonomy in the ICC mechanism has been improved. On the other hand, horizontal communication introduction might also create more complexities in system integration. Because the individual system connection is usually dedicated to a specific process and information linkage, the Modified Hierarchical Coordination structure has even more customisation elements added such as sharing of inventory information, and production planning. The logistics operation here is then referred to as 'customised logistics (type I)'.

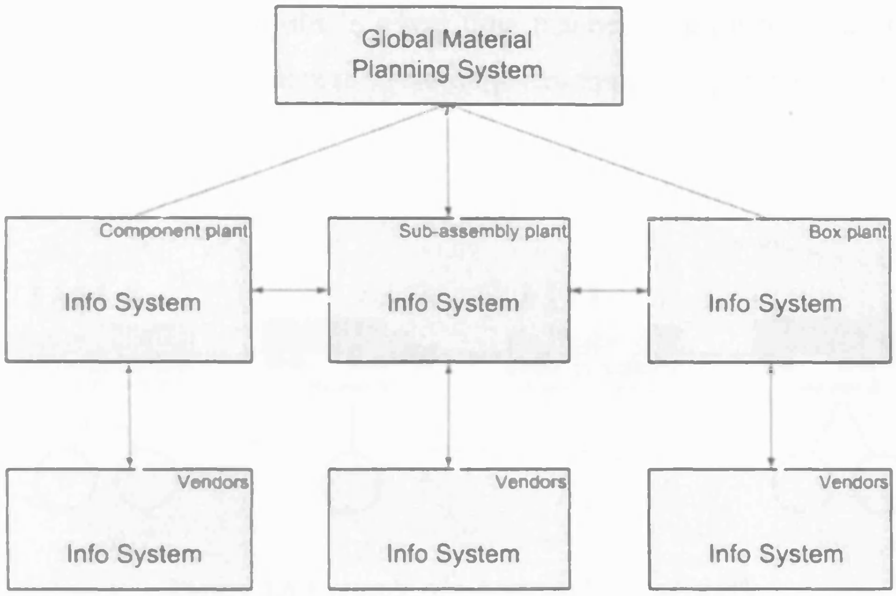


Figure 3.5 Example of modified hierarchical coordination structure
(Source: Berry and Naim 1996)

Heterarchical network

Formed by aligned interests rather than being authority or price-driven, a heterarchical network now shows great potential to enable a flexible yet efficient interfirm ICC mechanism. Each company involved translates or shapes the form of network according to its own needs. Similar to the Centralised Market, this structure operates on one single Web-based platform as shown in Figure 3.6. The circles in the diagram represent different e-business applications adopted by the companies, for example a transport management system, an order scheduling system, or a warehouse management system. However, unlike a centralised marketplace, the forged relationship and information linkage is more at the strategic level and in the longer term. Hence such a platform tends to be a closed ecosystem operating in a 'one-to-a-few' mode rather than being fully open.

An example that fits this type of architecture is Agoratrans, a network initiated by the alliance of Grupo DAMM, BT and Accenture (www.agora-eruope.com). Operating as a private logistics marketplace for Damm, Agoratrans brings all the major carriers of

Damm into this web-centric platform. Damm no longer suffers from poor visibility of information with different carriers. High system integration costs can be eliminated as well. All the data are now available in one single location and the company can trace and track all transportation jobs in a real time manner. The carriers may benefit by collaborating with other carriers to avoid empty running and provide better customer services to their shippers.

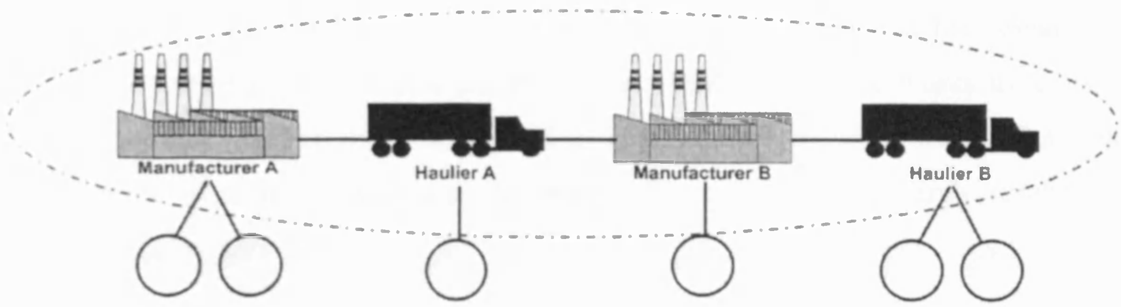


Figure 3.6 Example of a heterarchical network
(Source: Author)

Because this architecture type is a new business model, there are many practical issues involved in forging such networks as well as high risks of failure. For example, the issue of pushing conservative carriers towards using such a platform, and carriers' fear of exposing all activities to their customers, are all barriers to entry in this type of network. Moreover, it takes time for such a model to mature and it is believed the importance of such a mechanism will increase along with the development of Web-technologies and (industry-specific) open standards (Wang and Naim, 2007). Logistics operation of this category includes more complex and dedicated processes, hence it is termed 'customised logistics (type II)'.

3.5 Discussion – answer to RQ1

> ***RQ1. What are the supporting B2B e-business architectures for the provision of effective tailored logistics?***

Through the discussions from Section 3.2 to 3.4, a conceptual B2B ERA model was developed. Four fundamental architectures, dealing with different logistics scenarios, were proposed and discussed in detail with supporting case examples identified from the literature. This led to the answer of RQ1. It was found that information architecture choice is driven by customer demand and determined by an organisation's logistics strategy. However, the one-size–fits-all approach appears not to work. Efficiency and economy of scale requirements can be better met by hierarchical structures, while flexibility and speed are best achieved by heterarchical or open market structures. It is argued that the emergent heterarchical network mechanism seems to have the potential to satisfy the dual challenges in logistics operation of 'speed and flexibility' and 'low-cost and efficiency' (Allen and Boynton, 1991). However, it is felt that this duality is still to be proved. Further research is required to investigate in detail a number of electronic logistics networks to see how they may fully exploit the potential of a heterarchical network mechanism and whether the potential duality can be practically sustained. Research results are reported in Chapters 5-7.

3.6 Model validation and development of Research Questions 2-4

The next step after development of the B2B ERA is to validate this model through empirical investigation, i.e. applying it in an emerging e-business model termed the Electronic Logistics Marketplaces (ELM). Doing so will not only validate the model but also help to acquire practical insights into closed ELMs. This is important because although there have been many studies in the field of electronic marketplaces, the research from a logistics perspective has been largely neglected, especially that of closed systems. In fact, after analysing 71 Nordic doctoral dissertations in logistics and supply chain management from 1990-2001, Gubi *et al.*, (2003) found that some object areas (such as, alignment of networks, B2B e-commerce), and virtual logistics (such as plug-and-play technologies) had merely received attention. Given the chronology of the Internet and e-business development and the time it takes to produce PhDs, it is hardly surprising that very few completed theses before 2001 addressed this issue. In the following sessions, background information of ELM is firstly provided, and limitations are then highlighted in previous studies of ELM in order to justify the above research rationale. This will subsequently lead to the development of research questions 2-4.

From EM to ELM

Since the 1990s there has existed a rich body of literature on business-to-business (B2B) electronic marketplaces (EMs), facilitated by recent advances in information and communication technology (Grieger, 2003; Kaplan and Sawhney, 2000; Lai *et al.*, 2007). EMs are seen as an emerging business model with the potential for enormous influence over the way that transactions are carried out, relationships are formed, supply chains are structured, and profit flows are operated (Kaplan and Sawhney, 2000; Rayport and Sviokla, 1994). Enabled by Web-technology, they provide advantages in terms of low cost inter-organisation information connectivity, real time visibility, and flexible partnership configurations.

Definitions of an EM are diverse. Different authors assign different names and definitions under different contexts, such as marketspace, electronic exchange, electronic market, e-hub, electronic network, portal, and auction. One of the earliest and broadest definitions is offered by Bakos (1991), who referred to an EM as "an inter-organisational system that allows the participating buyers and sellers to exchange information about price and product offerings". Daniel *et al.*, (2004) narrowed the definition and described EM as "Web-based systems which enable automated transaction, trading or collaboration between business partners". They argued that Web-based systems have distinct features compared with traditional IOS such as Electronic Data Interchange and the extranet. A detailed summary of definitions and classifications can be found in Grieger (2003).

As B2B e-business shifts to the Internet, EMs have grown rapidly in usage (Rask and Kragh, 2004; Rayport and Sviokla, 1994). Utilising the Web has largely reduced the complexity and cost of implementation, and the integration of IOSs. Incorporating the concept of 'software as service' or 'on-demand computing' (Cherbakov *et al.*, 2005), EMs are emerging quickly as a viable alternative to large scale client-server solutions. The connectivity between organisations becomes cheaper, more flexible and easier. Claimed benefits include lower search costs, reduced transaction costs, wider accessibility to a large base of buyers or suppliers, improved flexibility, business processes automation, improvement in service quality, and reduction in inventory cost (Howard *et al.*, 2006).

An ELM is a specific EM model, which acts as an intermediary facilitating the exchange of logistics services. Figure 3.7 illustrates the change of supply chain structure introduced by an ELM. Traditional ways of communication between shipper and carrier are rather fragmented where they communicate with each other individually through different channels. It is costly and sometimes very time-consuming. Communicating through an ELM allows the connection of a number of shippers and carriers using a single interface, normally a Web-based system. An ELM can be used for either spot sourcing of transport services or long-term collaboration.

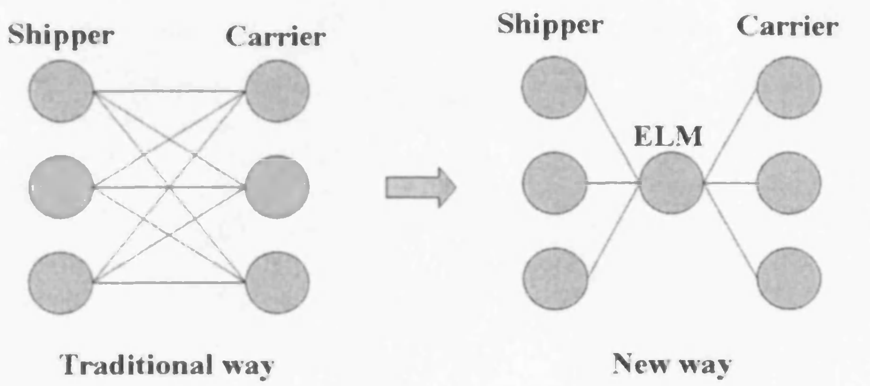


Figure 3.7 Ways of communicating between shipper and carrier: traditional vs an ELM
(Source: Author)

As shown in Figure 3.8 a basic ELM is normally composed of three key parties: shipper, carrier and technology provider, with the primary objective of reliable delivery. In some circumstances customers can gain access to an ELM. As the functions offered by ELMs are different, there may be other parties involved, such as freight forwarders and financial service providers.

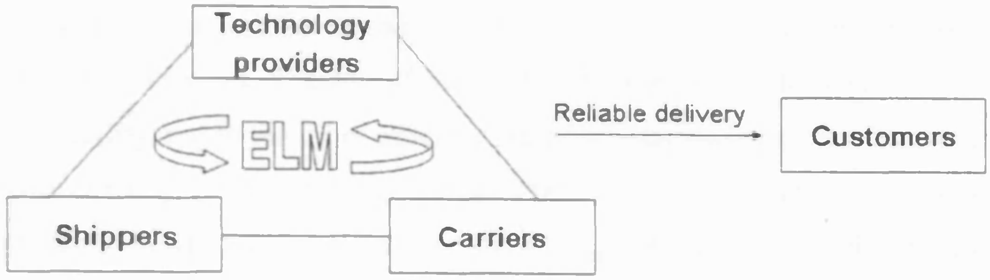


Figure 3.8 A basic ELM
(Source: Author)

From open ELMs to closed ELMs

Two types of ELM have emerged since the late 1990s: open and closed systems (Skjøtt-Larsen *et al.*, 2003). Open ELMs allow shippers and carriers to use their services with no barriers to entry. Open ELMs tend to focus on matching the supply and demand of transport and logistics services between shippers and carriers. A typical example is an online freight exchange for the spot trading of transport services. Another example is to use a strategic tendering system for long-term transport/warehousing procurement. A closed system tends to be focused towards the needs of particular shippers and/or carriers. Their characteristics are summarised in Table 3.3. Early ELMs were open systems, such as www.teleroute.com, and mainly price driven (Gosain and Palmer, 2004). Despite the benefits of lower search and coordination costs from using open ELMs, there is an increasing need for companies, and particularly shippers, to retain their linkages with preferred business partners (Dai and Kauffman, 2002). In the UK, a number of open ELM operators have found themselves struggling to secure the 'critical mass' for profit, or even for survival (Lewis 2002). Hauliers are often reluctant to join an open ELM, as they fear being judged purely on carriage rates and not on total service delivery. A trend was observed that "early days of freight exchanges must now put less emphasis on open-market exchanges and more on their ability to work with closed communities of users who trade with each other" (Lewis 2002; Rowlands 2003). This has resulted in the recent development of closed ELMs, aiming for long-term collaboration between shippers and carriers.

The operational scope provided by closed ELMs goes beyond basic load posting and matching services, and shifts to complex offerings that might encompass complete order fulfilment services. The use of closed ELMs is expected to lead to improved pipeline visibility and to the more efficient planning, execution and responsiveness of all supply chain players (Cruijssen *et al.*, 2007). Larger carriers or shippers can leverage such ELMs by collaborating on a single platform and eliminating the complex and costly integration of different inter-organisational systems. Small carriers may be able to use them to reach wider sources of logistics demand, or to collaborate with other similar companies. Rather than focusing on the identification and selection of trading participants as per open ELMs, the closed ELM focuses more on execution and long-term value-added activities between shippers and carriers.

Open ELM	***Closed ELM***
• Unlimited number of involved companies • Low scope (simple functionality), and long reach • Spot trading or strategic tendering of transport services • Low degree of information sharing and collaboration • Focus on selection and identification of potential buyers/suppliers	• Limited number of involved companies • High scope (complex functionality), short reach • Wide range of order-to-delivery processes • High degree of information sharing and collaboration • Focus on collaboration and execution

Table 3.3 Closed and open ELMs
(Source: Grieger, 2003, and Skjøtt-Larsen, *et al.*, 2003)

Previous research on ELMs has largely focused upon open marketplaces, and consequently overlaps with generic EM research already widely discussed in the literature (Eng, 2004; Howard *et al.*, 2006; Kathawala *et al.*, 2002; Rayport and Sviokla, 1994). Many intend to categorise EM approaches using different frameworks (Dai and Kauffman, 2002; Kathawala *et al.*, 2002; Zeng and Pathak, 2003).

Only Goldsby and Eckert (2003) and Gudmundsson and Walczuck (1999) explicitly define what an ELM is. Goldsby and Eckert examined an electronic transportation marketplace, and suggested using transaction cost economic theory to justify whether companies should use ELMs to source transport services. Gudmundsson and Walczuck proposed a theoretical model of global logistics brokerage system via an examination of existing ELM examples in practice. However both studies tend towards the open ELM model. There has been limited research on closed ELMs.

Table 3.4 classifies previous EM studies identified in the related literature. Most literature is found to be in the upper right quadrant, thus this is focused on open EMs for non-logistics applications. By contrast, there has been much less research focused on closed EMs for logistics applications as those in the lower left quadrant.

Non-logistics focused	Bytheway and Dhillon (1996) Dai and Kauffman (2002) McLaren *et al.*, (2002) Ho *et al.*, (2003) Le *et al.*, (2004) Chou *et al.*, (2005) White *et al.*, (2005) Howard *et al.*, (2006)	Malone *et al.*, (1987) Bakos (1991) Rayport and Sviokla (1994) Kaplan and Sawhney (2000) Barratt and Rosdahl (2002) Kathawala *et al.*, (2002) Skjøtt-Larsen *et al.*,(2003) Zeng and Pathak (2003), Eng (2004) Rask and Kragh (2004) Gosain and Palmer (2004) Howard *et al.*,(2006)
Logistics -focused	Rudberg *et al.*, (2002) Helo and Szekely (2005) Caplice (2007) Kale *et al.*, (2007)	Gudmundsson and Walczuck (1999) Lynagh *et al.*, (2001) Lewis (2001) Dai and Kauffman (2002) Zeng and Pathak (2003) Grieger (2003) Goldsby and Eckert (2003)
	Closed system	**Open system**

Table 3.4 Classification of EM studies
(Source: Author)

As can be seen from Table 3.4, only four studies have researched the closed EM for logistics application. Rudberg *et al.*, (2002) examined the use of the EM by looking at different collaborative supply chain planning scenarios. One of the scenarios, collaborative transportation planning is related specifically to ELM. While their study identified the key information flows in the transportation planning processes, they did not examine the 'execution' part of the ELM. Caplice (2007) examined the use of closed ELM for the strategic procurement of carriers and the planning of transportation. As with Rudgerg *et al.*, (2002), there is no consideration of execution.

Helo and Szekely (2005) examined historical developments in logistics, from internal systems like transportation management systems, warehouse management systems, and ERP through to external supply chain management softwares, including EAI. However, their study did not discuss the next generation development which goes beyond EAI, that is ELM. Instead of the one-to-one communication provided by EDI and EAI, ELMs are designed for participants to share a single system. The present study therefore complements and extends Helo and Szekely's study, while their study is based on secondary data only, this research is based on primary data and is an empirical study. This research also extends their work by investigating the relationship between ELMs and tailored logistics. Kale *et al.*, (2007) developed a cost model, quantifying the benefits of using a closed ELM, yet their discussion was theoretical without any primary data. This limitation again highlights the need of empirical research on ELMs.

Development of research questions 2-4

From the above discussion, it is clear that this research can fill the void in the literature by its in-depth empirical investigation of closed ELMs in practice, and by validating the conceptual model developed, lay the foundation for a better understanding of this infant model and for future research as well. The author intends to use the B2B ERA to categorise the different closed ELMs in practice, and to investigate the different operational models that support them. Once the operational models are established, the impact of closed ELMs on logistics provisions can be examined. A second research question is therefore developed:

> ***RQ2. Of the different architectures, how does the closed ELM, as an emerging business model, function and enable the provision of tailored logistics?***

Further, in any kind of ELM adoption, it is important for the organisations to make assessments with regard to benefits and costs in order to justify the investment decision. It is also equally important to analyse the motives and barriers which participants may face in the promotion and adoption of ELMs. An understanding of such issues allows organisations to recognise and realise appropriate competencies that will facilitate the success of an ELM implementation (Bytheway and Dhillon, 1996). However, studies of motivations/barriers, and costs/benefits in forming closed ELM are also scarce (Grieger, 2003; Lynagh *et al.*, 2001), despite the large body of literature on the generic issues in adopting traditional intra- and inter-organisational systems like ERP and EDI (Akkermans *et al.*, 2003; Gunasekaran and Ngai, 2004). Hence, a third research question is developed:

RQ3. What are the reasons for using a closed ELM within supply chains?

As discussed previously in Section 3.5, the Heterarchical Network type seems to be the most advanced and novel model, with the potential of being both flexible and economically viable. It is the greater level of horizontal collaboration that differentiates this type from the Traditional and Modified Hierarchical Coordination types which have a greater focus on vertical integration. While there has been a general lack of studies on closed ELMs, there has been a particular absence of research on 'Heterarchical Network' ELMs. These are rarely used in practice in contrast to the other types, but have the most potential for enabling network optimisation across companies (McLaren *et al.*, 2002; Sherer, 2005). Accordingly, a detailed examination of such model will provide highly useful insights and contribute to both the academic and practical body of knowledge. Thus, the fourth research question is:

RQ4. What are the reasons for and impacts of introducing a novel type of ELM, i.e. the Heterarchical Network?

3.7 Summary

Via a synthesis of the literature, a conceptual framework has been developed, termed B2B ERA, which has been supported through secondary case examples. Key characteristics of each B2B ERA forms have been discussed and the alignments to different logistics scenarios have also been established. After development of the B2B ERA, the author also gave reasons for applying it in the ELM context. Research questions 2-4 have been developed based on the discussion.

Chapter 4 Research Methodology

4.1 Chapter overview

This chapter presents a brief review of different research paradigms and strategies (Figure 4.1). The choice of research methodology for this research, namely, the case study approach, and reasons for this choice are given. Research design and data collection processes and methods are also explained in detail.

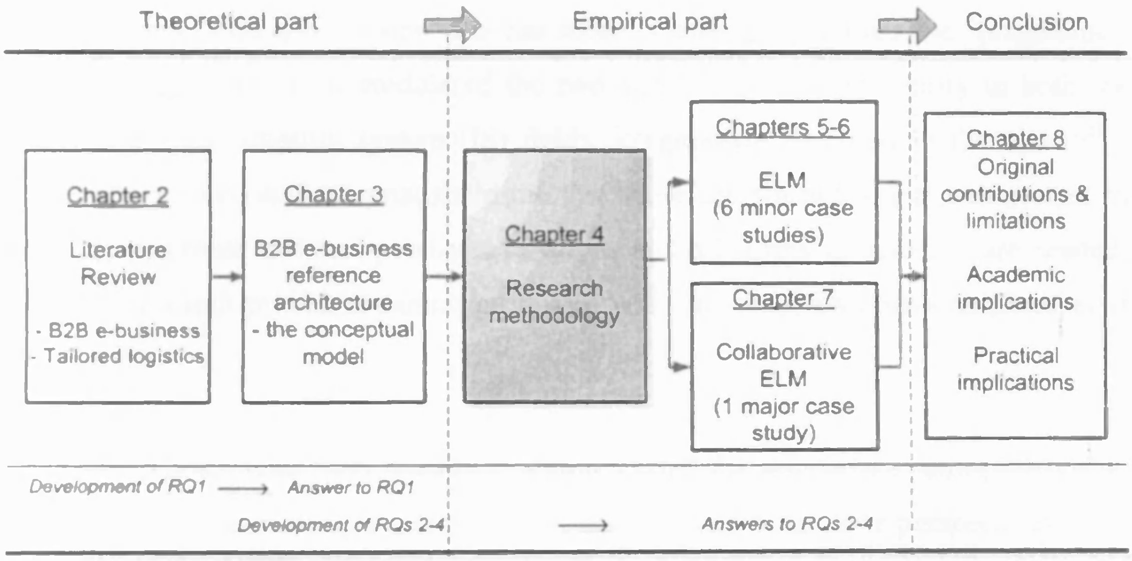


Figure 4.1 Thesis structure – research methodology
(Source: Author)

4.2 Research paradigms

The concept of the paradigm is central to all type of academic research, and refers to "the progress of scientific practice based on people's philosophies and assumptions about the world and the nature of knowledge; in this context, about how research should be conducted" (Collis and Hussey, 2003). There are a number of different paradigms which coexist in social science and science in general. Overall they can be classified into two main extremes: positivist and anti-positivist. The positivistic paradigm in social science and business studies is based on the approach used in the physical sciences. Both social and natural worlds are regarded as being bounded by certain fixed laws in a sequence of cause and effect (Collis and Hussey, 2003). The positivistic paradigm tends to produce quantitative data, use large samples and is concerned with hypothesis testing. Anti-positivists believe that an understanding of the social world is best achieved by analysing subjective accounts of a situation or a phenomenon. Anti-positivists tend to produce qualitative data, use small samples, but emphasise depth and richness, and are concerned with generating theories. The positivist also goes by other names like 'empiricist', and 'behaviourist', while the anti-positivist is sometimes called an 'interpretivist', 'non-positivist', 'phenomenologist' or someone concerned with 'hermeneutics' (Hughes, 1990). Although two main paradigms have been identified, it is best to regard them as the two extremes of a continuum because there are no clear-cut boundaries. In addition to the two main paradigms, a new one has recently emerged, termed the 'pragmatist'. This paradigm sits in the middle of the two and has gained popularity in both the logistics and information system (IS) fields. Pragmatism emerged in the late 19th / early 20th century and pragmatists argue that there are strengths and weaknesses in both the positivist and anti-positivist positions and all forms of research are needed, since all research problems cannot be solved with one research approach (Frankel *et al.*, 2005).

Goles and Hirschheim (2000) usefully differentiated the positivistic, anti-positivistic, and pragmatic diagrams by examining their assumptions from three perspectives:

- Ontology: the nature of reality
- Epistemology: the acquisition of knowledge
- Axiology: the role of values in research

A similar differentiation is to be found in the works of Bryman (2001), Burrell and Morgan (1979), Collis and Hussey (2003), and Hughes (1990). Their viewpoints are synthesised and summarised in Table 4.1. Epistemological and ontological assumptions consequently influence methodological decisions, and *how* we gain knowledge about the world. Research methodology is the rationale or basis for selecting the methods used to gather data, and for determining the sequence and samples of data to be collected (Frankel *et al.*, 2005; Gammelgaard, 2004). Hence, there are different methodological approaches for the different research paradigms, which have been added to the table in order to highlight key differences between the three paradigms.

Elements	*Objectivist approach*		*Subjectivist approach*
Ontology	Realism Reality is objective and independent of the individual. It is a 'given'.	There is an objective reality, existing externally to the individual. However, this reality is grounded in the environment and experience of each individual, and can only be imperfectly understood.	Nominalism Reality is equivocal and interpreted by the individual. It is socially constructed.
Epistemology	***Positivism*** Knowledge is objective, and is acquired by examining empirical evidence and testing hypotheses to uncover general or fundamental laws.	***Pragmatism*** Views the process of acquiring knowledge as a continuum, rather than as two opposing and mutually exclusive poles of objectivity and subjectivity. Research should select the approach and methodology most suited to a particular research question.	***Anti-positivism*** Knowledge is relative and reality is too complex to be 'known' by a single perspective. Researchers should focus on meaning and examine the totality of a situation.
Axiology	Research is value-free and unbiased	Values are relevant and important only insofar as they influence what to study and how to do so.	Research is value-laden and biased.
Methodology	Nomothetic Quantitative Deductive, testing of theory Typical research designs - cross-sectional studies - experimental studies - longitudinal studies - surveys - mathematical modelling - simulation	Can be both qualitative and quantitative. Whatever works best for the particular research programme under study Appropriate approaches for research questions	Ideographic Qualitative Inductive, generation of theory Typical research designs - action research - case studies - ethnography - feminist perspective - grounded theory - hermeneutics - participative enquiry

Table 4.1 Summary of different research paradigms
(Source: Bryman, 2001; Burrell and Morgan, 1979; Collis and Hussey, 2003; and Hughes, 1990)

In both disciplines of logistics and IS, positivists dominate the field, although the anti-positivistic paradigm has increasingly been adopted. For example, Chen and Hirschheim (2004) conducted an empirical study of 1893 articles published in eight major IS journals between 1991 and 2001. They found that 81% were positivistic studies and only 19% were interpretive studies. They also found that European journals tended to publish more qualitative studies than US journals. Sachan and Datta (2005) conducted a review of 442 articles on logistics research published in three major logistics journals between 1999 and 2003. Their review indicated that research in this discipline was still dominated by quantitative research methods with survey being the most popular one, possibly because much of the research originated from the so-called 'hard' disciplines (e.g. engineering, computer science and management science), where the quantitative approach prevails. Another possible reason is that logistics and IS research is still at a relatively immature stage, hence the lack of diversity in research methods (Collis and Hussey, 2003, New and Payne, 1995).

However the positivistic approach has several weaknesses (Naslund, 2002), for example, it is inappropriate for complex and ill defined issues, is past, not future oriented, or provides 'snapshots', not a wide canvas, and overemphasises the testing of already established theories and ideas. In fact, many have argued that paradigmatic unity (e.g. positivism dominance) is done at the expense of research variety and a deeper understanding of the real context and situation (Benbasat *et al.*, 1987; Checkland and Scholes, 1990; Goles and Hirschheim, 2000; Collis and Hussey, 2003; Gammelgaard, 2004; New and Payne, 1995; Becker and Niehaves, 2007; Naslund, 2002). It is contended that methodological triangulation, i.e. using both quantitative and qualitative approaches, provides multidimensional insights into many logistics and IS research problems (Mangan *et al.*, 2004; Kaplan and Duchon, 1988). As the study of how e-business impacts on logistics integrates both logistics and IS fields, and each field is multidisciplinary and still developing, it is desirable and appropriate to use multiple paradigms.

This research holds the 'pragmatistic' view and believes that different types of research problems require different solutions in terms of research approach and choice of method (Frankel *et al.*, 2005). Researchers should tailor their methods according to the problem at hand, instead of a presupposed set of assumptions laden in a theory (Vafidis, 2007). One major strength of pragmatism is its recognition of the intrinsic diversity of problem formulations and the potential cross-fertilisation between paradigms (Goles and Hirschheim 2000). Therefore, based on this point of view and taking into account the research aim and research questions formulated in Chapters 2 and 3, a multiple-case study approach was adopted in this study. Choice of this approach was not pre-determined because the author held an anti-positivistic view point; rather it was chosen because the author believed this approach would work best for this particular research. One potential drawback of the pragmatistic approach is that although there are linkages inherent in different research paradigms, they remain based on competing assumptions. Thus it requires a rigorous justification for the specific research method/tools a pragmatist chooses to investigate a specific subject or phenomenon. The rationale for choosing this approach is discussed in detail in the forthcoming section.

4.3 The selection of multiple-case study methodology

Burgess *et al.*, (2006) and Wacker (1998) identified two main research approaches: analytical and empirical. Each has three subcategories as shown in Table 4.2.

Analytical research	*Empirical research*
• Conceptual • Mathematical • Statistical	• Experimental design • Statistical sampling • Case studies o Single case study o Multiple-case study

Table 4.2 Different research approaches
(Source: Wacker 1998)

This research integrates the strategies of both approaches. The first stage of the research is the development of a conceptual model, i.e. an B2B ERA, based on secondary case examples and existing literature, therefore is analytical research. The second stage requires empirical research in order to verify and validate the conceptual model, and also gain insights into the ELM in practice. All three empirical research approaches were reviewed at the start of the research project. 'Experimental design' was quickly dismissed because it would be impossible for the author to control certain variables in an open system where ELMs operate. Purely questionnaire-based 'statistical sampling,' involving a large group of companies, was also rejected because it would lack sufficient depth, particularly in such a new area of study (Edwards *et al.*, 2001). There are also other drawbacks to statistical research such as model limitation, the possible omission of crucial variations, the abstract and remote character of key variables, the causal complexity of multivariate analysis, and the difficulty in understanding, interpreting, and especially implementing the results of studies (Bonoma, 1985; Meredith, 1998).

Case study research was adopted, because it is particularly suitable when we explore "why", "what" and "how" research questions and examine contemporary events (Voss *et al.*, 2002; Yin, 1994). The key difference between case study and statistical research is that while empirical statistical research methodologies "verify models for their empirical validity in larger populations to reduce the number of relationships in future research", empirical case studies "provide new conceptual insights by investigating individual cases for an in-depth understanding of the complex external world" (Wacker, 1998). A case study examines a contemporary phenomenon within its natural setting and the boundaries between the phenomenon and context are not clearly evident (Yin, 1994).

Benbasat *et al.*, (1987) also indicated that case research is very appropriate for those problems in which research and theory are at their early, formative stage, and the variables are still unknown and the phenomenon is not well understood. They also pointed out that the IS area is characterised by constant technological change and innovation. This is therefore a particular area where IS researchers often find themselves trailing behind practitioners, for example, in proposing changes or in evaluating methods for developing new systems. Researchers also usually learn by studying the innovations put in place by practitioners, in this case, the innovative ELM business model. Thus the case study research strategy is well-suited for capturing the knowledge of practitioners and developing theories from it. In fact, it is argued that the purpose of the case study approach is not to generalise findings into predictions about a population but to ground the development of theory in empirical observations and further refine it through the test of reality (Yin, 1994; Mills, 1967; Strauss and Corbin, 1990).

In summary, there are three main reasons why the research adopted the case study approach:

- The research questions formulated in Chapter 2 and 3 are exploratory and explanatory in nature, hence are "what", "how" and "why" questions and the case study approach is most suitable for answering them.
- The ELM is a new research area and few studies have been conducted in it. Case study research can provide in-depth insights into it.
- Through the study of the ELM in a real setting, the author can test the developed conceptual model and generate insights from practice.

Other advantages of case studies include the richness of their explanations, having high validity with practitioners, and their facilitation of theory testing, extension and refinement (Meredith, 1998; Voss *et al.*, 2002).

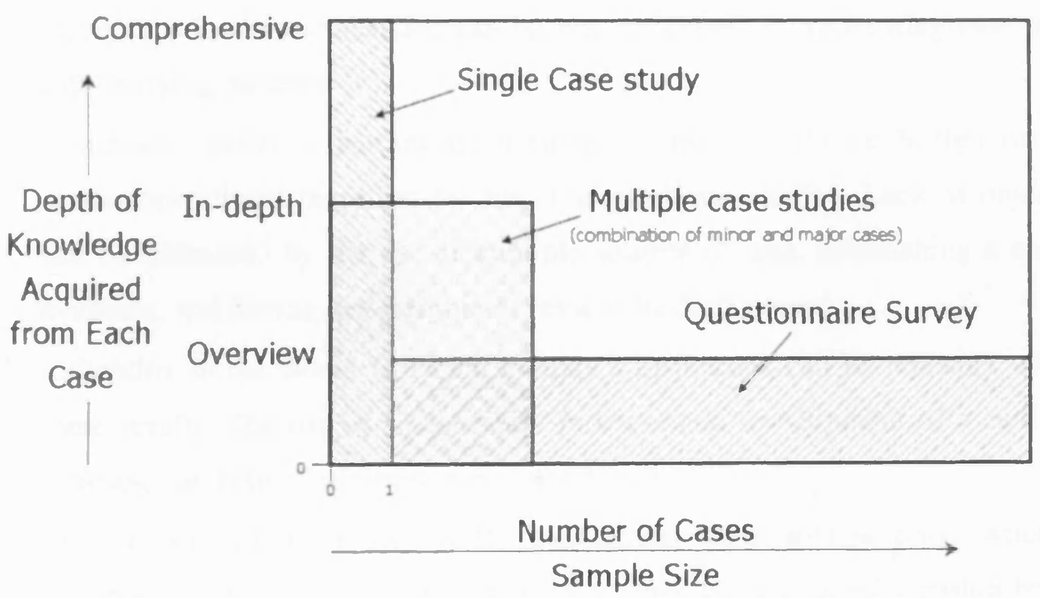


Figure 4.2 The depth and scope of multiple-case study research
(Source: based on Towill *et al.*, 2002)

In addition, although a single in-depth case study approach was considered, it was rejected as being too narrow and potentially unrepresentative. A single case study can also have more potential bias as a result of, for example, exaggerating easily available data. After careful consideration, a combination of minor and major case studies was decided upon in order to gain both the sufficient research depth and width as illustrated in Figure 4.2 based on Towill *et al.*, (2002). Multiple-case studies can also have higher external validity and help guard against observer bias (Voss *et al.*, 2002, Yin, 1994). However, a more specific reason for a major case study in this research was Research Question 4, developed in Chapter 3. As the research intention is to investigate in more detail the Heterarchical Network ELM type, using a single case as a major example is appropriate due to the lack of other examples of the same type (Yin, 1994).

Many criticisms of case study research are related to validity and reliability (Yin, 1994; Ellram, 1996; Voss *et al.*, 2002):

- *External validity* has been a major barrier in undertaking case studies. It reflects how accurately the results represent the phenomenon studied, and whether the results of a study are generalisable. Yin (1994) argues that different from statistical generalisation, case studies rely on 'analytical' generalisation, which requires the researcher to generalise a particular set of results to some broader theory. Lack of generalisation can be best addressed by replicating case studies and verifying patterns.
- *Construct validity* is another major barrier. It refers to the establishment of the proper operational measures for the concepts being studied. Lack of objectivity can be addressed by the use of multiple sources of data, establishing a chain of evidence, and having key informants review the draft report.
- *Reliability* is the extent to which a study's operations can be repeated with the same results. The use of a case study protocol and development of a case study database can help to minimise errors and biases.
- *Internal validity* is a concern to explanatory case studies only, where the researcher is trying to demonstrate whether there is a casual relationship between the independent variable and dependent variables. Using literal and theoretical replications can help to address this barrier. Time series analysis is another tactic to improve internal validity.

All four key issues were taken into consideration by the research, and the tactics adopted by the author to address them are summarised in Table 4.3. Details of the data collection process and analysis of data will be discussed in the next section.

Issue	*Case study tactic*	*Tactics adopted in this research*
External validity	Use multiple case studies and verifying patterns	• 6 case examples were studied • A generic analysis framework was adopted to analyse the similarities and differences between cases.
Construct validity	Use multiple data sources	• Interviews • Documentation • Archival records • System demonstrations • Process mapping • Site visits • Company websites • Media reports
	Establish chain of evidence	• PhD supervisors and participants from case companies acted as external reviewers and examined and verified the research protocol, including research questions, interview structure, and case study report. • Preliminary research findings were reported at internal workshops and industrial seminars. Logic, flow, clarity and content were evaluated and confirmed.
	Have key informants review draft case study report	• Multiple informants from each case were used. • Interview report was written up and cross checked with interviewees. • Case study report was reviewed and confirmed by case companies.
Reliability	Use of case study protocol	• A research protocol was developed, including aim/objectives, sample selection, data collection and analysis methods, interview structure, timetable and resources needed. • The protocol was further verified by PhD supervisors and piloted via an industrial workshop with mixed participants from academia, industry and government, and then approved by research funding bodies.
	Develop case study data base	• Database included research project proposal, interview guides, detailed summary and write-up of each interview, and other sources of collected data such as printed company documents, presentation, screen shots, etc.
Internal validity	Pattern matching, explanation building or time-series	• Pattern matching was achieved through literal replication: two examples for each ELM type, • Theoretical replication: comparison between different ELM types • Time series analysis was adopted in the major case study.

Table 4.3 Tactics adopted for research design based on Yin's (1994) criteria
(Source: Author)

Unit of analysis

The unit of analysis is "the kind of case to which the variables or phenomena under study and the research problem refer, and about which data is collected and analysed (Collis and Hussey, 2003)". Obviously the unit of analysis in this research was the ELM. However each ELM consisted of three basic participating parties (i.e. shippers, carriers and technology providers) and other value added participants, such as finance service provider as mentioned in Section 3.6, Chapter 3. One should therefore note that the number of participating companies was not necessarily equal to the number of units being analysed. In this study, there were six units of analysis, and 12 participating companies in total, as shown later in Table 4.6, Section 4.5.

4.4 Case research design and sampling

In order to validate the conceptual B2B ERA model developed, it was essential to select case examples for each architecture type. Purpose sampling was therefore adopted. It differs from random sampling, which is often used in empirical statistical research. The logic and power of probability sampling derive from its purpose: generalisation, whereas the logic and power of purposeful sampling derive from the emphasis on in-depth understanding (Patton, 2002). The descriptions of the B2B e-business architectures given in Figure 3.2, Chapter 3 are generic. In order to choose appropriate case studies, the research had first to define specific applications of these architectures within the ELM context.

Aligning architecture attributes with expected ELM characteristics

Different ELMs have different information architectures which are determined by the nature of how they are formed. Table 4.4 summarises the expected ELM characteristics for each of the four architectures defined earlier in Chapter 3.

Under the *Centralised Market*, organisations are coordinated with the market via bidding and pricing systems. This type is most suitable for 'routine' logistics. The centralised market represents an open ELM. Previously in Section 3.6, Chapter 3, the research distinguished the difference between open and closed ELMs. Open ELMs adopt a many-to-many connection via a marketplace, and are used for spot trading of transport services. Shippers and carriers have very loose relationships, being mainly price driven. Transport or other related services are traded as commodity. As open ELMs are not the focus of this research, they have been deliberately excluded from the study.

Logistics type (Attributes defined in Table 2.2, Chapter 2)	*Architecture (Attributes defined in Table 3.2, Chapter 3)*	*Expected ELM characteristics*
Routine	Open Market	• Open marketplace • Used for spot trading of transport services • Mainly price driven • Loose relationship between shippers and carriers
Standard	Traditional Hierarchical Coordination	• Closed system • Shippers build automatic link (via EDI or EAI applications) with carriers • Moderate relationship between shippers and carriers • Authority and contract procedure for coordination • Some easy customised functions
Customised (Type I)	Modified Hierarchical Coordination	• Closed system • Shippers build automatic link with carriers • Close relationship between shipper and carriers • Horizontal collaborative activities between shippers, or between carriers • Wide range of functionality with value added services
Customised (Type II)	Heterarchical Network	• Closed system • Shippers and carriers share one single platform with full visibility • Close relationship between shippers and carriers • High level of horizontal collaboration between shippers, or between carriers • Functionality goes beyond execution, and explores strategic gains through more advanced features

Table 4.4 Aligning architectures with ELMs
(Source: Author)

Traditional Hierarchical Coordination focuses on vertical integration. Sometimes referred to as a 'private' marketplace (Chou *et al.*, 2005), a dominant player (usually the shipper) creates an ELM for its own use. This type of ELM uses authority and other procedural coordination processes instead of a pricing mechanism. A shipper usually builds automatic linkages with its carriers for communication. This model can be applied to 'standard' logistics operations where some degree of customisation is being provided.

In the *Modified Hierarchical Coordination* model, a number of shippers may start to share one single platform to get connected with their carriers. Some horizontal collaboration is expected between shippers, or between carriers. More value-added elements are expected in this type of ELM, for instance, a wider range of transport, and warehousing operations, from inventory management, order processing to financial settlements. It can be used for the 'customised' logistics stream (Type I).

A *Heterarchical Network* is characterised by great level of horizontal collaboration between shippers. This network is normally a Web-based and hosted platform, and enables a high level of information sharing and joint activities. This encourages the reduction of empty running by identifying synergies within product flows and sharing the capacity of carriers. The ownership of such a network is usually via a consortium group. The network is designed and highly customised in servicing the consortium's specific needs, hence it facilitates 'customised' logistics (Type II).

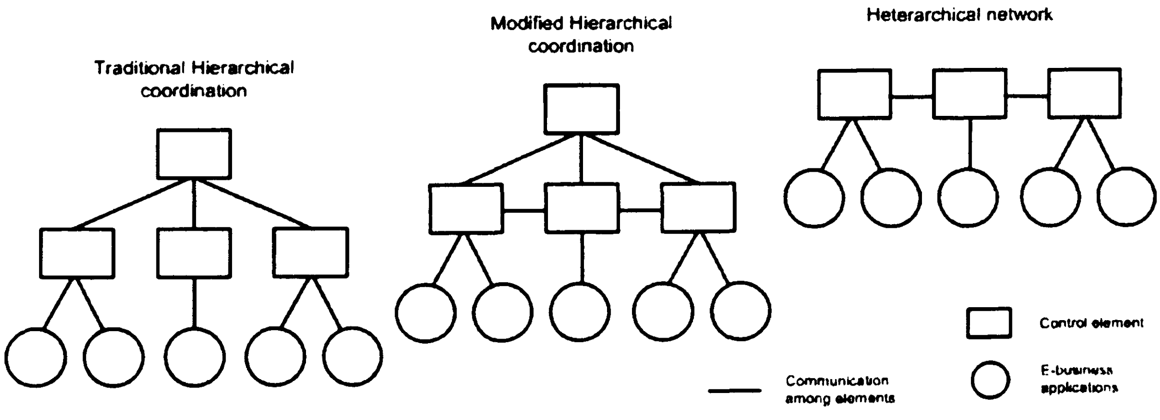


Figure 4.3 Research focus
(Source: Author)

Since the 'centralised market' type is excluded, this leaves the remaining three architectures as the research focus and representatives of the main types of closed ELMs (see Figure 4.3). The squares in the diagram represent control elements in the ELM which can be either shipper or carrier. The circles represent different e-business applications, namely, different interorganisational information systems used by the control elements. The line indicates the communication and connectivity between elements.

Development of the case research protocol

Based on the above contemporary characteristics of the three different types of architecture, a research protocol was developed for case study selection and data collection, composed of research objectives, provisional questions, targeted companies, planned activities, data collection and analysis techniques, major deliverables, and resources required (Appendix I).

An industrial workshop was organised to test the protocol, and a total of 13 participants attended drawn from technology providers, carriers, shippers, government policy officers, and university academics. The dynamics of group discussions helped to define the scope and boundaries of the case study protocol. By having individuals representing different stakeholder groups, it is possible to get a rich and diverse set of opinions. At the same time, commonalities and consensus may be achieved where appropriate (Collis and Hussey 2003). A summary of piloting activities is provided in Appendix II. The refined protocol with minor changes was then used to execute the case studies. These minor changes are;

- To include a RACI project governance model for the control of research quality and time. The RACI model specified who would be Responsible, who would be Accountable, who needed to be Consulted, and who should be kept Informed during the research process.
- Also relevance to beneficiaries was specified in order to obtain buy-in from potential participating companies.

The protocol then led to the later development of a "Major case study brief" with an overall project Gantt chart (Appendix III) and an interview guide (Appendix IV).

4.5 Case selection

In line with the expected attributes identified in Table 4.4, relevant case companies were identified based on the business directory B2B markets for transportation and logistics (Business.com, 2006) as well as other sources of information, such as, industry peers' recommendation, and government listings. Targeted companies' details are provided in Appendix I. Initial contact was then made with senior representatives of interested companies through email (Appendix V) and an introductory PowerPoint presentation. This was followed up by phone calls. The goal was to undertake six to ten case studies, and at least two cases for each type of closed ELM, as "in most conditions six to ten cases should provide enough prevailing evidence" (Ellram, 1996). This goal is also supported by Eisenhardt (1989) who pointed out that "there is no ideal number of cases, a number between 4 and 10 cases usually works well". He explained that with fewer than 4 cases, it is often difficult to generate theory with much complexity, and its empirical grounding is likely to be unconvincing; with more than 10 cases, it will quickly become difficult to cope with the complexity and volume of the data.

Although there are no precise guides as to how many cases should be sufficient, Perry (1998) argued that a recommended range is extremely useful considering the constraints of time and funding in postgraduate research. Through a review of the literature, he concluded that the widest accepted range seems to fall between two to four as the minimum and ten to 12 or 15 as the maximum. Meredith (1998) also referred to the number of analysis units acceptable for the statistical method and case/field study method from undertaking an extensive review of published operations management studies as shown in Figure 4.4. For a multiple-case study, the likely number of units of analysis will fall between two and eight, and at eight units, the use of small sample statistics may also become feasible.

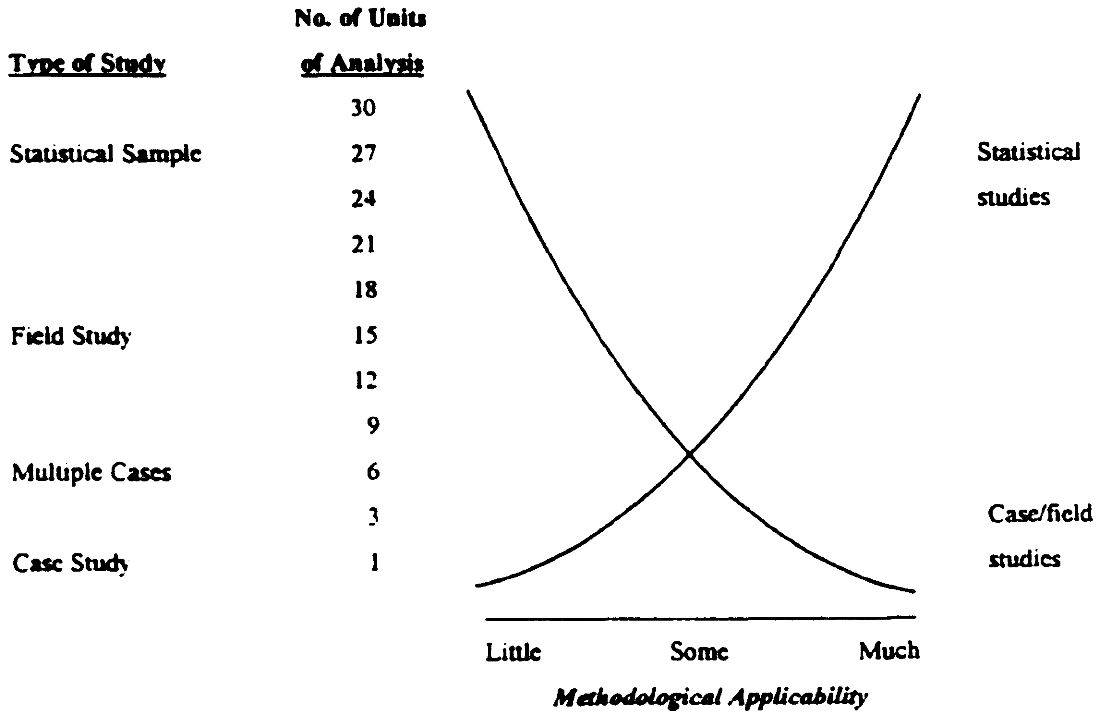


Figure 4.4 Methodological applicability relative to number of units of analysis
(Source: Meredith 1998)

The decision to have at least two cases for each type of closed ELM is also based on Yin (1994), who emphasises that replication logic, not sampling logic, should be adopted for multiple case studies. According to Yin (1994), the case must be chosen so that it either predicts similar results (a literal replication) or predicts contrasting results but for predictable reasons (a theoretical replication). Yin further points out that a few cases (2 to 3) might be used for literal replications and a few other cases (4 to 6) might be used for theoretical replications. In this research, therefore, choosing at least two cases for each type fulfils the need for literal replication. Six cases in the aggregate should provide compelling support for theoretical replication when across type of ELM analysis is needed. The selection of number of cases is also constrained by the case availability in practice, in particular for the Heterarchical Network type. To the author's knowledge, there are only two practical examples in Europe. Fortunately these two were both successfully recruited into the research.

The net result of case selection was that out of a total of ten companies contacted six agreed to participate in the study. The remaining four companies were unable to join the project. Two US cases, i.e. FTM.COM and NCM, did not participate in the research because they could not see how they could benefit from getting involved in the research project. In addition, gaining knowledge of other cases' operation through the Best Practice Guide (one of the outputs from this research) was not an attractive incentive to them. Another company, MBI from UK/Switzerland, failed to participate because of ongoing structural changes within the organisation. The UK company, i.e. Ticatrans, did not provide any feedback. The details of participating ELM examples are shown in Table 4.5, with two case examples for each type of architecture, to provide in-depth detail and richness of data, as well as a manageable study size.

ELM Case A was developed and owned by a fourth party logistics (4PL) provider, mainly for its own use to communicate with its carriers and shippers. To add service value to the shippers, Case A used sophisticated logistics management systems to enable seamless and automated processes, and to support the reengineering of its client shippers' current business processes in order to facilitate cost reduction and efficiency improvements. ELM Case B was developed by an independent software service provider specialising in supply chain software development, in particular in the retailing sector. The ELM solution was sold to individual shippers, mostly large organisations, to aid their transport management. ELM Cases C and D were both developed and owned by technology providers. Both technology providers were leading software development companies and had been very active in promoting 'software-as-service' or 'on-demand' concepts.

Both ELM Case E and Case F were owned by industrial consortia groups, and hosted by independent technology providers. Case E was selected as a major case example, because it was the Heterarchical Network type of B2B ERA the author was most interested in, and it had just been implemented, therefore provided the author with an opportunity to evaluate the effect of ELM introduction as well. Case F represented an unsuccessful example and was deliberately selected in order to understand fully the factors behind the failure.

As can be seen in Table 4.5, the cases' countries of origin were global in spread, the US, UK, Canada, and Spain.

Architecture Type	Case Name	Country of origin	Industry	ELM Ownership	Owner Description
Traditional Hierarchical Coordination	Case A	UK	Cross industries	Independent	A small-medium sized 4th-party logistics provider (4PL) established within the European logistics sector. With customers from automotive, retail (including FMCG), electrical wholesale, pharmaceutical and packaging industries. Had around 30 employees. Annual revenues unknown.
	Case B	US, research conducted via its UK office	Cross industries	Independent	One of the leading supply chain software providers with a particular focus on the retailing industry. Had 1856 employees and a customer base of 5,500 customers in more than 60 countries. Annual revenue US$277.5 million (2006).
Modified Hierarchical Coordination	Case C	US, research conducted via its UK office	Cross industries	Independent	One of the world's largest providers of business software, and the 10th largest software company in the world. Had 8,100+ employees and direct offices in 100 countries with 70,000 customers worldwide. Annual revenue approximately $2.1 billion (2006).
	Case D	Canada, research conducted via its Netherlands and UK offices	Cross industries	Independent	One of the leading providers of on-demand logistics solutions, with two specific target customer groups: transportation/logistics providers and manufacturers, retailers and distributors. Had 3,000+ customers in 60+ countries worldwide and 35,000 logistics messaging partnerships. Annual revenue US$52.0 million (2006).
Heterarchical Network	Case E	UK	Fast moving consumer goods (FMCG)	Shippers Consortia	Owned by three shippers, which are the world's leading manufacturers in the FMCG sector. - Shipper 1 specialised in confectionery, main meal and petcare products with operations in over 65 countries. Annual revenue in US$18bn (2006). - Shipper 2 was one of the world's largest FMCG companies, specialising in beauty, home and health care products. Annual revenues US$68.22 billion. - Shipper 3 was one of the world's largest soft drinks manufacturers. Had 74,000 employees worldwide. Annual revenue US$19.80bn (2006).
	Case F	UK and Spain	FMCG and Chemical	Shipper-oriented Consortia	Owned by three companies - A shipper, one of the leading beer companies in Spanish and European markets. Employees and annual revenue unknown. - A global management consulting, technology services and outsourcing company, had operations in more than 150 cities in 49 countries, with 158,000 employees. Annual revenues US$16.65 billion (2006). - A British telecommunication company, one of the world's leading providers of communications solutions and services operating in 170 countries. Had 106,200 employees worldwide. Annual revenues £20 billion (2006).

Table 4.5 Case example summary
(Source: Author)

4.5 Data collection and analysis process

The main data collection technique was the semi-structured interview (see the interview guide in Appendix V). Generally, interviews were carried out with staff members of the technology provider which held the ownership of ELM. In studying the Heterarchical Network type of ELM, namely Case E, data was collected in more depth and interviews were therefore also conducted with both shippers and carriers, to answer RQ4 which sought to elicit reasons for and impacts of understanding a novel type of ELM, i.e. the Heterarchical Network.

In most cases, interviews were carried out with at least two members of the company at different times. In Case B, it was only possible to secure one interview, but this was supplemented by attendance at a 4-hour industrial workshop on its ELM solution organised by the company. Such attendance provided more information about the functionality and application of its ELM solution as well as feedback from users who had already used the system. In total, 36 interviews were carried out with 47 interviewees from 12 participating companies. Table 4.6 provides basic statistics regarding the interviews conducted. Interview details are summarised in Appendix VI. Interviews typically lasted three to four hours and covered:

- Company background,
- Opportunities and challenges in the market,
- The ELM business model,
- Factors behind companies' use of the marketplace,
- Benefits/costs associated with the adoption, and
- Future outlook.

In addition, background information on each company and the interviewees' role within the organisation was obtained. This enabled the identification of any external factors that might have affected their judgments. Interviews were transcribed and cross-checked with interviewees to ensure maximum objectivity. It should also be mentioned that Case E, the major ELM case study example, was closely observed over a 12-month period. During this time, the author often spent whole days at the shipper's and technology provider's sites in order to examine ELM related processes and systems in detail. Informal contacts, for example, via email and telephone, were frequent and the time spent has not been included in Table 4.6. The detailed findings are reported throughout Chapters 5-7.

Case	*No. of interviews*	*No. of people interviewed*	*No. of companies*
A	4	4	1
B	1*	1*	1
C	3	3	1
D	2	4	1
E	24	33	6
F	2	2	2
Total	**36**	**47**	**12**

**This was supplemented by attending a 4-hour industrial workshop on Case B's ELM solution.*

Table 4.6 Interview summary
(Source: Author)

System demonstrations were another major data collection technique used. This facilitated the understanding of each case ELM's functionality, operational scope and supporting technologies and revealed potential technical barriers. All demonstrations were conducted by the technology provider in a face-to-face manner, with the exception of Case C, which was demonstrated by a product manager based in Spain via a web meeting using WebEx (a web conference software system). As regards case E, both shippers and carriers' in-house transport and logistics related systems which directly and indirectly connected with the ELM were also demonstrated and examined in detail. This helped the author obtain a full picture of how systems were integrated and what and how information was fed to/from the ELM. Operation manuals and instructions as well as company presentations on ELM were also obtained in order to obtain technical details and information on the required process linkages.

To complement the interviews and system demonstrations, other techniques were employed and sufficient time has been spent on accessing archival records and company websites, attendance at industrial seminars, site visits and use of existing business databases in the library. Different sources of data thus provided efficient triangulation of research results. Primary and secondary data are presented later.

Major case study data collection

The scope of data collection in Case E was extended to include shippers and carriers. While many studies of B2B marketplaces focus purely on the single party market maker (for instance, the technology provider or shippers), it was believed by the author that a study of all three parties involved, i.e. shipper, carrier and technology provider, could lead to a more comprehensive understanding of the system. This was particularly important given the novelty, rarity in practice, and lack of research on this type of ELM. The reasons why this study did not directly involve customers in the case study were twofold:

- The functionality of the ELM is designed only for the use of shippers and carriers, there was no direct interaction with customers. As the system clearly focused on on-time delivery performance, the data provided by the system would provide factual evidences as to whether there had been any improvements of on-time delivery performance or not. There was no need to obtain customers' confirmation for triangulation purpose. The system's functionality is described in detail in Chapter 7.
- Through interviews with shippers' key account managers, it appeared that customers perceive such ELM initiative to be shippers' continuous improvement scheme, and were only interested in its outputs, that is on-time deliveries. Further, shippers did not want to involve customers in the development stage of ELM for the moment, in order to avoid unnecessary complexities.

The ELM Case E commenced in March 2006, while the research began in June 2006. The case was continuously observed for a 12-month period until June 2007. More background information on Case E will be provided in Section 7.3, Chapter 7.

As Shipper 1 was the company who had initiated and lead the ELM project, in-depth interviews were conducted with company personnel in managerial positions, in order to obtain a full understanding of its supply chain management practice, and thus understand the context and operating environment of the ELM initiative. Hence, as well as interviews with ELM project managers, the data collection also covered all main logistics functions within the company from key account management, customer service management to distribution planning, warehouse management, carrier management, distribution cost, in-bound and ex-factory logistics, and distribution information systems. In addition, project-related documents were obtained included meeting minutes, Gantt-chart, carrier roll out analysis, and technical instructions like geo-fence definition, telematics specifications, and the ELM user manual. As regards Shipper 2, an interview was conducted with the project manager but interview activity did not span as widely as with Shipper 1, largely due to time constraints. It was also felt that as Shipper 1 had initiated and led the development of the ELM case system, the research findings derived from the interviews with Shipper 1 would be representative across three shippers. Indeed, it was confirmed at a later data collection stage, that the rationale behind the ELM initiative was largely the same for all three shippers, and it was this same rationale which had brought the three shippers together to set up the Case E ELM project. Chapter 7 will report the motivations in detail. Shipper 3 agreed to participate in an interview but failed to do so due to unexpected change in project manager role. Lack of interview data was offset by careful examination of relevant archival project memories, documents and information on the company's website.

% total business	*Carrier 3*	*Carrier 2*	*Carrier 1*	*Other*	*Total*
Of Shipper 1	34%	23%	11%	32%	100%
Of Shipper 2	65%	2%	0%	35%	100%
Of Shipper 3	50%	0%	0%	50%	100%

Table 4.7 Carriers' transport volume percentage for Shipper 1
(Source: Author)

Three carriers were selected for participation in the study which accounted for 68% of Shipper 1's total delivery volume, 67% of Shipper 2's, and around 50% of Shipper 3's (see Table 4.7). This ensured the research findings derived from the three carriers are representative of all the carriers involved in Case E.

Carrier 1 was co-owned by a group of 4 hauliers with 10 small and medium sized (SME) regional hauliers as partners. It had an annual turnover of around £22 million in 2006. Carrier 3 is one of the largest independent hauliers in the UK with annual turnover at around £70m for the same year. It specialised in ambient deliveries and had 320+ trucks & 640+ trailers. Carrier 3 provided services to all three shippers, and was responsible for the delivery of between 30-65% of each shipper's load. Carrier 2 was half size of Carrier 3 with 150+ trucks (640 trailers) on site, and provided service to various industries, ranging from steel, FMCG to plastics. The mix of big and SME hauliers would also ensure the detection of differences in attitudes or perceptions towards the use of ELM from carrier's perspective. Guided by the research protocol and the developed interview guide, the data collection concentrated on the carriers' company background, existing process and IT systems, perceptions of the ELM in terms of investment and its impact on the processes and relationship with shippers. Issues and concerns as well as expectations were explored.

Because the interviews were conducted during implementation of the ELM, details on progress were also sought, along with any issues that had arisen during this process. Apart from the techniques mentioned above, additional data collection methods were used to improve the external validity of research findings:

- Detailed process mapping, especially information flow between shippers, the ELM and carriers.
- Online observation and time series analysis: Case E created a username and password to enable the author to use the ELM, which provided first hand experience of the system. It also enabled the author to observe the system's implementation over time. Quantitative data on delivery performance was collected directly from the system database in order to examine whether there was any performance change due to the introduction of such ELM.
- Participation in system trials assisted understanding of how the system functioned and identified of any potential issues.

Further, different triangulation techniques were adopted which provided more robust research findings (Benbasat *et al.*, 1987; Stuart *et al.*, 2002).

- Data triangulation: a range of different sources of data were collected as discussed above.
- Investigator triangulation: two researchers were involved in the data collection process, which helped to capture a greater richness of data. Data accuracy was also improved through the cross check and consolidation between the two.
- Method triangulation: Case data in this research was mostly qualitative. However, it also involved quantitative data analysis, mainly in Case E.

Data analysis

Data analysis begins simultaneously with the gathering of data, and continues throughout the data collection process and beyond. As suggested by Ellram (1996) and Voss *et al.*, (2002), the first step of data analysis is documentation. Accordingly, every interview was written up in detail and data derived therefrom combined with other materials. Every case example was then written up using the same structure in line with the research protocol.

The next step was analysis within case. Using the data analysis framework (being discussed in Chapter 5, see Figure 5.2), concepts such as supporting technologies, collaborative arrangements and process/functionality, were grouped together as categories. These categories served as building blocks to structure the case ELM business model. Thus, the case ELM's characteristics were identified, and then compared with the proposed attributes developed in the conceptual model. The overall idea was to allow the unique patterns of each case to emerge before seeking to generalise across cases (Eisenhardt, 1989; Ellram, 1996; Voss *et al.*, 2002).

Having undertaken detailed within-case analysis, cross-case analyses were conducted. Cross-case patterns were then sought by looking for similarities and differences between pairs of cases for each type of ELM. Using the analysis framework (Figure 5.2), this process was conducted in a systematic way. Logical connections for any differences/similarities were explored through various data sources in order to obtain external validity. Differences and similarities were also compared and consolidated between different types of ELM.

4.6 Summary

In this chapter, three main research paradigms, i.e. positivism, antipositivism and pragmatism have been demonstrated, and the point of view held by the author with regard to this research, i.e. 'pragmatism', has been highlighted. Based on this, use of the multiple-case study research methodology has been justified taking into account the research aim and questions developed in Chapters 2-3. Advantages of case study research, in particular multiple-case study, have been illustrated. Disadvantages have been presented as well, and tactics developed to tackle these issues have been explained.

Case research design and sampling have been presented in detail. Purposeful sampling was adopted in order to gain sufficient understanding of each type of closed ELM. The research protocol was developed and testified via an industrial workshop. This was used as a guide to develop the major case study brief, and interview outline. Six case examples were successfully recruited into the project, two for each type of closed ELM. Case E was also selected as a major case example and was examined in more detail in order to gain in-depth understanding of the Heterarchical Network type of ELM.

Multiple data collection techniques are adopted for resource triangulation. The main data collection technique is semi-structured interview. This is coupled with system demonstrations, company documentations, site visits, process mapping and time series analysis. Finally, the data analysis process has been presented, with the use pattern-searching as a key strategy.

Chapter 5 Electronic Marketplaces for Tailored Logistics

5.1 Chapter overview

The chapter aims to evaluate different types of closed ELMs in order to answer Research Question 2 (Figure 5.1):

> ***RQ2. Of the different architectures, how does the closed ELM, as an emerging business model, function and enable the provision of tailored logistics?***

It looks to establish likely ELM operational models and investigate the relationship between ELMs and tailored logistics.

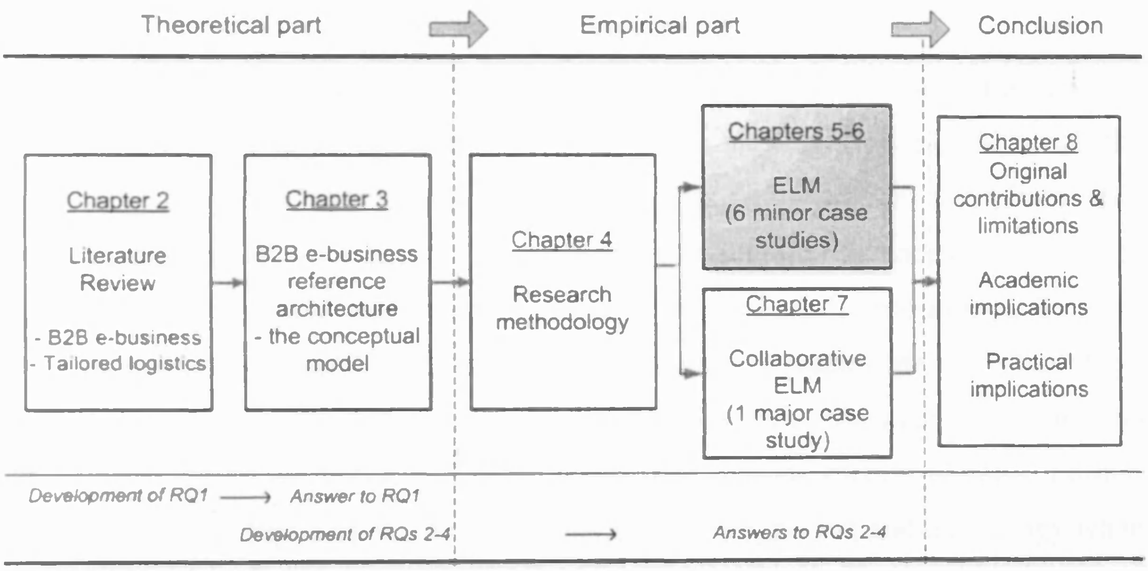


Figure 5.1 Thesis structure – ELM operational models and linkage with tailored logistics
(Source: Author)

5.2 Analysis framework

There are various ways to analyse information architectures. A detailed discussion can be found in Pai and Lee (2005). Conventional development of information architectures uses the technology-oriented approach (Zachman, 1987; Cahoon *et al.*, 2000; Kwok, 2003; Puschmann and Alt, 2005; Chen *et al.*, 2007; Urdaneta *et al.*, 2007). Information architectures are developed by systematically building data models. These data models are combined to form a comprehensive information system and define technology infrastructures. The problem associated with these information architectures is that due to them being derived from the data process approach and information system analysis, they over-emphasise the technological aspects and lack flexibility to cope with an ever changing environment (Pai and Lee, 2005; Pant and Ravichandran, 2001). In the late 1990s, the concept of process-driven architecture gained popularity and consideration was also given to corporate strategies. Under this approach, the architecture is oriented for business processes integration across all functional barriers (Kim and Lee, 1996; Periasamy and Feeny, 1997; Teng and Kettinger, 1995). More recently, it has been argued that the centrality of the coordinative and collaborative relationship between enterprises should not be neglected, as a supply chain is a cooperative system and exists on the group dynamics of its members (Webber, 2003; Pant and Ravichandran, 2001; Janssen and Verbraeck, 2005; Chandra and Kumar, 2001).

According to Baeza-Yates and Nussbaum (2006), there are three fundamental elements that need to be considered: technology, process and people. Although the approaches mentioned above provide useful insights from different disciplines, they tend to focus on just one element. The discipline of Computer Science mainly focuses on 'technology', along with a small element of 'process'. Information Systems concentrate on the research of 'process', while Sociology studies 'people'. Therefore, in order to obtain a more balanced and comprehensive view, the study of information architecture should incorporate all of the above, not just one specific element. Folinas *et al.*, (2004) also highlight the need to focus on process, people and technology when studying e-business integration.

Because this study is specifically focused on B2B models, the 'people' element is specified as 'collaboration', as given in Figure 5.2. This concurs with the work of McLaren *et al.*, (2002)'s on systems for collaborative SCM, where type of collaborative relationship, uniqueness of process and degree of information system integration were examined. The shading in Figure 5.2 indicates the weighting put on each of the three elements in this study, and is in line with the recommendation given by Baeza-Yates and Nussbaum (2006). Because this research investigates ERA from the business and logistics perspective, more weighting is naturally applied to collaboration and process, while essential research on enabling technologies is also conducted.

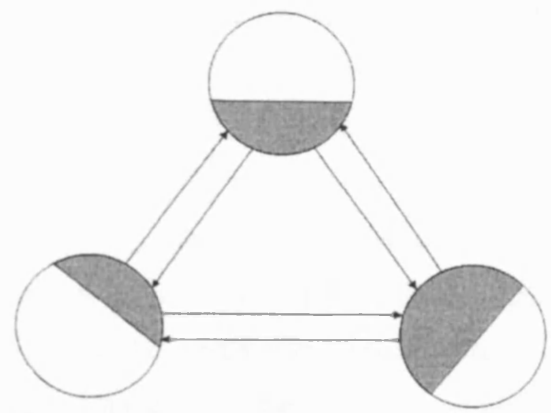


Figure 5.2 Analysis framework
(Source: adapted from Baeza-Yates and Nussbaum, 2006)

Technology

The traditional method for B2B integration includes EDI and EAI systems (Helo and Szekely, 2005). While ELMs may utilise EDI messages, they provide a higher degree of process coordination and enable transactions between multiple parties rather than the one-to-one communication provided by EDI and EAI. They are designed for participants to share a single system, rather than attempt to integrate separate systems (Lynch, 2005). ELMs could therefore enable not only large companies but also medium and small sized firms to use logistics services (Eng, 2004; Yang *et al.*, 2007).

As briefly mentioned in Section 2.2, Chapter 2, the on-demand model has changed the way companies use software. It drives more agile and streamlined processes and largely reduces the cost and time of deployment (Dubey and Wagle, 2007; O'Sullivan, 2007). According to Lynch (2005) and O'Sullivan (2007), the on-demand model has impacted on the operation of an ELM in the following ways:

- *Delivery method*: Users only require an internet connection and a browser to get access to the system. Role-based visibility is highly configurable and can ensure the data is shared at the authorised level only.
- *Deployment method*: Companies do not need to invest in server/database infrastructure, thus fixed cost is largely reduced. They can leverage an existing

'live' infrastructure instead. High configurability reduces the time and risk of deployment.

- *Upgrade process*: Traditional client-server upgrades are usually time-consuming and involve significant implementation work. On-demand could deliver upgrades automatically without user intervention or business disruption. Additional change of logic, e.g. the introduction of Work Time Directive (WTD) can easily be added on.
- *Pricing model*: Traditional package solutions usually charge through the licensing fee. Customers also need to make upfront investments in infrastructure for implementation. Both can be costly. On-demand offers very low fixed cost and usage-based variable costs termed 'pay as you go' pricing. It could include an annual subscription for customers who have predictable usage or transaction fees for customers who have less predictable usage.

Even though the 'on-demand' model seems to be very promising at the moment, traditional in-house systems have their advantages in terms of full control, high security and convenience. Depending on the functions a specific ELM provides, other technologies can be deployed, such as telematics systems for real time tracing and tracking.

Process

'Process' encapsulates various logistics activities conducted in a closed ELM. In practice, it is often referred as the operational scope of an ELM. Consequently the operational scope includes various functions an ELM provides in order for those logistics activities to be executed smoothly. For example, through an empirical research of 50 EMs, Petersen *et al.*, (2007) developed a typology by functionality of generic B2B marketplaces, mainly from a purchasing process perspective. Purchasing processes can include: design and planning, sourcing strategy development, relevant supply chain base identification, and the execution of transactions. Though the processes identified are of open marketplaces, Petersen *et al.* (2007) found that B2B EMs offer a variety of different value propositions. According to Dai and Kauffman (2002) and Stockdale and Standing (2002), the functionality of a closed EM is usually driven by the 'leader' of the community's needs and strategy and determined by the value proposition developed. This then affects the underlying structure, and defines the boundaries and responsibilities of participants. Through the study of two transportation EMs, Zeng and Pathak (2003) contended that the processes can range from basic load bidding services, consignment tracking and tracing, to complex offerings that encompass not only transportation transactions but complete order fulfilment services .

Collaboration

Collaboration is a process of decision-making among interdependent parties. It means two or more parties work together, have mutual understanding and a common vision, and achieve collective objectives (Stank and Daugherty, 2001). The importance of collaboration has been widely discussed in the literature (Barratt, 2004; Holweg *et al.*, 2005; Stank and Daugherty, 2001; Sahay, 2003; Cruijssen *et al.*, 2007). It enables coordination of operations across business entities, as the supply chain management needs systematic effort to provide integrated value to meet customer needs and expectations (Burgess *et al.*, 2006). For instance, collaboration between shippers and carriers will improve equipment utilisation by enabling the consolidation of inbound and outbound deliveries. This can be achieved through electronic sharing of information on shipment plans and availability of transportation resources (Sahay, 2003).

There are two types of collaboration (Barratt, 2004): vertical collaboration and horizontal collaboration. In the context of the ELM, this research defines the former as the collaboration between shippers and carriers, while the latter refers to the collaboration between shippers or between carriers. The degree of collaboration can vary from arm-length to close partnership (McLaren *et al.*, 2002; Barratt, 2004).

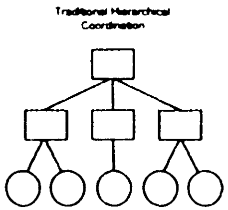
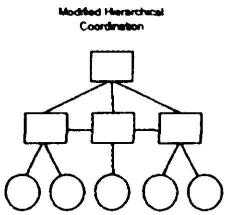
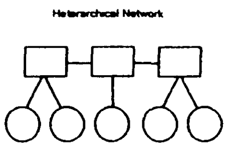
In the closed ELM, the vertical collaboration is expected to be high according to the attributes identified in the B2B EAR proposed in Chapter 3, being characterised by a high degree of process automation and information visibility. However, it is argued that the greater potential lies in horizontal collaboration in transport and logistics management (Cruijssen *et al.*, 2007). For example, joint planning between shippers could largely reduce empty running and achieve better optimisation, not only at the supply chain level but at the network level. The shared use of carriers between shippers could provide economy of scale for carriers to improve their capacity utilisation. On the other hand, collaboration between carriers could provide the economy of scope for shippers, since different carriers might specialise in the delivery of different goods or different modes or different regions.

In reality, there are many factors affecting collaboration such as power, trust, interdependence, information sharing, and incentive alignment. Detailed discussions can be found in Barratt (2004), Chae at el. (2005), Simatupang and Sridharan (2004), and Cruijssen *et al.*, (2007).

5.3 Data analysis

This section discusses the key elements of each type of closed ELM and hence lays the foundation for identifying the existence of supporting operational models. Table 5.1 presents a summary of the six case studies, identifying their B2B e-business architecture, the operational scope, collaborative arrangement and underlying technology. It also evaluates the interaction between the supporting architectures and tailored logistics. The process functions for each case ELM were found to be similar. To generalise the findings, a generic operational scope template, i.e. standardised process model, was developed as given in Figure 5.3. The functionality of each case was mapped against this template.

As previously mentioned in Chapters 3 and 4, this research study focused on closed ELMs. Thus, the 'centralised market' architecture which represents open ELMs was omitted, and the related type of logistics provision, i.e. 'routine' logistics, was therefore not within the scope of study. Accordingly when the impact of the closed ELM on tailored logistics is examined in Section 5.4, the discussion focussed on 'standardised', and 'customised (type I and II) logistics only.

Cases	Information architecture	Operational scope (process/functions)	Collaborative Arrangement (I, II, III)*	Underlying technology	Supporting tailored logistics
A		• Order receiving • Loads building • Shipment planning • Job tendering • Tracking and tracing • Proof of delivery (POD) • Self billing • Reporting	II Has optimisation of carriers and of shippers. But carriers and shippers themselves do not collaborate.	- Client –server with Web based functions - Pricing model: software licensing fee and implementation fee	Standard logistics
B		• Planning • Communication (accept/deny loads) • Tracking and tracing • Pre-invoicing and Performance report	II	- Client-server with Web functions - Pricing model: software licensing fee plus implementation fee	
C		• Purchase order generation • Shipment planning • Carrier sourcing • Visibility and events • Import and export • POD • Self billing • Reporting	I + II + III I+III limited to technical collaboration	- Hosted, Web-based - PAYG: predicated volume range	Customised logistics (*Type I*)
D		• Order receiving (purchase order=PO) • Suppliers communication (delivery note = DN) • Trade compliance • Match PO with DN • Carrier communication (accept/deny loads) • Tracking and tracing • Performance report	I + II + III I+III limited to technical collaboration	- Hosted, Web-based functions - PAYG per transaction	
E		• Job alerts • Real time tracking and tracing • Performance report	I + II + III	- Hosted, Web-based functions - PAYG per transaction	Customised logistics (Type II)
F		• Planning • Communication (accept/deny loads) • Tracking and tracing • Pre-invoicing and Performance report	I + II + III	- Hosted, Web-based functions - PAYG per transaction	

*Key: I, horizontal collaboration (HC) between shippers; II, vertical collaboration (VC) between shipper and carrier; III, HC between carriers.

Table 5.1 Six cases summary
(Source: Author)

CASE	Purchase Order Generation	Shipment Order Notification	Shipment Consolidation	Shipment Planning	Release to Carrier (tendering)	Delivery Execution	Shipment tracing & tracking	Import & Export	POD Control	Financial settlement	Reporting
A		√	√	√	√	√	√		√	√	√
B		√		√	√	√	√		√	√	√
C	√	√			√	√	√	√	√	√	√
D	√	√			√	√	√	√	√	√	√
E		√					√				√
F		√	√	√	√	√	√		√	√	√

Figure 5.3 Summary of cases' operational scope and standardised process model
(Source: Author)

Traditional Hierarchical Coordination (Cases A and B)

Technology

Both ELM cases are traditional client-server systems but with Web-based functions for communication with carriers and shippers. Orders can be imported from the shipper's ERP system automatically, or can be input manually via the Web. The system can interface with a wide range of enterprise systems. Carriers are assigned a username and password to a website to gain access to the orders. Large carriers can afford to build automatic linkages with the system, while small hauliers simply use the Web to share data and only an Internet connection and a browser are needed. Case A does not charge either shippers or carriers for data transactions but requires a one-off fee to cover the costs associated with system integration. In Case B, it is the shippers who buy the solution and pay most of the charges. As with Case A, carriers are occasionally asked to pay one-off charges to cover system integration costs.

Process

As can be seen from Figure 5.3, there are only slight differences between Case A and B in terms of functionality. In Case B, orders are consolidated to maximise vehicle fill by the in-house transport management system before being imported into the ELM. The reverse logic holds for Case A, with load consolidation taking place within the ELM. Another difference is that in Case B, once orders are loaded into the system, carriers can input which routes they would like to undertake, as well as their capacity and rates. Therefore, the transport planner has visibility of each carrier's availability before finalising the schedule. In Case A, the schedule is created before tenders are sent to carriers. The transport scheduler will fine tune the plan if there are any rejections. Once the job is accepted by carriers, the system tracks and traces the status of shipments and alerts relevant parties in the case of any unexpected delay or other event. Proof of Delivery (POD) is obtained and uploaded onto the system for financial settlement. Finally, tailored performance reports are created for different users.

Collaboration

In both cases, there is a great degree of vertical integration between carriers and shippers. Case A is facilitated by the 4PL provider and in Case B there is a direct link between shippers and carriers. In contrast, horizontal levels of collaboration are very limited.

In Case A, shippers themselves do not collaborate with each other, nor do the carriers. This is due to the fact that they operate in very diverse industries where there is no requirement for collaborative arrangements. But in Case A, the 4PL provider acts as an intermediary and understands both parties' requirements. It can mediate between partners with potentially conflicting interests. Therefore, although there is a low level of horizontal collaboration, the whole ELM community benefits from both economy of scope and scale. Carriers can receive a greater volume of deliveries which increases vehicle utilisation. Shippers receive a good level of service at a reasonable cost.

The Case B solution is enabled via vertical integration, which is traditionally the way shippers communicate with carriers. However, because communication with many small carriers is fragmented and time-consuming, according to the interview conducted with the technology provider's product manager, some shippers have urged those small carriers to work together to create a cooperative in order to provide a single interface with shippers. In so doing, the small carriers could compete with bigger carriers and secure larger volumes from shippers. The cooperative may then allocate the loads amongst its members based on, say, their geographic coverage.

Modified Hierarchical Coordination (Cases C and D)

Technology

Both Cases C and D are Web-based solutions, deploying the 'on-demand' model. They therefore differ from Cases A and B, since they are browser based systems with no desktop installation required. A single database ensures that all data is located in one place, which improves transaction speed and information visibility. The system can be integrated with a range of legacy enterprise systems. As with Traditional Hierarchical Coordination, shipment status can be inputted in various ways, for example, via EDI, Web, email-based methods or mobile phone.

In both cases, the technology provider hosts the ELM and is responsible for creating communities based on community leaders' requirements. Such leaders may be either shippers or carriers. Different homepage configurations are established for different users as required. Usually it is the community leader who takes the initiative and pays for all services. As previously indicated, both cases deploy the on-demand pricing model, also known as Pay-As-You-Go (PAYG). For Case C, the fee is charged annually based on predicted transaction volumes, while in Case D there is a charge per transaction.

Unlike Case C, Case D's system does not have all the functions under one umbrella, rather, a modular approach is deployed and the participants can buy just one or several functions based on their individual needs. The central data bus is the key function of this ELM, where customers, shippers and carriers are connected and data is transferred. Based on this, the hosting company create a number of databases for specific purposes. For example, there is a database to support consignment visibility applications and performance reporting applications and there is another database to support transport management applications. Because it is usually the shipper who initiates the ELM, the connection between the systems and the shipper is highly automated and integrated.

Process

Compared to Traditional Hierarchical Coordination, the operational scope is extended (see Figure 5.3). It is not only the shippers and carriers that get involved but the customers are also integrated into the system. Customers can either generate Purchase Orders (Case C) or have the visibility of inbound delivery through the ELM (Case D). Customers' involvement in the system indicates that the communication within this type of ELM is not as straightforward as the two way dialogue between shipper and carrier in the previous type. Figure 5.4 is drawn in order to provide a better understanding of the information flows between the three parties.

Case C in Figure 5.4 is an example of an international order-to-delivery logistics operation. Purchase orders are initiated by customers, and then passed to the agency which is the regional representative for a shipper (a manufacturer). Upon the receipt of a purchase order, the agency generates a sales order, and passes it on to the shipper. Next, the shipper confirms or amends the order if necessary, and then sends a tender request to its carrier. A carrier either accepts or rejects the tender. Once the tender has been accepted, both the agency and the shipper will be notified. Then the carrier schedules collection and delivery. During the delivery process, carrier updates the job status whenever necessary. All parties involved, i.e. shipper, agency and customer, will have the same visibility of the job status. Once the delivery is completed, the carrier posts the invoice. The ELM system will compare the invoice with estimated costs in the tender (with a pre-defined limit) and alerts any dispute if any. Finally, the payment is settled between carrier and shipper, and between customer and agency. Reports, for example, delivery on time (DOT) performance, and cost per case delivery, can be generated based on different users' own configuration.

Because of deploying a modular approach, the communication between the three parties in Case D is done via two inter-connected modules: visibility module and transport management module. The whole ELM system is composed of these two modules. The shippers can choose to have only the visibility module for information on order delivery progress, or have the combined solution which deals with the whole order to delivery process. Figure 5.4 provides a typical example of the combined solution. Purchase orders (POs) are generated by customers, and then standardised by the ELM system before they are passed on to the shipper. Upon the receipt of POs, the shipper will then prepare a delivery note (DN) which again is formatted to a standard form before sending it to the related carriers. Different from Case C, the tendering process is not necessary in Case D, because the transport rate has already been pre-determined between shipper and carrier. The rest of the processes are similar to those in Case C. The carrier will update the delivery progress, and payment will be settled between shipper and customer, and between shipper and carrier. Again in Case D, the visibility of job status is extended to include three parties: shipper, carrier and customer.

One distinct feature of both cases is that they support global logistics. Therefore 'import and export' functions are built in and the systems provide global trade compliance checks and customs clearance assistance. The ELM communities also benefit from value-added services provided by the hosting company such as currency converters and cross boundary legal advice.

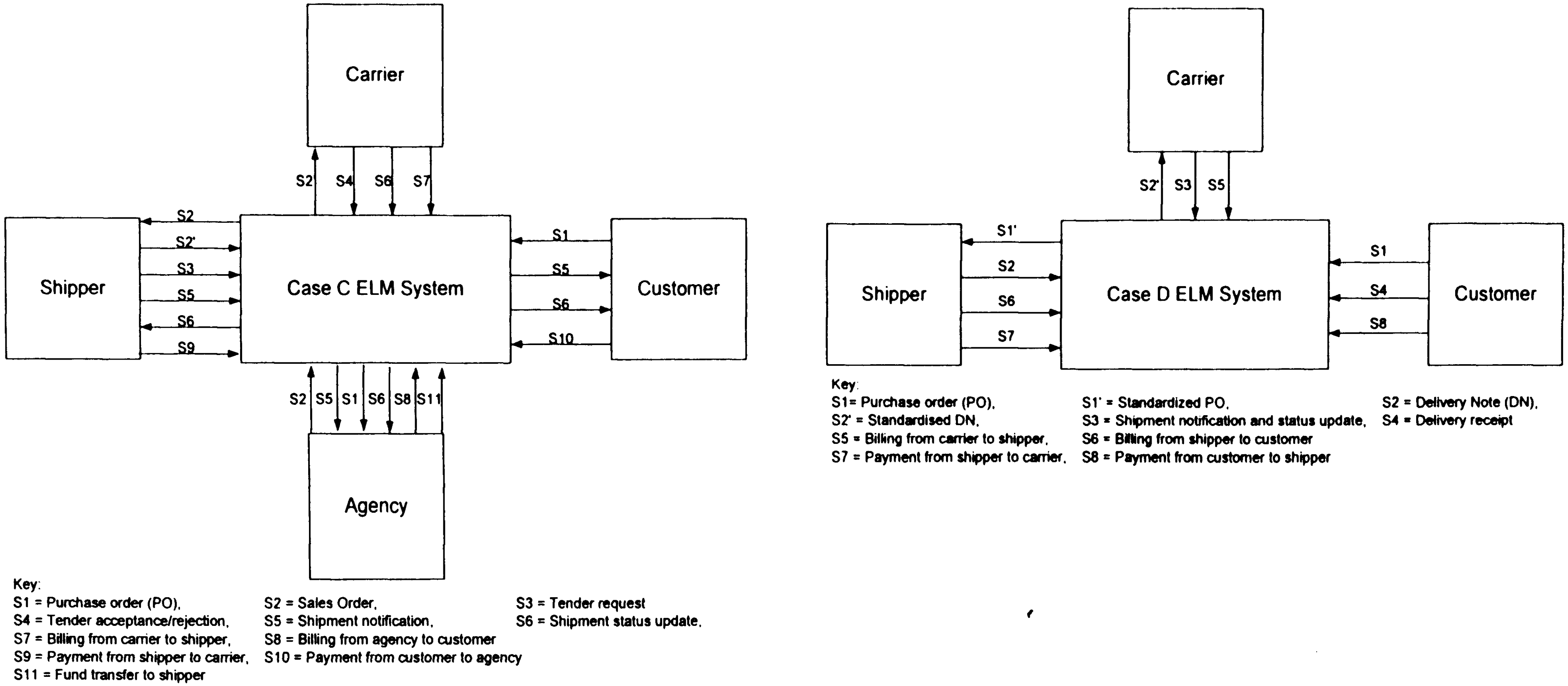


Figure 5.4 Cases C and D process demonstration
(Source: Author)

Collaboration

Through the hosted system, there are many private ELM communities sharing one single platform. But there is no structured horizontal collaboration between community leaders or participants, though technically they share the same infrastructure and database. Horizontal collaboration only occurs occasionally at an ad hoc level. Compared with Traditional Hierarchical Coordination, there is a greater level of vertical integration in Cases C and D. Shippers, carriers and customers are all integrated together through sharing the same system. This leads to enhanced speed of communication and the full audit trail of all shipment changes. Because shippers can get spot quotes from the connected carriers, Case C and D's systems also incorporate some limited features of open ELMs.

Heterarchical Network (Cases E and F)

Technology

Both cases are hosted by the ELM technology provider and are Web-based systems. Shippers share a single database and website, and are charged based on transaction volume. The ELM technology provider is responsible for setting up different homepages for different participating companies. Carriers do not need to pay any transaction fee nor a fee for system integration. In Case E, real-time tracking and tracing is deployed. Carriers therefore need to bear the capital cost of buying telematics and consequently the variable cost to download data via the telecommunication system. In Case F, there is no specific requirement to purchase any hardware.

Process

Although the underlying technology is the same, Figure 5.3 shows that there are large differences between Cases E and F in terms of functionality. In Case E, as currently deployed, the ELM provides only three functions: real time tracing and tracking, exception alerts, and performance reports. Other functions, such as transport planning, tendering, and financial settlement, are conducted through legacy systems. Despite limited functionality, this does not make the deployment of the system any easier. Because real time tracking and tracing is much more advanced than the retrospective tracking and tracing observed in other cases, it requires more investment and collaborative effort to execute. In the future, functions such as joint scheduling and delivery will be included if current functionality sustains performance and fulfils shippers' needs. It can be seen from Figure 5.3 that Case F's functionality is the same as Case B's, but with the added capability of identifying back haulage opportunities and enabling joint deliveries between shippers. This is similar to shipment consolidation embedded in Case A. The only difference is the way synergies being identified: Case F is conducted between shippers while Case A is facilitated by the 4PL provider. In both Cases E and F, customers are not integrated into the ELM system.

Collaboration

In contrast to the other architectures, there is a greater degree of horizontal collaboration between shippers. Not only do they share the same ELM infrastructure, they may also share the same carriers and deliver to the same customers. This involves a certain level of information sharing. However, the collaboration between shippers and their carriers through the ELM has given rise to some issues and conflicts. In Case E, it has been found that carriers are reluctant to join due to the heavy investment required to buy and maintain telematics. Nevertheless, shippers attempt to incentivise carriers who service more than one shipper to join by promoting volume synergies. But for some carriers who just provide a service to a single shipper, the incentive is not big enough to justify their investment.

Compared with Case E, in Case F the scope for horizontal collaboration is improved. Shippers attempt to optimise transport operations not only within a single company but also across companies. However, this also creates some practical problems. For example, shippers might compete with each other for carriers when the demand for transport service is greater than the supply; or shippers might be reluctant to share commercially sensitive information, such as rates and volumes. These issues will be examined in more detail in Chapter 6. Such issues largely explain the practical failure of the Heterarchical Network model in Case F, which was established in 2000 but ceased operation in 2006. More importantly, the lack of synergies of loads between shippers failed to secure a 'critical mass' because of the very different products being delivered, such as one shipper requiring delivery of fast moving consumer goods while another required the transportation of chemical products.

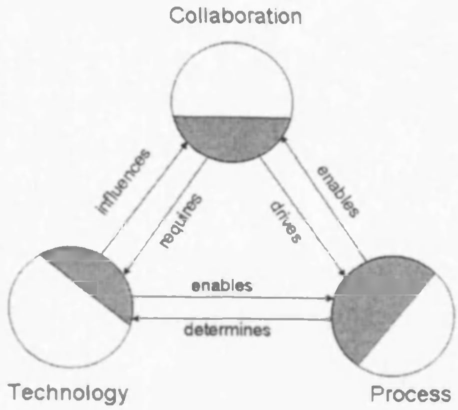


Figure 5.5 Interrelationship between the three elements
(Source: Author)

In all three types of closed ELM, the technology, process and collaboration elements are all inter-linked with each other, as shown in Figure 5.5. The collaborative needs, for example, information sharing and visibility, cost and service benefits, between shippers and carriers, are the driving forces in the development of an ELM. Such driving forces then determine the design of the various processes deployed in an ELM to fulfil such needs. The process design in return affects the choice of technical solutions. However, the rapid development in ICT provides opportunities for companies to think beyond existing collaborative arrangements and changes the dynamics between shippers and carriers. Enabled by the advances in technology, many processes which previously were costly to integrate can now be more easily simplified and streamlined. This lowers the barriers for collaboration. Hence it is both 'market-pull' and 'technology-push' which have accelerated the recent ELM developments.

5.4 Answering Research Question 2

RQ2. Of the different architectures, how does the closed ELM, as an emerging business model, function and enable the provision of tailored logistics?

Research Question 2 is answered through the establishment of operational models and the examination of closed ELMs' impact on the provision of different logistics operations. Analysis is presented in the sections below.

Different operational models that support closed ELMs

Through six case studies, the key features of each type of closed ELM have been identified in terms of technology, process and collaboration arrangements as described in the previous section. These serve as fundamental prerequisites to deploy a specific ELM model as summarised in Table 5.1. Which type to choose is largely determined by the strategies of the ELM leader or business needs of participating companies. Three different types coexist in practice and their boundaries tend to blur. Many companies, especially large organisations, which can afford a large investment and are capable of hosting in-house systems, still use the traditional package solution. This approach is dominant in private ELMs, that is, Traditional Hierarchical Coordination types. The 'on-demand' model is prevalent in Modified Hierarchical Coordination and Heterarchical Network types of ELM. In particular, the research found that the 'on-demand model' has its advantages in supporting global logistics or managing large distributed logistics processes. Across all the cases, an ELM is believed to serve as a crucial information hub for end-to-end supply chain operations. In addition, overall, a migratory trend of adoption from Traditional Hierarchical Coordination towards adoption of Heterarchical Network ELM type is observed.

Under Traditional Hierarchical Coordination, the ELM is customised for shippers' use. Hence carriers who serve different customers might need to individually integrate with each ELM or log into different systems to communicate with each shipper. This can be costly and time consuming. But because the solution is largely shipper driven and carriers are not in a powerful position to influence decisions, they will have to follow what the shippers require in order to secure contracts from them. The situation improves in Modified Hierarchical Coordination. For example, there are increased chances for shippers, who engage the same carriers, to utilise a common ELM. In such cases, carriers can integrate more easily and efficiently with shippers.

The Heterarchical Network has the biggest potential to enable network optimisation across companies, but it implies greater risks as well. In practice there exist a number of constraints as discussed in the analysis of Cases E and F. These include asymmetry of benefits, conflict of interests, and a lack of complementary volumes. These issues will be examined in more detail in Chapter 6. Because of such issues, the research finds there may be a need and an opportunity for third parties to move in and engage in Heterarchical Networks. Traditional technology providers do not necessarily understand the requirements, nor can they mediate effectively between partners with potentially conflicting interests. This supports previous generic research on horizontal collaboration by Bytheway and Dhillon (1996).

Further, the research finds that as the development of a closed ELM is largely driven by shippers, carriers are usually more reactive than proactive towards the use of an ELM. Power plays a significant role in this regard. Technology is not a major barrier for the successful implementation of an ELM, as many packaged solutions can function well. More issues arise from the collaborative arrangement between shippers and carriers. However, some shippers increasingly see the importance of treating carriers as strategic partners rather than disposable commodities, and transport is now seen as a key element for overall supply chain excellence. Therefore, some of the issues discovered in this study are likely to be less dominant in the future.

ELMs' impact on the provision of tailored logistics

The study confirms the author's proposal (i.e. the conceptual B2B ERA model discussed in Chapter 3) that different types of ELM should be adopted for different provisions of tailored logistics. The Traditional Hierarchical Coordination type of ELM tends to focus on process automation with a limited offer of value added services. Accordingly, it facilitates the 'standard' provision of logistics operation. The Modified Hierarchical Coordination type of ELM tends towards the 'on-demand' model and has more flexibility in terms of system and functionality configurations than the Traditional Hierarchical Coordination type. It also enables a degree of horizontal collaboration between shippers. Thus, it has more elements of customisation, although promising a fully customised service is not possible. It therefore corresponds to 'customised logistics Type I'. Finally, the Heterarchical Network is highly customised for each consortia group's specific needs. It provides the most advanced features of logistics services with a far greater level of both horizontal and vertical collaboration involved. Therefore it enables 'customised' logistics (Type II).

The above discussion is further supported by the following classification analysis, which attempts to verify the proposed alignment between ELM and tailored logistics. In order to do so, it is necessary to examine the different outcomes of tailored logistics provisions supported by the different types of closed ELM, and try to identify the potential common trait. The logic can be demonstrated using an input-output diagram (Figure 5.6). The output can be evidenced and evaluated using Johansson *et al.*'(1993) four value criteria as discussed earlier in Section 2.3, Chapter 2. Different emphases on the four criteria lead to the different types of tailored logistics, as indicated in Table 2.2, Chapter 2. The inputs are represented by the configurations of the three key elements of ELM architecture.

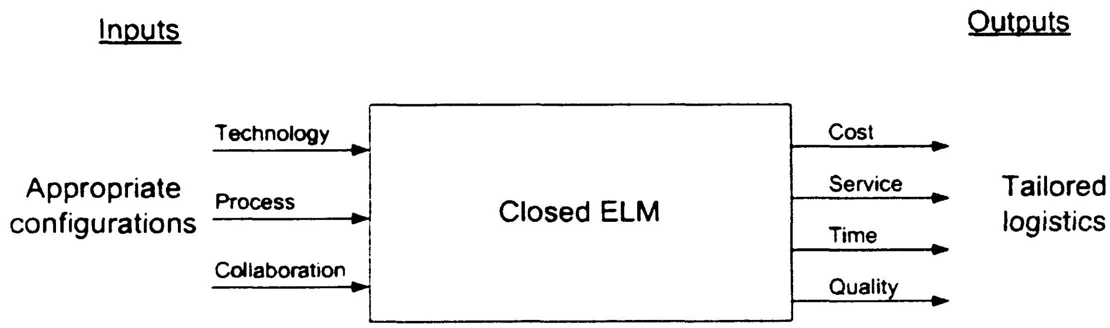


Figure 5.6 Analysis of the logic of alignment between ELM and tailored logistics
(Source: Author)

A 1-3 Likert ranking scale was deployed for data analysis of ELM and tailored logistics alignment (See Figure 5.7) where 1 signified arbitrary, 2 medium, and 3 high effect. Scores were allocated to both ELM and tailored logistics attributes. These are summarised in the table of Figure 5.7. Individual scores are added together for each case, with all the attributes considered equally weighted. Then the paired total value for each case example was plotted on the adjacent diagram and similar case scores were grouped together.

Case example	ELM attributes			Tailored logistics (TL) attributes			
	Collaboration	Technology	Process	Cost	Service	Time	Quality
A	2	1	2	3	2	1	1
total score	5			7			
B	1	1	2	2	2	1	1
total score	4			6			
C	2	2	3	2	3	2	2
total score	7			9			
D	2	2	3	2	3	2	2
total score	7			9			
E	3	3	2	2	3	3	3
total score	8			11			
F	3	2	3	3	2	2	3
total score	8			10			

Categorisation scale 1-3 as defined in the text.

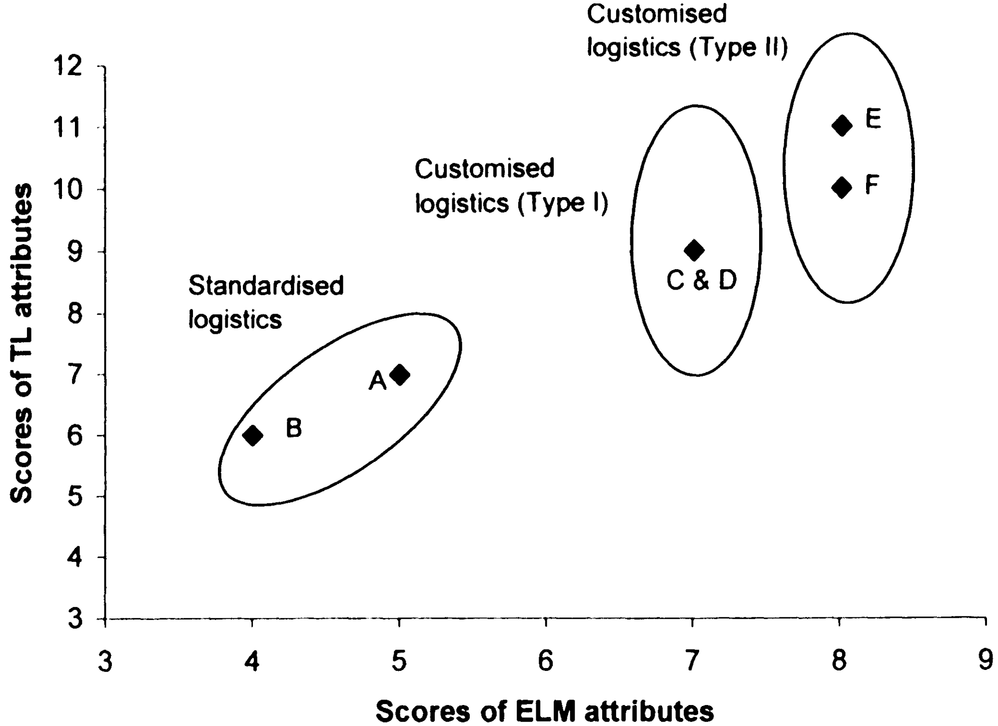


Figure 5.7 ELM and tailored logistics alignment analysis
(Source: Author)

First, the ELM attributes of each case was ranked. Under 'Collaboration', scale 1 implied an ELM was largely vertical integrated with little or no horizontal collaboration. Scale 2 meant that horizontal collaborative activities occurred yet at an ad hoc level. If ranked as 3, an ELM was characterised by both tight vertical and horizontal collaboration. Cases A and B were obviously vertically integrated, with no active horizontal collaboration between either shippers or carriers. But as Case A deployed a 4PL business model, it could still achieve the potential benefits enabled by horizontal collaboration without shippers or carriers adopting the initiative themselves. It acted as an agent, consolidating the synergies between shippers, and utilising the capacities between carriers. Hence a higher score was allocated to Case A. Cases C and D were largely the same; a greater level of vertical integration with ad hoc horizontal activities. Hence, both have been given a score of 2. Shippers actively collaborated with each other in Cases E and F, hence achieved the highest level of horizontal collaboration. Both scored a 3.

Under 'Technology', Cases A and B deployed a traditional client-serve approach with some web features, for instance the carriers could log into the system to accept the tender or confirm time of collection. This represented the basic level of web-technology adoption, so both were ranked at 1. Cases C, D, and F were Web-based systems providing increased information visibility between participating companies. The use of a single database and the communication via a single platform greatly accelerated the speed of order handling. But they did not integrate with more advanced features as Case E did. The combination of telematics, Global Positioning System and web-services in Case E was more complex and advanced than the retrospective tracking Cases C, D, and F provided. So Case E was ranked at 3, and 2 was allocated to Cases C, D and F.

Under 'Process', the scores were determined by the scope of an ELM. The more extended the scope, the higher the score. As shown in Figure 5.3, Cases C and D were ranked the highest as the scope of their ELM was extended to include not only shippers and carriers but also customers in the system. Case F was given a score of 3 as well, because the system had an added functionality to enable the synergies between shippers to be identified. This is a more strategic functionality by which network optimisation becomes possible. Cases A and B incorporated moderate order to delivery activities, thus were given a score of 2. Case E was given a score of 2 too, since the business model is not yet able to enable network optimisation.

Next, scores were allocated to the four elements under tailored logistics for each case. As defined earlier in Chapter 2, the 'Cost' element evaluated how well a case example influenced the total cost of order delivery process from shippers to customers, including distribution, administration and inventory costs. A higher score meant greater cost saving delivered by an ELM. 'Service' assessed a case example's ability to deliver the correct products at the planned time, and flexibility to meet customer demands/market changes. A higher score indicated better service. 'Lead time' examined the ability of an ELM to control the time taken from order receipt to making a delivery to customers. 'Quality' was represented by the efforts made by participating companies in an ELM to remove variability from the logistics process, particularly in terms of uncertainty in the delivery processes. A higher score meant a more focus towards reducing variability.

Through the examination of the six cases, the research found two major benefits associated with logistics cost reduction in using a closed ELM: the reduction of communication and administration costs by simplifying the business processes rather than rate reductions through intensified competition between carriers as in an open ELM, and the reduction in physical distribution cost through potential horizontal collaboration between shippers, and/or carriers. While communication and administration cost reductions were achieved across all six cases (typically between 5%-20% according to interviewees), only the business models of Cases A and F targeted the latter. They were therefore allocated the highest score of 3, while the remaining cases scored 2 because the business model had not as yet attempted to focus on cost reduction generated through synergies between shippers.

In terms of 'service', interviews conducted with executives from the six case examples confirmed this to be of equal and of more importance in Case E to shippers than 'cost'. The tight connectivity between shipper and carrier led to quicker and more flexible customer response. Improved communication also reduced cycle time by removal of traditional manual interventions; and performance control and monitoring reduced freight errors. All these achieved benefits led to improved services to customers. In addition to the benefits cited, Cases C and D fully integrated customers into the system. Customers had full visibility of each order's delivery status. Moreover, the value-added services provided by technology providers, for example, regulatory and compliance services, eased customers' burden in handling the international trade of products and "guaranteed the viability of an end-to-end solution to be viable (a quote of one of Case C's customer from Case C's website)". Hence Cases C and D were assigned a score of 3. Case E was also given a score of 3, because the real time tracking and tracing can provide the customer with the exact information about a specific order, for instance, where it is and at what time it arrives at the customer's site. Customers will be notified in case of any unexpected delays or other events, and thus can prepare alternatives to compensate for the expected delays. The rest of the cases shared the common benefits discussed above and were allocated a score of 2.

The ability to control the lead time from order to delivery varied in the six cases. Both Cases A and B deployed the traditional approach; orders were received from customers via a separate system, and then planned and sent to carriers for delivery execution. Once the products has been picked up at the point of collection, a shipper (Case A) or the 4PL provider (Case B) relied on carriers to keep them updated on events. They then fed back the information to customers. In some cases, they only became aware of a problem when they were contacted by the customer. Therefore, the control mechanism deployed in both cases was at a low level, hence both cases were assigned a score of 1. The situation was better in both Cases C and D due to the extended information visibility between shipper, carrier and customer. Activities from the point when a customer generated an order to the point when the products were received by the customer were all processed in the same system. This improved the speed of communication. Both shippers and customers had the access to the updated information at the same time during the delivery process. Therefore a greater level of control was achieved. Both Cases C and D were allocated a score of 2. Case F was also assigned a 2 because the system had designed a function which allowed a shipper to see the available capacity of its carriers during the planning process. This helped in preventing tenders being rejected by carriers, in particular at the peak demand season when carriers are constrained by their capacities. Case E was given a score of 3, again

due to its ability to provide the management team with real time information on a specific order. None of the remaining cases was capable of doing this.
Finally, with regard to the 'quality' component, i.e. reducing supply chain uncertainties and variability, different cases addressed this at various levels. In both Cases A and B, it was found that the management team tended to deal with the uncertainties in a reactive way, with the main focus being placed on the day-to-day execution level. Therefore these two cases were given a low score of 1. Because of the integration of carriers and customers into the same system, Cases C and D were in a better position to control the variability in the supply chain, so addressed the variability issue at a moderate level, and were given a score of 2. Shippers in Cases E and F took a proactive approach in reducing supply chain uncertainties. Case E utilised the 'critical mass' gained through horizontal collaboration between three shippers in order to implement the system. Real time tracking and tracing also enabled management to be proactive in any disruption occurrence. Case F exploited the potential benefits of reduction in empty running via the identification of compensated flows between shippers in order to gain competitive advantages. Therefore both were allocated a score of 3.

Overall, the classification analysis results shown in Figure 5.7 were consistent with what would be expected from the conceptual classification shown in Table 3.2, Chapter 3. The first cluster corresponded to the Traditional Hierarchical Coordination type of ELM, and had low values for most items and represented 'standardised' logistics. The second cluster corresponded to the Modified Hierarchical Coordination type of ELM with relatively high ratings for the items. So it would be reasonable to align this with 'customised logistics (type I)'. The third cluster had highest values on both ELM and tailored logistics attributes. Therefore, this corresponded to the Heterarchical Network type of ELM, and represented 'customised logistics (type II).

The results also suggested that from 'standardised' to 'customised' logistics provisions, the emphasis shifts from cost, service to quality. At the same time, the level of collaboration, process integration and information linkages increase as well. When cost reduction is achieved and competitive customer service is maintained, greater opportunity lies beyond one company's own distribution boundary. Although the study found the Heterarchical Network type of ELM to be more difficult to sustain, leading companies, for instance, the ones in Cases E and F have already seen the great potential of such business model. Given the increasing pressures shippers face from customers, and the rapid technical advances in ICT field, it is believed that more companies will be willing to adopt the Heterarchical Network business model for customised logistics solution. Chapter 7 will examine in more detail this type of ELM through the major study of Case E.

Further, the results indicated that the choice of information architecture is driven by customer demand and is determined by an organisation's logistics strategy. The co-existence of different models and their unique characteristics in supporting the logistics operation also confirm that the one-size-fits-all approach is unlikely to work. The research also supports the argument raised in Chapter 3 after development of the B2B ERA conceptual model, that the requirements for efficiency and economy of scale can be better met by hierarchical structures, and that the emergent Heterarchical Network mechanism seems to have the potential to satisfy the dual challenges in logistics operations of 'flexibility' and 'efficiency'. However, it is felt that there is still a long way to go before the full potential of this type of ELM is realised, as there are many practical constraints to be resolved, as evidenced by the failure of Case F.

Moreover, findings suggested that technically it is already possible for shippers to use a hosted platform, creating a closed ELM for long-term collaboration with its carriers, while leveraging the open ELM on the same platform for spot purchasing of transport services. While this has not happened yet in practice, the capabilities of the cases examined indicate that it is highly possible for such a hybrid model to emerge.

5.5 Discussion and summary

Using the analysis framework developed, this chapter examined six ELM case examples with respect to three key elements: technology, process and technology, and established the foundations for understanding the operational models available to support closed ELMs.

Two different technological choices were found to have been adopted in practice: the traditional in-house model and the hosted on-demand model. While each model has its advantages and disadvantages, it is likely that the on-demand model will gain more popularity in the future. From the process aspect, different ELMs offer different functionalities, but all ELMs focus on logistics transport planning and execution activities. More strategic functions, like network design, and business simulation, are usually achieved through separate decision-support systems. The level of horizontal collaboration differentiates the three types of closed ELM. Little horizontal collaboration has been found in Traditional Hierarchy, while the situation improves in Modified Hierarchy Coordination achieved at an ad hoc level, and Heterarchical Network has the greatest level of horizontal collaboration. However, this also means there are more complexities and difficulties involved. Different parties have different expectations of ELMs. Accordingly, an ELM needs to have an appropriate mechanism to accommodate these different expectations. Issues like power and culture in supply chains play an important role in sustaining an ELM and these will be examined in detail in the next Chapter.

Based on the established operational models, the impacts of the three main types of closed ELM on tailored logistics were subsequently examined. Driven mainly by different shippers' strategic needs, three types of closed ELM had emerged and co-existed in practice, and the level of customisation and complexity differed.

Through explorative research, the study also confirmed key attributes previously defined in the conceptual B2B ERA model proposed in Chapter 3 and therefore provided empirical validation of the model. Once validated, the conceptual B2B ERA model can now be translated into an ELM-specific communication analogy for better illustration of the communication structures (see Figure 5.8). At the same time, the three types of ELM are termed hereafter 'private', 'shared' and 'collaborative' marketplaces for simplicity, since the terms reflect the key characteristics of each type. The Traditional Hierarchical Coordination is used by a dominant company for its own use, hence is termed a 'private' ELM. The Modified Hierarchical Coordination type of ELM is shared by different shippers with limited horizontal collaboration between parties, hence is named a 'shared' ELM. The Heterarchical Network type has the highest level of horizontal collaboration, since shippers start to truly explore the collaborative activities between them, so is termed a 'collaborative' ELM. It will be explored in depth in Chapter 7.

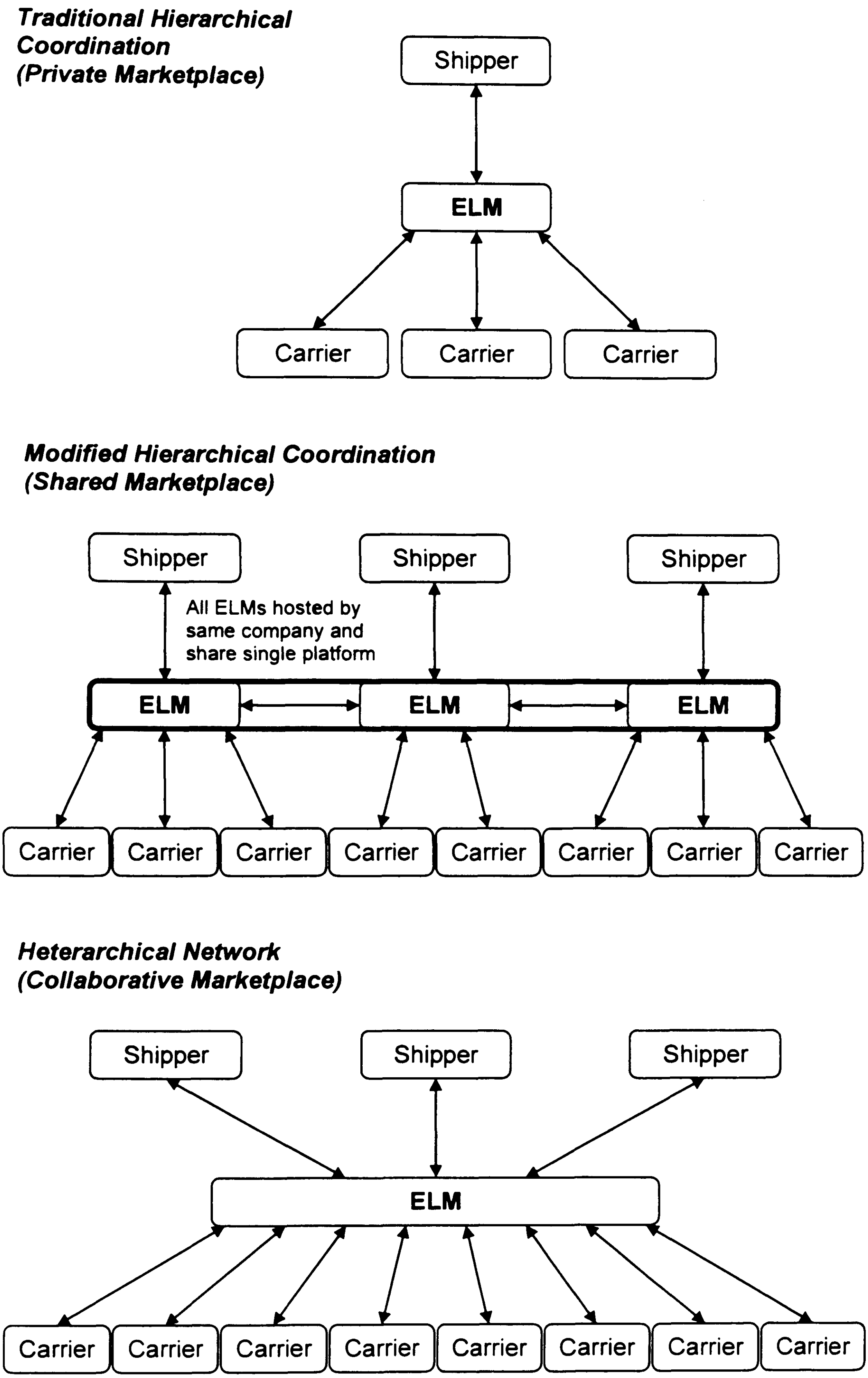


Figure 5.8 Closed ELM communication typology
(Source: Author)

It needs to be pointed out that the B2B ERA model emphasises the coordination and control mechanism between enterprises, so it serves as fundamental guiding framework for the design of an ELM or other B2B integration systems for tailored logistics. The typology in Figure 5.8 is not intended to replace the B2B ERA model. Together with the *process* model developed earlier (Figure 5.3), this serves as an *informational* model in attempting to explain the ERA model in more detail.

Under Traditional Hierarchical Coordination architecture, a dominant supply chain player is the supervisor control element. In the context of private ELM, this means that a shipper or a freight forwarding company (e.g. 4PL) acts as the supervisor control element, and communicates with its subordinate control elements, i.e. individual carriers. There is no horizontal connection between carriers. In practice, many companies own their own ELMs. These individual ELMs are stand-alone, and not connected with each other. Accordingly, this means that there is no horizontal collaboration between shippers either.

In a 'shared' ELM, shippers still act as the supervisor control elements and create their own marketplaces. However, because all the individual ELMs share the same platform, a shipper from one marketplace can collaborate with a shipper from another. The same applies to carriers because they are technically all connected with each other. The occasional collaboration between carriers to surge the peak demand is one example of practice in a shared ELM.

A Heterarchical Network, i.e. a collaborative ELM, removes the boundary of the individual marketplaces in a shared ELM and ensures that participating shippers and carriers are aligned through common interests. In this case, the community of a collaborative ELM itself becomes the supervisor control component.

Chapter 6 Evaluating the Reasons for the Use of ELM within Supply Chains

6.1 Chapter overview

In the previous chapter, an understanding of how closed ELMs function and enable the provision of tailored logistics has been established. Following this, this chapter aims to identify the reasons why companies use closed ELMs within supply chains and, thus attempts to answer Research Question 3 (Figure 6.1).

RQ3. What are the reasons for using a closed ELM within supply chains?

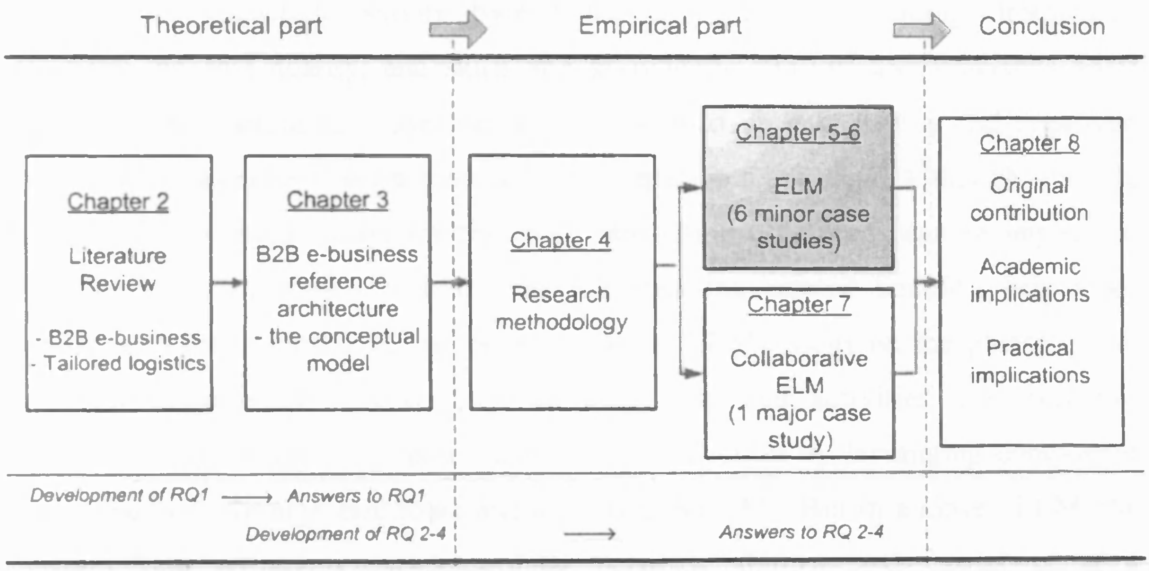


Figure 6.1 Thesis structure – reasons of using closed ELMs within supply chains
(Source: Author)

6.2 Theoretical background and the development of evaluation criteria

The underlying rationales for ELM adoption largely influences the design of operational models, and determines the technical choice, process and relationship configurations between shippers and carriers. As the forming of a closed ELM is largely driven by shippers, one needs to understand what their motives and expected benefits are in doing so. This research is also interested in exploring what are the motives and potential benefits from the carrier's perspective. Without sufficient support from carriers, an ELM may fail to secure the 'critical mass', which is seen as a key factor to sustain any EMs in the long-term (Daniel *et al.*, 2004; Stockdale and Standing, 2002). Moreover, it is also essential for an organisation to assess the potential barrier and cost associated with the adoption of a closed ELM in order to justify the investment and choose the appropriate type of ELM.

Various studies have discussed the different motives for generic IOS adoption. Kärkkäinen *et al.*, (2007) identified three main drivers for the interfirm use of information systems in the supply chain: transaction processing, supply chain planning and coordination, and order tracking and delivery coordination. However, their discussion did not explicitly address the specific motives for companies joining a closed EM. Howard *et al.*, (2006) conducted empirical research looking at the motivations and barriers in automotive EMs, and discovered the main motives to be material cost reduction, supply base reduction, common sourcing, transaction efficiency, product quality, and skills and knowledge. Barratt and Rosdahl (2002) found that motivations for buyers in an EM focused on cost saving and improved process, whereas sellers' main motivation was market expansion. Although some of the motives discussed above, for instance, transaction efficiency, can be applied to any EM, including closed ELMs, most are sourcing related benefits, hence not directly relevant to closed ELMs, because closed ELMs focus on the planning and execution of logistics activities, not on trading related activities. For example, companies may be able to obtain material cost reduction by leveraging component price reductions through electronic auctions from an EM. But in a closed ELM, the transport rate is largely pre-determined between shipper and carrier using a contractual procedure. Accordingly, this motive cannot be applied to a closed ELM.

Rask and Kragh (2004) analysed in total 41 secondary cases in various sectors and identified four main categories of motive for EM participation: efficiency, exploration, positioning and legitimacy. The efficiency motive is driven by price reduction, process time reduction, and cost reduction. Exploration implies that participating companies use an EM to test new markets, new processes, or for explorative learning. The positioning motive is indicated by companies' intention to increase buyer/supplier reach, avoid dependence, and increase bargaining power. Finally, the legitimacy motive means that companies participate in an EM to follow existing buyer/supplier, or from fear of falling behind technological development. Although providing useful insights, the underlying gains from the four types of motives identified by Rask and Kragh fall largely into economic benefits. A more comprehensive category of motives underlying EM participation was developed by Standing *et al.*, (2006) who claimed that a wide range of motives should be taken into account: economic, relational, service and community. Standing et al's classification support findings in the various studies discussed above and provide a structured way of analysing the motives from a multiple dimensional perspective. Therefore, it is later adopted in this study to structure the discussion of research findings.

Motivations are closely linked to benefits. As mentioned earlier, many benefits discussed in the literature centre on open systems. Research most closely related to the benefits of the closed system consists of studies by McLaren *et al.*, (2002), Easton and Araujo, (2003), Gosain and Palmer (2004), Cassivi *et al.*, (2004) and Fu *et al.*, (2006). Large similarities exist among the benefits identified in these studies, which can be summarised as four main categories: risk/uncertainty reduction, customer service improvement, cost savings, and process efficiency gains, especially time-based delivery performances. Though the aforementioned studies provide useful insights, they do not focus on the specific benefits derived from ELMs and have not carried out an in-depth investigation of benefits achieved at an operational level. Building on these previous studies, this research probes further the benefits for both shippers and carriers in this regard, and the four categories identified are used to guide the analysis of specific benefits from ELMs.

The four categories identified above concur with Johansson's value metrics (quality, time, cost and service) referred to previously in Chapters 2 and 5 during the discussion on tailored logistics and its alignment with ELMs. 'Quality' is equivalent to 'risk/uncertainty reduction'. Quality can enable the management team in an organisation to be more proactive rather than reactive towards logistics management. This category is thus renamed 'more proactive management approach' in order to better reflect the related benefits. The 'time' element in Johansson's value metrics influenced both 'process efficiency' and 'customer service', thus 'time' was not adopted as another category of benefits since it is believed to be an input to the two categories mentioned above. The finalised benefits categories are:

- Operations management approach (proactive/reactive),
- Customer service,
- Cost savings, and
- Process efficiency.

There have also been various discussions of the barriers to adopting generic IOS applications. Pramatari (2007) identified three main types of challenges in implementing a collaborative Web-based store ordering platform: technical, organisational and multi-party coordination. Murtaza *et al.*, (2004) pointed out that one of the biggest challenges facing companies that are or wish to be part of an EM is integration. Because in many EMs, only basic data and documents which use the XML format are exchanged with back-end applications, and there is no end-to-end transaction flow taking place. Howard *et al.*, (2006) argued that one should consider the process of adopting new EMs in the broader context of culture, structure, leadership, user and inter-firm relationships, and focusing solely from a technical perspective may lead to the failure of such adoption. Barratt and Rosdahl (2002) indicated that lack of capital is the biggest barrier for an EM to be sustainable, followed by suppliers' resistance, lack of standardised technology platforms, and the different regulations of different countries. Le *et al.*, (2004) have suggested that the limited information sharing, low levels of trust and unbalanced power between EM participants inhibit the adoption progress.

Stockdale and Standing (2004) from a SME perspective classified the potential barriers into internal and external ones. The former includes lack of understanding (from a market-maker's point of view) of company needs, no technology standards, and the e-competence of industry sector. The latter covers identification of benefits, global trading, financial constraints, supply chain integration and understanding of the e-environment. Other studies have tended to examine in general the challenges or issues associated with e-business or e-commerce adoption (Quayle, 2002; Zank and Vokurka, 2003; Angeles and Nath, 2007; Pavlou *et al.*, 2007). Yet again, these studies have not explicitly explored the potential barriers to adopting closed ELMs. As this research examined an ELM from three key aspects, namely, technology, process and collaboration, they could be used to categorise various issues arising from the study.

Barriers discussed in previous studies are largely included in these three categories. Further, an individual user's readiness is perceived to play an important role in the successful implementation of an EM (Howard *et al.*, 2003; Liu *et al.*, 2003). Therefore 'people' was added as a fourth category. Barriers to ELM adoption were thus classified as:

- Technical barriers: any technology related issues like file transfer standard, connectivity, back-end system integration, scalability of the software architecture, and technical ability of participating companies
- Process barriers: designed functionality, alignment of existing processes with new processes, different needs of participants, national regulation constraints
- Collaborative barriers: pricing model, resource constraints, cost/benefits allocation, participants' resistance, trust and power, culture, information sharing boundary, competitive conflicts
- People barriers: managerial leadership skill, user involvement and resistance

Generally, the costs of implementing an ELM are similar to any generic EM, and include set up costs like investment in infrastructure and running cost, such as data transactional cost, and licence maintenance (O'Reilly and Finnegan, 2007). As many shippers or carriers do not have the expertise in-house to build a customised solution for their own use, using an off-the-shelf solution is popular. If they do so, the fixed cost is usually large with relatively lower running cost. As discussed earlier in Chapters 2 and 5, using hosted solutions brings low fixed cost and ease of implementation due to rapid technical developments, hence they have become more prevalent in recent years (Lynch, 2005). In addition to technology deployment cost, staff cost is considered to be another main type of cost. However, because it varies largely from case to case, it is hard to compare and quantify. It is therefore not a focus of this study.

To summarise from the above discussions, a set of evaluation criteria was developed as shown in Table 6.1, and then used to structure the analysis of research findings.

	Motivations	*Barriers*	*Benefits*	*Costs*
Criteria developed	• Economic motives • Relational motives • Service motives • Community motives	• Technical barriers • Process barriers • Collaborative barriers • People barriers	• Operations management approach (proactive / reactive) • Customer service • Cost • Process efficiency	• Set up cost • Running cost

Table 6.1 Evaluation criteria of closed ELMs
(Source: Author)

It should be noted that data collected from the six case examples in order to evaluate the reasons for using an ELM within supply chains was mainly obtained from technology providers, with exception of major Case E, where data was also obtained from shippers and carriers. A potential for bias therefore existed. However, although data collection was mainly from technology providers, such data was likely to be objective because of technology providers' neutral positions. The data generated from Case E, discussed in detail in Chapter 7, to some extent supported this argument. So the results obtained therefrom were considered to be acceptable.

6.3 Motivations for using closed ELMs

As discussed previously, the research adopted the four categories developed by Standing *et al.*, (2006). It also incorporated other key references listed in Table 6.2 from the literature into the context of closed EMs in order to operationalise the four constructs. Research findings are then highlighted against the generic motives and are shown in Table 6.3. Also provided in Table 6.3 is an indication as to whether motivation to use closed ELMs existed among shippers and carriers, since these are the main users of ELMs. It should be noted that responses to the interview questions on the motivation factors were prompted based on the criteria identified from the literature, as this was considered to help the interviewees to respond in a more structured way. A different pattern of responses may occur if those factors were unprompted. The same principle applies to Table 6.4 when potential barriers were explored. It should also be noted that Case E is a major case study which involves three shippers and three carriers. The motivations presented in Table 6.3 are the results generalised across shippers and carriers. Individual shipper and carrier motivations will be discussed in more detail in Chapter 7.

Motive Type	*Motivation factor for EM participation*	*Key References*
Economic	Maintain control of order-to-delivery process	McIvor and Humphreys (2004), Ho *et al.*, (2003), Lewis and Talalayersky (2000), Goldsby and Eckert (2003)
	Productivity and efficiency improvement via process automation, improved visibility and quick information exchange	Kaplan and Sawhney (2000), McLaren *et al.*, (2002), Eng (2004), Rask and Kragh (2004)
	Resource utilisation and cost reduction	Kumar and Van Dissel (1996), McLaren *et al.*, (2002), Bengtsson and Kock (2000), Skjøtt-Larsen *et al.*, (2003), Silveira and Cagliano (2006), Howard *et al.*, (2006)
	Secure market competitiveness	Stockdale and Standing (2004), Fu *et al.*,(2006)
Relational	Reduce uncertainties and opportunism in the supply chain	Martinez *et al.*, (2001), Kumar and Van Dissel (1996)
	Desire to coordinate and collaborate in exchanging information and conducting transactions	Kumar and Van Dissel (1996), Rask and Kragh (2004)
	Build strong bond to 'lock in' key partners, or seek greater commitment	Shi and Daniels (2003), Goldsby and Eckert (2003), Gosain and Palmer (2004)
	Eliminate communication complexities	Dai and Kauffman (2002)
Service	Delivery performance and customer service improvement, as well as lead time reduction	Lewis and Talalayersky (2000), McLaren *et al.*, (2002), Folinas *et al.*, (2004), Silveira and Cagliano (2006), Howard *et al.*, (2006)
	Reliability and responsiveness via improved flexibility and adaptability	Martinez *et al.*, (2001), McLaren *et al.*, (2002), Shi and Daniels (2003), Ho *et al.*,(2003), Folinas *et al.*, (2004), McIvor and Humphreys (2004)
	Uniform visibility of pipeline information across companies	Folinas *et al.*,(2004)
	Real time communication and visibility	Martinez *et al.*, (2001), Murtaza *et al.*, (2004)
	Information richness leads to continuous improvement	Silveira and Cagliano (2006)
Community	Knowledge sharing and market intelligence gains	McLaren *et al.*, (2002), Standing *et al.*, (2006)
	Desire to impact on an industry sector as a whole, and promote industry specific standards	Todeva and Knoke (2005) Standing *et al.*, (2006)

Table 6.2 Motivations for using electronic marketplaces
(Source: Author)

From the shipper's perspective, all of the motives proposed by Standing *et al.*, (2006) were identified during the course of interviews. Given that shippers are normally the main driving force behind the adoption of an ELM, this finding was perhaps to be expected. It was also found that large similarities existed across cases. In fact, shippers' motives under 'economic' and 'relational' categories were exactly the same. Under 'service', 'real time communication and visibility' was the only motive for shippers from Case E, whereas shippers from other cases considered retrospective tracking and tracing sufficient for current business operations and there was no need for real time visibility.

Despite the large similarities, it should be noted that not all motivations existed in each case, and that the relative importance of each also differed. By far the biggest motivation in Cases A and B was the opportunity to reduce cost through improved efficiency. The efficiency gains were expected to be from increased process automation and, removal of human intervention, and thus quicker information exchanges. The use of a Web-based system was expected to largely reduce the cost of B2B integration and minimise, if cannot eliminate, the use of sophisticated EDI/EAI systems. Another important factor was the increased visibility offered by the marketplaces. This was particularly so for two cases, i.e. Cases C and D, involved in global supply chains, where there can often be difficulties in tracking the containers before they arrive at the port. In a global supply chain, multi-mode transport is usually a common practice which can involve multiple carriers and various financial, and cross boarder service providers. Hence timely access of the consignment status can help to detect earlier any exceptions or delays. The management team can then take proactive actions whenever necessary. This improves the communication between shippers and carriers, and/or between shippers and their customers.

'Rational' motives were found to be consistent across shippers in all six cases. By integrating carriers into the ELM, shippers expected to reduce uncertainties introduced by carriers' potential opportunism behaviour and lack of control of outsourced logistics processes. Therefore 'lock-in' business partners and maintaining control of order-to-delivery process were found to be the motives only from the shippers' side. An ELM is also expected to simplify the communication processes between shippers and carriers. This was considered by all cases to be the most common motive for a closed ELM to come into form.

With regard to 'Service' motives, uniform visibility gained through the use of a single system for a shipper(s) to communicate with all carriers and/or customers was a high motive across all shippers in the six cases. By knowing what exactly is going on with a specific consignment, customer service level is expected to be improved in response to any queries raised by a customer. This could also result in lead time reduction, because the orders are handled faster in an ELM than in the various traditional enterprise systems. Further, it was believed that the information gained from an ELM system could help the management team to identify potential problematic gaps and seek further improvements. This point was particularly highlighted by three interviewees in Cases A, B and F, and interviewees from the remaining three cases also concurred with its importance.

'Community' motives only existed in Cases E and F, and were considered by other cases to be of less importance. As both Cases E and F were shipper consortia, they were in a better position to share knowledge and promote industry-wide activities. So this finding was not of a surprise. In only one case (Case E), was a motivation specifically identified to introduce universal industry standards. Case E comprised three major shippers in the grocery sector in the UK who were developing a collaborative marketplace, one of the functions being to provide real time track-and-trace facilities through telematics equipment. The ELM had specific data transfer standard placed on it, which, given the transport demand generated by participants and the fact that all contractors had to use the marketplace, could lead to the introduction of industry standards. Details are discussed further in Chapter 7.

Motive Type	*Motivation factor for the use of Case ELMs*	*Case A*		*Case B*		*Case C*		*Case D*		*Case E*		*Case F*	
		S	C	S	C	S	C	S	C	S	C	S	C
Economic	Maintain control of order-to-delivery process	•		•		•		•		•		•	
	Productivity and efficiency improvement via process automation, improved visibility and quick information exchange	•	•	•	•	•	•	•	•	•	•	•	•
	Resource utilization and cost reduction e.g. via effective scheduling and routing	•	•	•	•	•	•	•	•	•	•	•	•
	Secure market competitiveness	•	•	•	•	•	•	•	•	•	•	•	•
Relational	Reduce uncertainties and opportunism in the supply chain	•	•	•	•	•	•	•	•	•	•	•	•
	Desire to coordinate and collaborate in exchanging information and conducting transactions	•	•	•	•	•	•	•	•	•	•	•	•
	Build strong bond to 'lock in' key partners, or seek greater commitment	•		•		•		•		•		•	
	Eliminate communication complexities	•	•	•	•	•	•	•	•	•	•	•	•
Service	Delivery performance and customer service improvement, as well as lead time reduction	•	•	•	•	•	•	•	•	•	•	•	•
	Reliability and responsiveness via improved flexibility and adaptability	•	•	•	•	•	•	•	•	•	•	•	•
	Uniform visibility of pipeline information across companies	•		•		•		•		•		•	
	Real time communication and visibility									•	•		
	Information richness leads to continuous improvement	•		•		•		•		•		•	
Community	Knowledge sharing and market intelligence gains									•		•	
	Desire to impact on an industry sector as a whole, and promote industry specific standards									•			

Key: S = Shipper, C = Carrier

Table 6.3 Motivations for the use of case ELMs
(Source: Author)

From the carrier's perspective, there were fewer motivations for becoming involved in an ELM. The primary focus was not on economic gains, but on relational motivations, in other words, to improve communication and maintain the relationship with shippers. Accordingly the 'desire to coordinate and collaborate' in securing contracts and satisfying shippers was the most common motive for carriers becoming involved in an ELM in all six cases. Because most closed ELMs are driven by shippers, joining an ELM is often not an optional activity for carriers since it becomes a condition of securing the contract from shippers. Power plays a significant role in this regard. Hence economic gains, though also very important, comes second in terms of motivation. Those carriers, who believe that the use of advanced information technology can bring market competitiveness, are usually more active in seeking economic benefits via using an ELM than traditional conservative carriers. They see the benefits of cost savings on assets and drivers management, and reduction of communication and administration work. Finally, no carriers were interested in 'community' motives, perhaps due to the fragmented market and lack of interests in horizontal collaboration between carriers. To-date, a consortium-group led ELM initiated by carriers has not been witnessed by the author or reported in the literature (Kale *et al.*, 2007). Overall, it was felt that carriers were usually being pushed, rather than being pulled into an ELM.

The above motivations were identified mostly at individual case level. Through interviews, it became apparent that there were a number of external factors that influenced the uptake of ELMs. To codify these, a PESTLE (Political, Environmental, Societal, Technological, Legislative and Economic) analysis was carried out as the external environment in which the marketplace and its constituent companies operate determines certain motives at higher level (Daniel *et al.*, 2004). The PESTLE analysis results give a broad picture of the context in which an organisation operates and its relationship with the external environment. This can be used to provide the context for an organisation and its relationship with the external environment. Through this analysis, the following factors were identified as further motivators:

- *Political* factors: Pan-European and global trading has lengthened supply chains which requires effective tracking and tracing of consignments and timely communication between shippers, carriers and other participating companies.

- *Environmental* factors: Increasing environmental concerns like CO_2 emissions and congestion are compelling the transport industry to reduce empty running and maximise asset utilisation. Increasing emphasis on corporate social responsibility is also having an effect by encouraging business to question its freight decisions as well as those of their suppliers and contractors. This factor has also been highlighted in previous research on e-commerce impact on logistics and transport by Hesse (2002).
- *Societal* factors: Efficiency can be affected by local delivery constraints where rigid delivery windows or routes are specified. This, in return, requires better schedule adherence via effective scheduling and dynamic routing abilities.
- *Technological* factors: The growth in Internet and wireless technologies, together with the software-as-service concept make it easier and cheaper to share information, control the order to delivery process, and respond more quickly to changing market demands. This helps the uptake of an ELM.
- *Legislative* factors: Regulations like the Road Transport Directive in Europe (Department for Transport, 2006) may constrain transport operations. The use of advanced ELM solutions can help to manage day-to-day operations in a more efficient manner.
- *Economic* factors: Increasing cost of fuel and lack of drivers puts pressure on day-to-day operations.

Finally an Ishikawa diagram is presented in Figure 6.2, which consolidates all the above discussed findings at the aggregate level. Motives only from shippers' side are specified in the diagram, and the remaining motives are generic ones applied to both carriers and shippers.

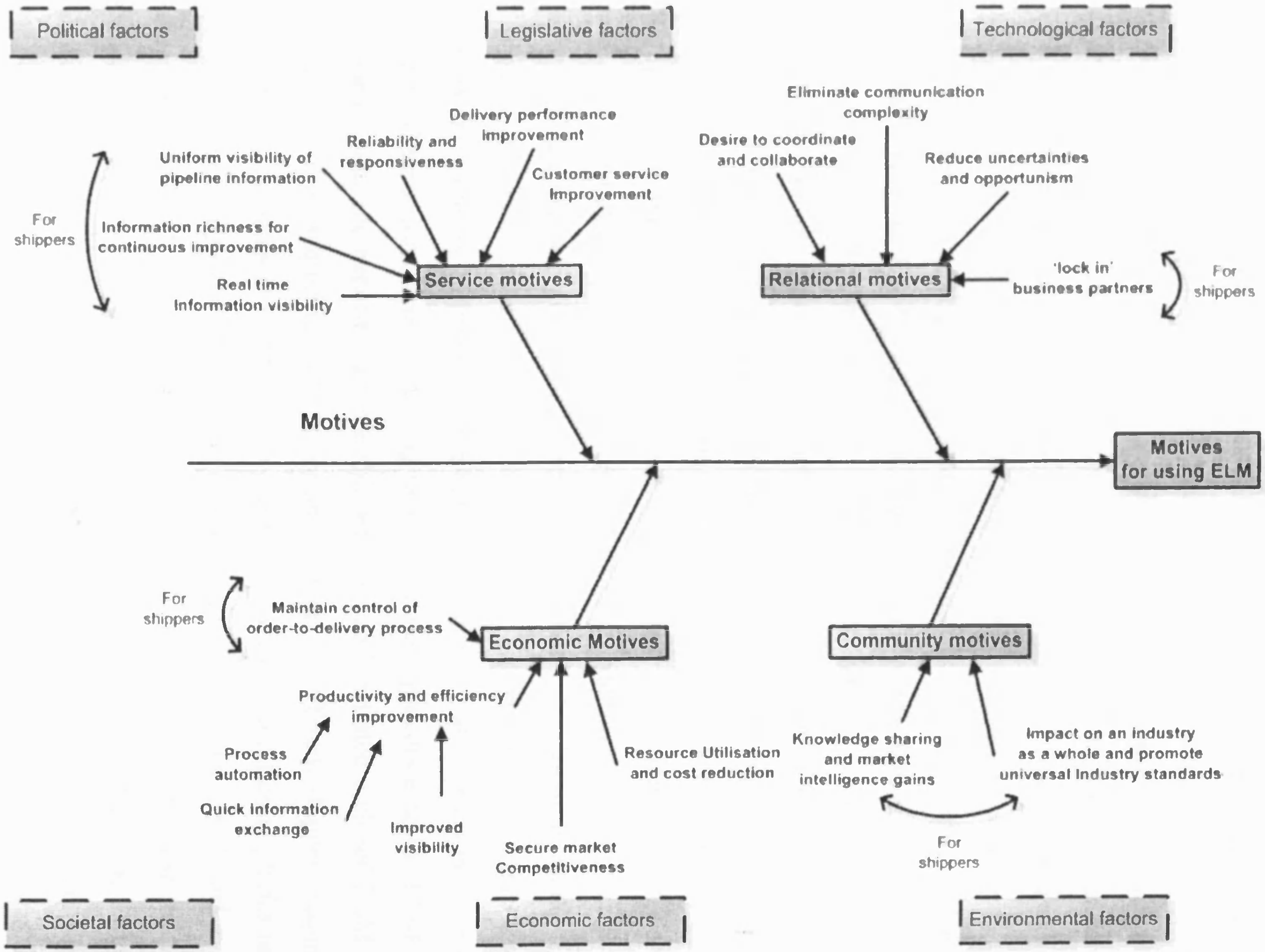


Figure 6.2 Summary of motives for using an ELM
(Source: Author)

6.4 Barriers to using closed ELMs

As regards the four main categories of barriers, i.e. technical, process, collaboration and people, the research results across the six cases are summarised in Table 6.4.

The data collected through interviews indicated that a major barrier came from inter-firm collaborative arrangements. Being developed mostly by shippers, an ELM can be very biased towards shippers' needs and provide fewer incentives for carriers. The asymmetry of cost/benefit allocation can jeopardise the smooth implementation of an ELM. For example, in Case E, the real time tracking and tracing function was built in and this required significant investment from carriers in telematics equipment. As not all of the shippers could guarantee delivery volumes in the long-term, carriers were reluctant to join this ELM. This slowed the progress towards implementation and was consistent with the findings reported by Wilson and Vlosky (1998) in respect of a generic IOS, namely, that the more unbalanced the benefits, the greater the risks for successful implementation. Hence, a closer partnership with balanced allocation of benefit/cost is needed in place to ensure that the carrier is fully willing to participate. Shippers can improve this by providing incentives to participating carriers, for example, subsidising the development of applications or agreeing longer-term contracts. During adoption of a closed ELM system, the research found that its introduction could cause short-term disruption to the stable relationship between carriers and shippers. Shippers see the benefits of bringing all carriers into one single system, whereas for carriers, adapting their operational processes to the ELM might not yield economic benefits as those shippers who had initiated a closed ELM might be the only ones requiring ELM adoption. Further, if different shippers require the participation in different ELMs, carriers will have to log onto different platforms, thus increasing the complexity of inter-firm communications. This was confirmed in all six cases. Carriers will have to build up automatic interfaces with those ELMs, or otherwise they will experience time-consuming input work. The same issue was observed by Eng (2004) in a generic EM and Pramatari (2007) in a store ordering Web platform adoption. Though there is a trend towards integrating individual ELMs in practice, and emerging technologies like Web-services and interoperability standards may enable this, it will still take a long time to realise based on case study findings.

Barrier Type	***Barrier factor to participate in Case ELMs***	*Case A*		*Case* **B**		*Case C*		*Case D*		*Case E*		*Case F*	
		S	C	S	C	S	C	S	C	S	C	S	C
Technical	Lack of data transfer standard	●	●	●	●	●	●	●	●	●	●	●	●
	High risk of system failure	●	●	●	●	●	●	●	●	●	●	●	●
	Scalability issue due to capacity constraints	●	●	●	●	●	●	●	●	●	●	●	●
Process	Functionality design biased towards shippers		●		●		●		●		●		●
	Added functions for carriers leads to added cost		●		●		●		●		●		●
Collaboration	Fear of information sharing	●	●	●	●	●	●	●	●	●	●	●	●
	Lack of synergies					●		●				●	
	Legislation constraints									●	●	●	●
	Integration with different ELMs		●		●		●		●		●		●
	Cost and benefits asymmetry		●		●		●		●		●		●
People	Learning difficulties in using the system	●	●	●	●	●	●	●	●	●	●	●	●
	Change resistance	●	●	●	●	●	●	●	●	●	●	●	●
	Fear of being watched		●		●		●		●		●		●
	Fear of losing job	●	●	●	●	●	●	●	●	●	●	●	●

Key: S: Shipper, C: Carrier

Table 6.4 Barriers to using case ELMs
(Source: Author)

The research found the lack of synergies between the needs of shippers in a closed ELM could lead to the failure of ELM adoption, even if the system technically functions well. This was clearly evidenced by Case F. The fear of sharing information on the part of both shippers and carriers was another important factor which inhibited the potential benefits of ELM to be realised. For example, in Cases C, and D, there were opportunities between shippers for joint scheduling of deliveries for better fleet utilisation and transport cost reduction, however, shippers might have different vehicle requirements or be reluctant to disclose commercial information like transport rates. Many optimisation efforts were therefore still within a company's own supply chains, rather than across a wider network. Even in Case E, although companies had started to explore such synergies, their efforts were focused only on the sharing of technical infrastructures. In Case F, it was carriers who did not want the data to be shared between shippers because carriers charged different rates to different shippers according to factors such as volume, back loading opportunities, etc. The same fear was found in Cases A, B, and D. The study also found there were some legislation barriers to a successful collaborative ELM. For instance, complementary flows might exist between two shippers in a region, however, a product safety issue might arise if one shipper delivered food and another deliver plastics or chemicals. Moreover, some restrictions might be put in place by insurance companies. Hence joint deliveries between shippers of various products could be constrained if not handled properly.

Process barriers arose from the designed functionality but were not found to be of significant importance. Technology providers usually have the capability to add or modify any functions demanded by participating companies. Thanks to Web technologies, configurability and adaptability have improved significantly when compared to traditional enterprise management systems. This was clearly observed during system demonstrations conducted by technology providers in all six cases. In Case D, the technology provider could even offer modular solutions where companies could pick up different function modules and need not to pay for the whole package. In Cases C and D, ELM systems were hosted by the technology provider. In order to attract more companies to participate, value added functions such as taxation, currency conversion, and cross boarder assistance had been added to ensure a smooth delivery process. This helped to remove potential international operation barriers. However, functionality design across all cases was found to be still biased towards shippers, hence carriers demanded more functions to be designed for their convenience.

As regards technical barriers, the technological capabilities of the companies involved, particularly of carriers were expected to be one of the concerns. However, a range of available ways of connecting with the central ELM platform (e.g. email based input, web form) had made these less of a barrier. The minimum level of requirement for carriers involved is only an internet connection and a browser. Big carriers could also afford to build automatic linkages with the ELM. Smaller carriers just needed to manual input information from the Internet. It was expected that given that shippers are normally the drivers within the supply chain for ELM adoption, they would have less technical problems. The study confirmed this assumption. It was found that large shippers had sufficient skills and resources for sophisticated functions while small shippers tended to use simpler functions. Data security and privacy were of less concern due to the nature of closed systems. Overall, there was strong evidence that Web-based ELMs had largely reduced the technical barriers to entry for carriers, especially SMEs. However, the maintenance of an ELM could still provide a challenge to the technology provider and/or shippers. A particular issue with centralised software architecture is the volume of transactions across the ELM. If large, there might be serious delays and scalability issues. The use of a single platform for communication between shippers and carriers also implied a high risk of system failure. Finally, although data could be standardised using XML or other formats for communication in all six cases, there has lack of universal industry-wide standards. Even XML-based message standards defined by industry groups are currently well over 100 and still growing (Worden, 2007). This was perceived by technology providers to be a barrier for wide adoption of ELMs in practice.

'People' issues arise from the individual user's lack of skills and willingness to use an ELM. For example, all ELMs require in-house training of staff in various functions. The more complex the functionality, the more time and effort is needed. For example, one of carriers in Case E, spent in total one year on training in order to familiarise staff (both drivers and back office staff) with ELM system usage so that scheduling might be in line with ELM system specification and to improve their ability to input more information on consignments. Change in processes or procedures can also generate resistance. Some administration staff might fear job loss and the use of in-cab systems to communicate with drivers could lead to fear of being continually watched and monitored. The latter was more a concern of carriers. However, these issues were considered by interviewees to be less significant than the collaborative issues discussed above.

Finally an Ishikawa diagram (Figure 6.3) was drawn showing consolidated results across cases at the aggregate level. As with motivations, barriers' level of significance varies across cases. This was supported by information collected from companies' archival records and during the course of interviews. These differences are highlighted in Section 6.7, together with those relating to the other three evaluation criteria: motives, benefits and costs.

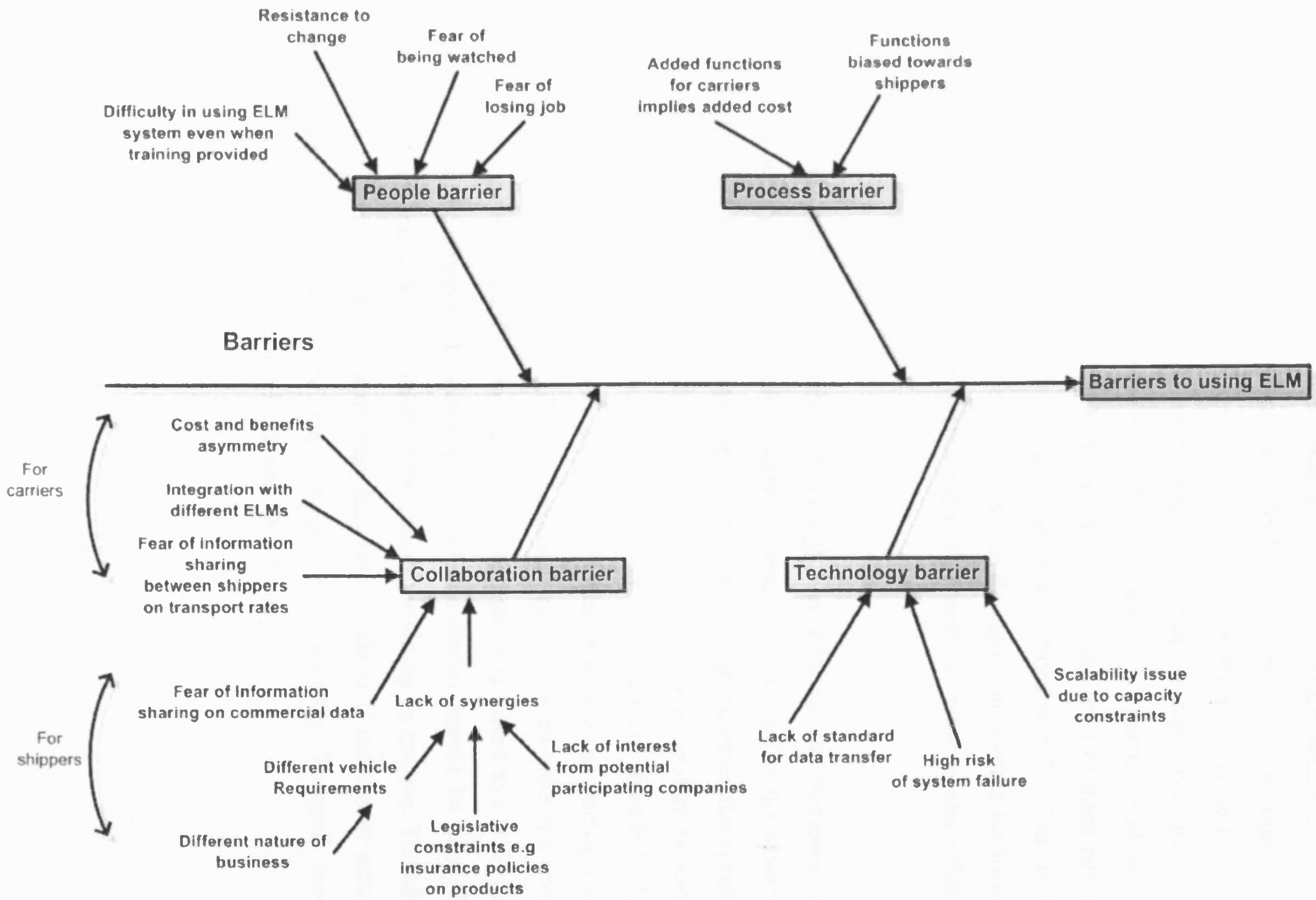


Figure 6.3 Barriers to the use of an ELM
(Source: Author)

6.5 Benefits of using closed ELMs

The research identified a broad range of benefits from the use of ELMs. Many of the benefits were dependent upon the functionality of the marketplace itself and could be grouped under four categories: improved process efficiency, cost savings, more proactive management and improved customer service. As shown in Table 6.5, large similarities existed across cases under the four categories, probably because of the overlap of functionalities between the six cases (see Figure 5.3, Chapter 5). Moreover, again, as in the case of motives and barriers, the significance level of these benefits varied from case to case, as will be demonstrated in Section 6.7. Due to the similarities, the main benefits can be summarised at the aggregate level in the form of an Ishikawa diagram, where the overall benefit is seen as reliable and efficient delivery (Figure 6.4).

Improved process efficiency is achieved through streamlining the processes, and providing the supply chain with more accurate information. Information is transmitted electronically between all parties involved in the ELM. This increases the speed of information transfer. Improved data integrity and traceability is another important factor impacting process efficiency. In an ELM, all shipments are recorded, along with details of which carrier transported the load. Further, tracking and tracing allows confirmation that a load has been collected, indicates its location en-route and reveals when delivery has occurred. In many cases this information is linked to a self-billing function, where the shipper calculates how much the carrier should be paid. This replaces the more traditional approach of the carrier providing an invoice. Therefore, any disputes relating to whether a delivery has been made or if the carrier actually undertook the movement can be resolved quickly and easily. Reduced human interventions also lead to less paper work and data errors.

Benefit Type	***Benefit factor to participate in Case ELMs***	*Case A*		*Case* **B**		*Case C*		*Case D*		*Case E*		*Case F*	
		S	C	S	C	S	C	S	C	S	C	S	C
Process efficiency	Reduced paper work and data errors	•	•	•	•	•	•	•	•	•	•	•	•
	Reduced delivery errors and disputes	•	•	•	•	•	•	•	•	•	•	•	•
	Better information sharing and transaction efficiency	•	•	•	•	•	•	•	•	•	•	•	•
	Productivity improvement across functions	•	•	•	•	•	•	•	•	•	•	•	•
	Shorter order processing time	•	•	•	•	•	•	•	•	•	•	•	•
	Elimination of under or overcharges and disputed bills	•	•	•	•	•	•	•	•	•	•	•	•
Cost savings	Reduced capital investment if using hosted solution	•	•	•	•	•	•	•	•	•	•	•	•
	Simpler management of all carriers	•		•		•		•		•		•	
	Better warehouse scheduling	•		•		•		•		•		•	
	Improved economy of scope	•		•		•		•		•		•	
	Better vehicle and route scheduling		•		•		•		•		•		•
	Better management of labour, insurance and administrative work		•		•		•		•		•		•
	Improved economy of scale		•		•		•		•		•		•
Operations management approach	Better tracing and tracking	•	•	•	•	•	•	•	•	•	•	•	•
	Better decision-making	•	•	•	•	•	•	•	•	•	•	•	•
	Better inventory control	•		•		•		•		•		•	
	More accurate cost information & better budget control	•	•	•	•	•	•	•	•	•	•	•	•
Customer service	Better communication	•	•	•	•	•	•	•	•	•	•	•	•
	Better on time delivery performance	•	•	•	•	•	•	•	•	•	•	•	•
	Reduced delivery time and variability	•	•	•	•	•	•	•	•	•	•	•	•
	Less disputes about delivery performance	•	•	•	•	•	•	•	•	•	•	•	•
	Increased capability to deploy e-business enabled business model	•	•	•	•	•	•	•	•	•	•	•	•
	Better response to changes	•	•	•	•	•	•	•	•	•	•	•	•

Key: S: Shipper, C: Carrier

Table 6.5 Summary of benefits of individual case ELMs
(Source: Author)

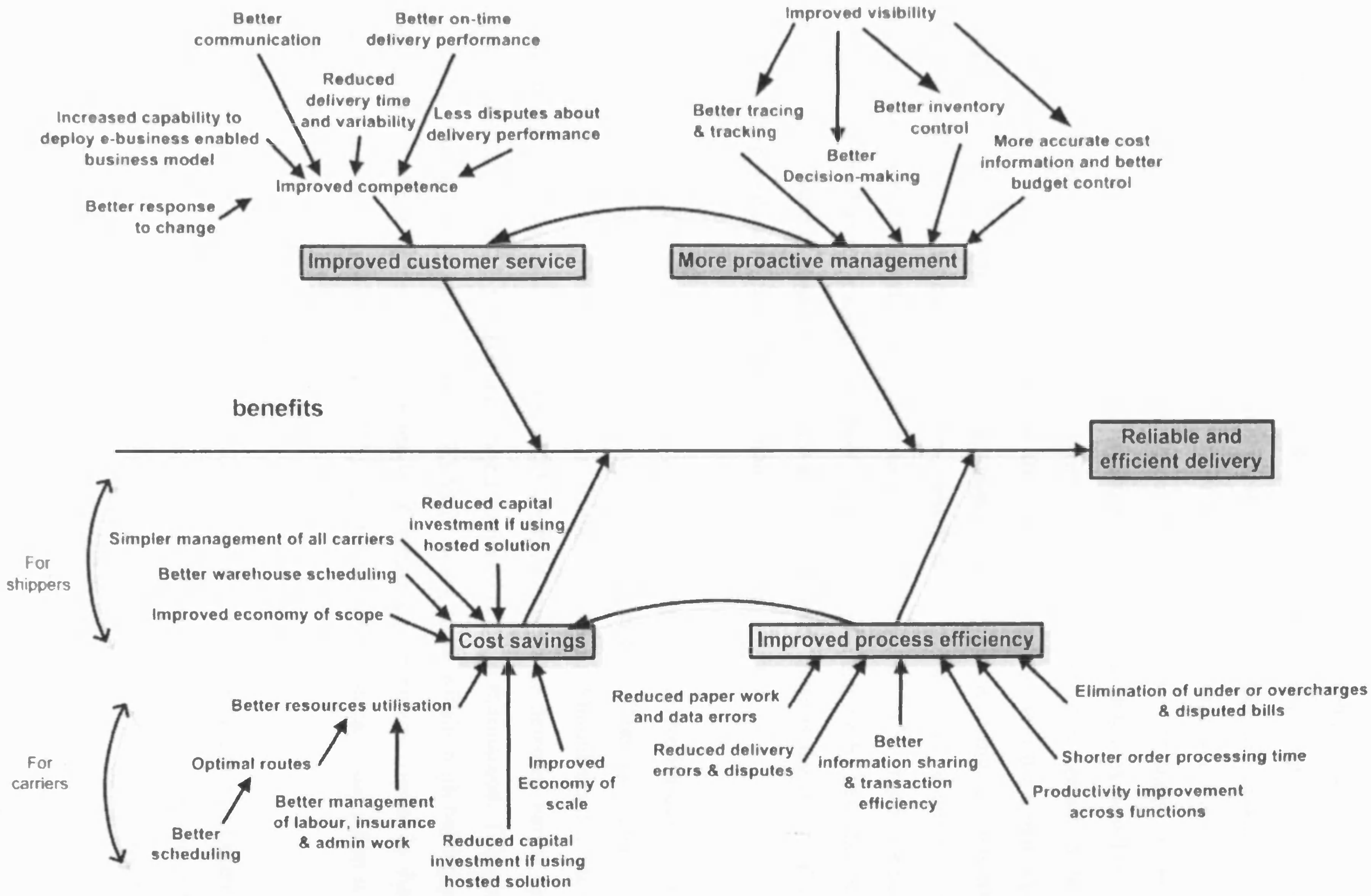


Figure 6.4 Benefits arising from the use of an ELM
(Source: Author)

Another area of benefit was cost savings. While improved process efficiency contributes towards this, there are other benefits accrued by both the shipper and carrier. In the case of the former, there is the opportunity to simplify the day-to-day management of carriers, as all information is transmitted through a single interface. Equally, where the marketplace permits horizontal collaboration (for instance, in Cases C, D, E, F) it is possible for the shipper to benefit from improved flexibility in the provision of transport services, and therefore gain economies of scope. From a cost perspective, the range of different available ELMs means that it is possible for the shipper to avoid significant setup costs through the use of a hosted system. Shipper benefits may also extend beyond the transport journey, with the opportunity to improve warehouse operations through greater visibility of incoming and outgoing loads. From the carrier's perspective, a key benefit is the better use of resources. The greater visibility of loads and their progress enables scheduling to be more effective and avoids delays having a knock-on effect. In addition, because the ELMs examined in this research were closed systems, once a carrier joined, there is the potential for them to receive more loads and therefore gain economies of scale.

A third area of benefit was in more proactive management of deliveries through the increased supply chain visibility among supply chain partners. The track and trace facility within ELMs enables managers to see where loads are. Should a delay occur, the improved visibility offered by the ELM enables this to be detected earlier and therefore decisions can be taken to ensure customer service is maintained. This may involve re-routing the vehicle or, if the ELM is being used within a global supply chain, possibly choosing an alternative mode of transport. Inventory control in these long supply chains can also be improved by identifying where stock is and when it is likely to arrive.

Finally, ELMs can deliver improved customer service, with proactive management being just one part of this. A shipper can be more responsive to customer requests, especially if they can draw on a large pool of different transport options. They can also reduce order-to-delivery time as information flows between shippers and carriers are faster. When delays occur, the shipper has earlier notification of this and so can contact the customer to warn them of the delay while, if a dispute should arise in respect of delivery performance, it is possible for more accurate information to be obtained to identify the root causes of the problem. The fact that in some circumstances the ELM (for example, Cases C, D, E and F) is neutral can further enhance this benefit, as there is less suspicion that the data is distorted. Finally, from a carrier's perspective, being able to participate within an ELM improves their capabilities, and therefore competitiveness in delivering a solution that meets the needs of the shipper.

As can be seen from the discussion above, there are a wide range of benefits which can be obtained for both the shipper and carrier participating in an ELM. However, many of the benefits are specifically related to the delivery of improved service to the shipper's customer while maintaining efficiency. While the exact benefits will vary between applications, it appears that there may be greater benefits in adopting an ELM for the shipper rather than the carrier.

6.6 Costs of using closed ELMs

Identifying the costs of purchasing, installing and running an ELM is difficult as they can be affected by many factors including:

- The structure of the marketplace
- Whether it is operated in-house or hosted
- The number of functions
- The number of organisations participating
- The number of users

Table 6.6 summarises the relative level (low, medium and high) of technology investment in individual ELM cases. An Ishikawa diagram is not provided in this section, given the rather simple and straightforward classification of costs incurred.

The shipper related costs can vary according to the type of ELM used. If the system is operated in-house for example, in Cases A and B, a suitable IT infrastructure needs to be provided. The level of expenditure needed depends upon the capacity required for the ELM and current provision. The other main setup cost is for the software, which is then supplemented by an annual maintenance fee. This research found that generally (but not always) in-house ELMs were deployed where there were large volumes of shipments so as to achieve economies of scale. The data from interviews suggested that setting up hardwares and installing software applications usually involved large investment. Once the system was up and running, incremental cost would occur due to annual licensing fee and upgrading expenses. In this case, the running costs compared with the setup costs were relatively low.

Cases / *Cost Type*	*Case A*		*Case B*		*Case C*		*Case D*		*Case E*		*Case F*	
	S	C	S	C	S	C	S	C	S	C	S	C
Set up cost	○○○	○	○○○	○	○	○	○	○	○	○○○	○○○	○
Running cost	○	○	○	○	○○	○	○○	○	○○	○○○	○○	○

Key: S = Shipper, C = Carrier; ○: Low, ○○ Medium, ○○○ High

Table 6.6 Summary of costs in using case ELMs
(Source: Author)

If using a hosted system like Cases C, D, E and F, then the most popular approach was for the marketplace to charge on a Pay-As-You-Go (PAYG) basis. A fixed amount would be charged for each shipment, with the term "shipment" being defined within each contract. In the four hosted case ELMs, it was usually the 'community leader' who initiated the ELM, and paid for the shipment transaction fees incurred. The community leader in most cases was a shipper, or sometimes a freight forwarder who was in charge of logistics provisions for the shipper. In the case examples studied, the cost per load varied between £0.60 and £2, the exact amount being affected by:

- The cost of hosting the software;
- Communication method with the ELM;
- The level of software development;
- The value of the product;
- The volume of goods to be processed through the ELM.

A key advantage of this approach is that costs are proportional to the amount of usage. However, the technology provider takes a significant risk in developing such a system as a lack of volume may make it difficult to deliver a return on investment. For instance, in Case F, the initial setup costs could not be covered and so the marketplace evolved into an in-house system. Compared to the in-house system, hosted solutions were found to incur low setup costs and a medium level of running costs.

The carriers also incurred both setup and running costs. These were particularly dependent upon the means of communication used to transmit information to the ELM. For most of the ELMs studied, mobile telephones or a computer with Internet connection were sufficient to share information. While both the setup and running costs of using these methods were relatively low, they were best suited to circumstances where retrospective (as opposed to real-time) monitoring of loads was required. Real time information is best provided by telematics equipment which needs to be fitted to each vehicle that may be used within an ELM. Consequently, there can be high setup costs for carriers, and running costs are also higher as information needs to be transmitted more frequently via a wireless data network. This was clearly evident in Case E. In addition to investment in software and hardware, a one-off system connection fee may also be charged to carriers, for instance, in both Cases A and B. In Cases C and D, the connection fee was paid either by the community leader or split between the participating companies. Overall, it was observed that the cost incurred by carriers was relatively low, with one exception, Case E. In Case E, carriers needed to pay both high setup and running costs due to the advanced feature of real time tracking designed in the system. Such cost details will be examined later in Chapter 7.

Technology providers usually incur large system development costs regardless of whether the ELM is an in-house or hosted solution. Like any other ICT applications, the system will then face relatively small incremental costs for each additional transaction until the capacity of the system is approached (Bakos, 1991).

Despite the tangible cost associated with the adoption of an ELM, investment in human relationships and inter-organisational processes is of the same importance for a successful adoption. There is also a learning cost associated with the use of most IT systems for inter-firm coordination. Training cost occurs in order to train people to use the ELM correctly, within both the shipper and the carrier.

6.7 Link with tailored logistics

Having examined each of the four key evaluation criteria as the reasons for using ELM within supply chains, it was observed that despite the large similarities across case ELMs, the level of significance for each factor under each evaluation criteria varied from case to case. Table 6.7 brings together the results derived from all six cases, and highlights the differences. Consolidating the results discussed in previous sections, this table also attempts to show the differences in the context of tailored logistics.

Evaluation criteria	*Cases* / *Factors*	*Case A*	*Case B*	*Case C*	*Case D*	*Case E*	*Case F*
Motivations	Economic motives	ooo	ooo	oo	oo	o	ooo
	Relational motives	oo	oo	ooo	ooo	oo	oo
	Service motives	oo	oo	ooo	ooo	ooo	ooo
	Community motives	o	o	o	o	ooo	ooo
Barriers	Technical barriers	o	o	o	o	o	o
	Process barriers	o	o	o	o	o	o
	Collaborative barriers	o	o	oo	oo	ooo	ooo
	People barriers	o	o	o	o	o	o
Benefits	Operations management approach	o	o	oo	oo	ooo	ooo
	Customer service	oo	oo	ooo	ooo	ooo	oo
	Process efficiency	ooo	ooo	ooo	ooo	oo	oo
	Cost savings	ooo	ooo	oo	oo	o	ooo
Costs	Set up cost	ooo	ooo	o	o	ooo	oo
	Running cost	o	o	oo	oo	ooo	oo
Tailored logistics		**Standardised logistics**		**Customised logistics Type I**		**Customised logistics Type II**	

Key: o: Low, oo Medium, ooo High

Table 6.7 Summary of the reasons for using case ELMs within supply chains
(Source: Author)

Cases A and B were largely driven by economic gains, and subsequently the benefits were mainly from cost savings and improvement in process efficiency. As shippers and carriers did not attempt to explore the potential benefits enabled by horizontal coloration, they encountered relatively low barriers across all four categories. However, because both cases deployed a traditional client-server in-house approach, the set up costs incurred were higher compared with the on-demand solutions in Cases

C and D. This corresponds to the characteristics of 'standardised logistics' defined in Table 2.2, Chapter 2 and Table 4.4, Chapter 4 where the emphasis is placed on cost yet with a reasonable service level, as well with limited collaboration between shipper and carrier.

Moving away from economic consideration, Cases C and D were deployed largely due to expected service and relational gains. As a consequence, they achieved higher benefits in terms of process efficiency and customer service through the active engagement of customers in the system. As horizontal collaboration occurred at an ad hoc level, there were no rigid structural requirements between shippers, or between carriers. Hence the collaborative barrier was at the medium level. Technical, process and people barriers were largely the same as in Cases A and B. Because the on-demand model was deployed in both cases, the set up costs were largely reduced compared with Cases A and B, and running cost were maintained at a medium level. Cases C and D findings fitted well with the attributes of 'customised logistics type I' as defined in Table 2.2, Chapter 2 and Table 4.4, Chapter 4, where value is focused on service and customised end-to-end logistics provision can be provided.

In Cases E and F, community motives together with service motives were of significant importance to both consortia groups. Actively exploring the synergies between shippers brought both cases strategic advantages in proactive management of their supply chains. Although Case F failed due to lack of complementary flows between shippers, the logic behind the initiative shows great potential for benefits. If these shippers were from the same or similar sectors, synergies would have been identified. With appropriate system, process and relationship configurations, there is no reason why this business model could not be viable. However, horizontal collaboration challenges shippers in various ways as discussed previously, and great effort is required to cope with potential conflicts and overcome the fear of information sharing. Collaborative barriers in Cases E and F were therefore at highest level. Both cases could be aligned to the 'customised logistics type II' defined in Table 2.2, Chapter 2 and Table 4.4, Chapter 4 where systems are highly customised towards specific needs of consortia group, and go beyond executional functionality towards more strategic features.

In a nutshell, the above findings further confirmed the classification analysis conducted in Section 5.4, Chapter 5. There were different emphases on the reasons for using ELMs within supply chains in private, shared and collaborative ELMs. These reasons drove the design and configuration of ELM systems, and largely influenced the potential outcomes. The capabilities required of an ELM system increase as the service provision goes from standardised to customised logistics.

6.8 Comparison of closed and open ELMs

Based on the foregoing discussions in addition to the generic differences listed in Table 3.3 in Chapter 3, reasons for using open and closed ELMs differ and their associated benefits and costs also differ. Those differences are highlighted and summarised in Table 6.8. It should be noted that differences shown in this table are not comprehensive, rather they are key points found from the review of the literature on open ELMs and case study findings on closed ELMs.

The motives for using an open ELM are mainly search and transaction cost reduction and efficiency as well as the wide pool of potential shippers or carriers (Grieger, 2003; Gulledge, 2002; Howard *et al.*, 2006; Kaplan and Sawhney, 2000; Rask and Kragh, 2004). Closed ELMs focus more on operational excellence in terms of both delivery efficiency and effectiveness. In order to have a loyal and stable relationship with carriers, shippers are committed to using closed ELMs to reduce supply chain uncertainties and maintain strict control of order-to-delivery processes. Service and relational motives are of significant importance in a closed ELM as well. More importantly, motives also include wider concerns like community, societal and environmental issues, which are rarely the case in an open ELM.

While it has been widely reported in the literature that opportunistic behaviour in an open ELM is a major barrier along with data privacy and online security (Bakos, 1991, Kim and Ahn, 2006, Malone *et al.*, 1987), barriers to the use of closed ELMs are mainly related to the collaborative arrangements between shippers and carriers, and between shippers themselves. Unbalanced benefits and cost allocation and fear of information sharing are factors which can largely inhibit their adoption.

Factors / *Type of ELM*	*Motivations*	*Barriers*	*Benefits*	*Cost*
Open (Grieger, 2003; Skjøtt-Larsen *et al.*, 2003; McLaren *et al.*, 2002)	• Focus on transaction and procurement efficiency • Reduce search cost • Reduce purchasing price • Reach large pool of potential shippers and carriers	• Opportunistic behaviours • Low level of trust • Security and data privacy • Uncertainties • Limited functionality and value added services	• Sourcing related benefits: for shippers, better transport rate and wider selection of carriers; for carriers, pool of more potential shippers and surge own transport capacity • Flexibilities	• Low switch cost for participants • Relatively low system set up cost and running cost • Relatively low investment in human relationships and inter-organisational processes • Process specific learning cost
Closed	• Focus on operational excellence • Reduce uncertainty • Build loyalty and lock in business partners • Control over order-to-delivery process • Improve customers' satisfaction • Wider concerns like community knowledge share and environmental factors	• Collaborative agreement between shippers and carriers • Asymmetry of cost and benefits allocation • Misalignment of different parties' needs • Information sharing	• Execution related benefits: proactive management and control, cost reduction, service and efficiency improvement • Stabilities over long term • Market competitiveness through alignments between shippers and carriers, and/or between shippers	• High switch cost for participants • Relatively high system set up cost and running cost • Relatively high investment in human relationships and inter-organisational processes • Relation and process specific learning cost

Table 6.8 Comparison of open and closed ELMs: motivations, barriers, benefits and costs
(Source: Author)

The different natures of open and closed ELMs determine that they pursue different benefits. The former focuses more on the gain of search and transactional cost reduction, and the latter more on execution related benefits. This research found that the use of a closed ELM brings shippers more profits and more strategic gains over the long-term. Strategic alignments and stable supply chains can help organisations improve their customer satisfaction and market competitiveness.

The associated costs vary as well. The open ELMs deploy a many-to-many business model and there is thus a loose relationship between shippers and carriers. This implies that companies can switch their exchange partners from one to another easily. Therefore, the exit cost is low. A closed ELM, on the other hand, usually involves high relationship-specific investment. It creates a strong bond between shipper and carrier. Further, the more complex functionality means there is also a relatively high system development and maintenance cost.

6.9 Summary

Empirical evidence from 6 ELM cases indicated that shippers tended to emphasise proactive and efficiency-oriented motives. The decision to initiate or participate in a closed ELM was driven by internal expectation to obtain competitive advantages in logistics management. Carriers' participation is motivated primarily by external pressure from shippers, rather than purposely planned with expected outcomes. Industry specific competitive conditions were the driving forces behind both parties' use of ELMs.

The study also indicated that shippers were transforming their relationship with carriers. Consistent with Bakos and Brynjolfsson's (1993) regarding the relationship between buyers and suppliers, many shippers were finding it more profitable to work closely with only a small number of partner carriers, comparing with playing off a large number of carriers against one another. This was the fundamental reason for the formation of a closed ELM. In addition, the research demonstrated that there were economic, relational, service, community and environmental motivations for adopting an ELM. While the majority of motivations were in evidence for shippers, carriers were more motivated by economic and relational issues. In terms of barriers, a key factor was the collaborative arrangement between participants. The misalignment of different parties' needs and unbalanced cost/benefits allocation could lead to the failure of the whole system. Accordingly, it is important for open dialogue to exist between shippers and carriers to ensure a clear understanding of shippers' motivations for introducing the marketplace.

The research also identified the key benefits and costs associated with implementing an ELM. It is found that ELMs can improve process efficiency, reduce costs, encourage management to be more proactive, and improve customer service. It also revealed that some benefits to be unique to either shipper or carrier. However, a major issue is how evenly the benefits are spread between the carrier and shipper. In order to motivate carriers to invest in non-contractible relationship-specific resources, shippers need to provide their carriers with incentives. Otherwise negative disruptions might occur due to carriers' resistance. This conforms with Clemons *et al.*'s (1993) argument that the importance of benefit balance should be emphasised in the adoption of inter-firm systems by buyers and suppliers. In terms of shipper costs, the research found that two main pricing strategies existed, depending upon whether the system was operated in house or hosted. Consequently, there was a degree of flexibility which enabled companies to choose a marketplace type appropriate to their requirements. Cost incurred on the carriers' side mainly depended upon the method of communication with the ELM. Ultimately, the level of this cost would be determined by shippers when they designed the functionality of the ELM.

Finally, the different levels of significance of motives, barriers, benefits and costs were consolidated, when examined in the context of tailored logistics. The findings suggested appropriate alignments between those factors with different types of logistics provisions, and further supported the classification analysis conducted earlier in Chapter 5. A comparison between open and closed ELMs was also presented, highlighting key differences. While the research has provided insights into the reasons why companies look to adopt ELMs, much of the analysis has been dependent on the perspective of the ELM providers as they represent the majority of the interviews. Although technology providers are in a neutral position with an understanding of both carriers and shippers, it should be noted that there is a potential for bias in their views.

Chapter 7 A Collaborative ELM

7.1 Chapter overview

While Chapter 6 has discussed the generic motives and costs and benefits in using closed ELMs within supply chains, this chapter aims to understand the specific rationale for using the Heterarchical Network type of ELM, hereafter referred to as a 'collaborative ELM', and evaluate the impact of introducing such an ELM through an in-depth study of Case E from the UK's fast moving consumer goods industry (Figure 7.1). Therefore, the objectives of this chapter are to:

1) understand why companies form a collaborative ELM
2) investigate how it has been implemented
3) examine the impacts it brings to the supply chain
4) predicate the necessary conditions for a successful implementation

The above objectives will help to address Research Question 4.

RQ4. What are the reasons for and impacts of introducing a novel type of ELM, i.e. Heterarchical Network (termed as Collaborative ELM)?

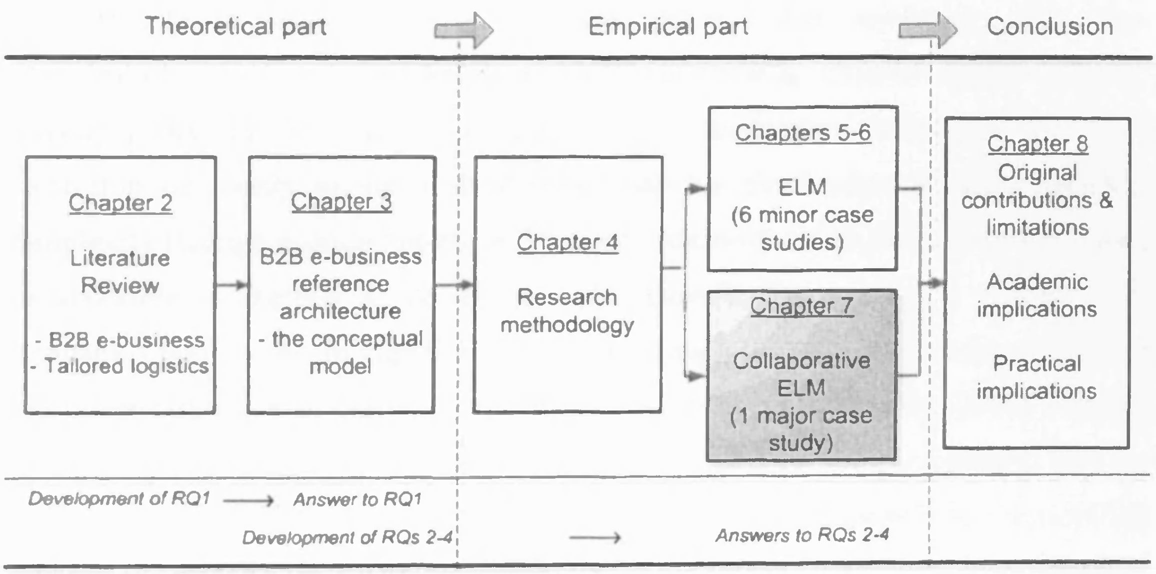


Figure 7.1 Thesis structure – a collaborative ELM
(Source: Author)

7.2 The 'Collaborative' ELM concept

The 'collaborative' ELM model means that a small group of companies, in most cases shippers, collaborate with each other and create an ELM for joint use. The functionality is highly customised towards the specific needs of the consortium group (McLaren *et al.*, 2002). Its heterarchical network nature also indicates that each participant, at least theoretically, can communicate directly with every other participant. In line with the concept of 'on-demand computing', collaborative ELMs are usually hosted by a third party technology provider (Cherbakov *et al.*, 2005). Shippers are aligned by common interests rather than contract or authority based procedures. Such an alignment is sometimes termed 'horizontal collaboration' (Bengtsson and Kock, 2000). It is the greater level of horizontal collaboration that differentiates collaborative marketplaces from 'private' and 'shared' marketplaces, which have a greater focus on vertical integration.

There are a number of generic motivations behind collaborative electronic marketplaces. They are summarised in Table 7.1 using the same categories identified in Chapter 6, with added factors specifically derived from the horizontal collaboration literature. These added factors are put in bold type in the table. The most common motivation factor for collaborative EM participation is that buyers try to share the expenses of managing a marketplace while maintaining control of the order-to-delivery processes (Martinez *et al.*, 2001). Other motivation factors include group ownership can easily secure 'critical mass' and the elimination of communication complexity through a single interface. The strongest motivation factor is that by using collaborative marketplaces, companies can identify the synergies beyond each company's boundaries. In logistics, this can encourage the reduction of empty running and better utilisation of carriers' capacity at a network level (Sherer, 2005). Further, because the buyers in the group are often industry leaders or large companies, they are in a good position to facilitate the development of uniform standards for transmitting data and coordinating business processes (Dai and Kauffman, 2002; Le *et al.*, 2004).

Motive Type	*Motivation factor for EM participation*	*Key References*
Economic	Maintain control of order-to-delivery process	McIvor and Humphreys (2004), Ho *et al.*, (2003), Lewis and Talalayersky (2000), Goldsby and Eckert (2003)
	Productivity and efficiency improvement via process automation, improved visibility and quick information exchange	Kaplan and Sawhney (2000), McLaren *et al.*, (2002), Eng (2004), Rask and Kragh (2004)
	Resource utilisation and cost reduction	Kumar and Van Dissel (1996), McLaren *et al.*, (2002), Bengtsson and Kock (2000), Skjøtt-Larsen *et al.*, (2003), Silveira and Cagliano (2006), Howard *et al.*, (2006)
	Secure market competitiveness	Stockdale and Standing (2004), Fu *et al.*, (2006)
	***Pool of complementary resources**	**Kumar and Van Dissel (1996), Martinez *et al.*, (2001), Bengtsson and Kock (2000)**
	***Reach a critical size ('critical mass')**	**Martinez *et al.*, (2001), Golicic *et al.*,(2002), McIvor and Humphreys (2004), Standing *et al.*, (2006), Howard *et al.*, (2006)**
	***Network optimisation, economy of scale and scope of logistics operations**	**Martinez *et al.*, (2001), Standing *et al.*, (2006)**
	***Risk, infrastructure and expenses sharing**	**Kumar and Van Dissel (1996), Bengtsson and Kock (2000), Standing *et al.*, (2006)**
	*** Access to superior technology**	**Frankel and Whipple (1996) Zineldin and Bredenlow (2003)**
Relational	Reduce uncertainties and opportunism in the supply chain	Martinez *et al.*, (2001), Kumar and Van Dissel (1996)
	Desire to coordinate and collaborate in exchanging information and conducting transactions	Kumar and Van Dissel (1996), Rask and Kragh (2004)
	Build strong bond to 'lock in' key partners, or seek greater commitment	Shi and Daniels (2003), Goldsby and Eckert (2003), Gosain and Palmer (2004)
	Eliminate communication complexities	Dai and Kauffman (2002)
Service	Delivery performance and customer service improvement, as well as lead time reduction	Lewis and Talalayersky (2000), McLaren *et al.*, (2002), Folinas *et al.*, (2004), Silveira and Cagliano (2006), Howard *et al.*, (2006)
	Reliability and responsiveness via improved flexibility and adaptability	Martinez *et al.*, (2001), McLaren *et al.*, (2002), Shi and Daniels (2003), Ho *et al.*,(2003), Folinas *et al.*, (2004), McIvor and Humphreys (2004)
	Uniform visibility of pipeline information across companies	Folinas *et al.*, (2004)
	Real time communication and visibility	Martinez *et al.*, (2001), Murtaza *et al.*,(2004)
	Information richness leads to continuous improvement	Silveira and Cagliano (2006)
	***Ability to comply with strict customer requirement**	**Cruijssen *et al.*, (2007)**
Community	Knowledge sharing and market intelligence gains	McLaren *et al.*, (2002), Standing *et al.*, (2006)
	Desire to impact an industry sector as a whole, and promote industry specific standards	Todeva and Knoke (2005) Standing *et al.*, (2006)

* Added factors from the 'horizontal collaboration' literature

Table 7.1 Motives for collaborative electronic marketplaces
(Source: Author)

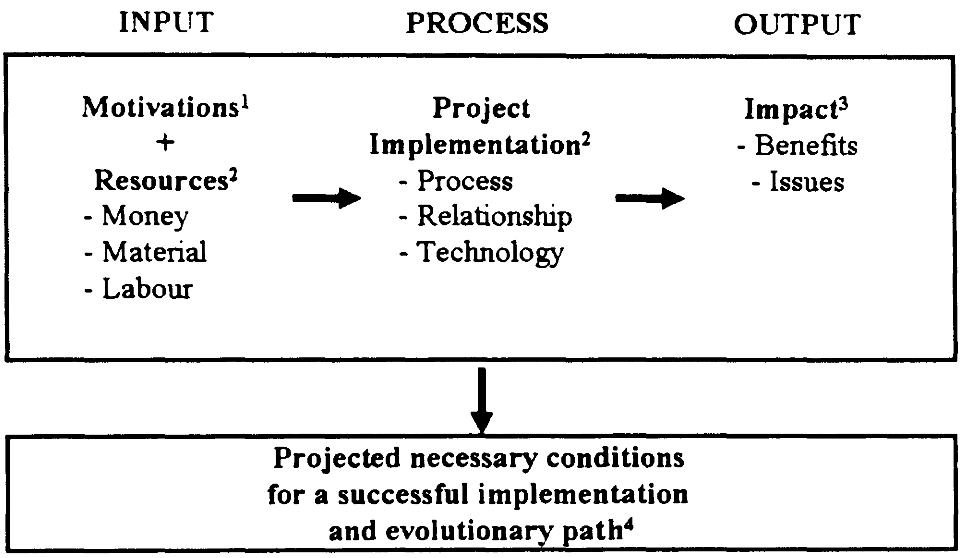
However, the above motivations are based on generic research on horizontal collaboration. They have yet to be empirically tested in depth within the context of ELMs. This is partly due to closed ELM systems being in the infancy stage of early industrial take-up. Moreover, collaborative ELMs have to address issues of vertical and horizontal collaboration between members, potential conflicts between different companies, and individual logistics solutions. Therefore, a higher risk of failure exists. This, to some extent, further explains why empirical examples have been rare in practice.

7.3 Case E background

As mentioned in Chapter 4, Case E was chosen from the FMCG industry. It was formed by three leading manufacturers in the UK: a soft drinks company, a beauty and health care company, and a food company. They all have well-established product brands, and, to a large extent, have the same customer base (for example, big retailers like Tesco, ASDA, and Sainsbury's) and use similar transport providers. Aiming for better control of their delivery process, the three companies decided to form an ELM for their joint use, with a major feature being real time monitoring of the status of all consignments regardless of carrier. The manufacturers between them use 15 main transport providers who operate over 3,000 trucks and 9,000 trailers. When the system becomes fully functional, it will monitor around 400,000 journeys per year. Gaining access to this case at the beginning of the project provided the author with a first-hand opportunity to observe the implementation stage of the system and examine the impacts it has had on the supply chain. The ELM Case E started in March 2006, while the research began in June 2006. By April, 2007, the trial running of the ELM had been largely completed, with full implementation imminent. The author continued to observe this case until end of June, 2007, a full observation period of one year. This was also the research length of time agreed with participating companies.

The study aimed to reflect the change process experienced by both shippers and carriers. An input-output diagram (Figure 7.2) shows the data analysis structure. 'Input' includes the motivations for forming the ELM as well as resources (financial, labour and material resources) needed. 'Process' demonstrates how the business model is being realised. Under this, the author examined the case from three aspects:

supporting technologies, relationship configurations and functionality (i.e. the processes designed in the ELM) based on Folinas *et al.*, (2004). 'Output' covers both benefits and issues discovered. Examination of the case example also enabled the author to identify the prerequisites for the successful implementation of a collaborative ELM, and predict the possible evolutionary path of the case example.



Note
[1]This research output relates to Objective 1 as defined in Section 7.1.
[2]This research output relates to Objective 2 as defined in Section 7.1
[3]This research output relates to Objective 3 as defined in Section 7.1
[4]This research output relates to Objective 4 as defined in Section 7.1

Figure 7.2 Data analysis structure
(Source: Author)

7.4 Data analysis

The analysis of data collected follows the analysis model shown in Figure 7.2. Consideration is therefore given first to the inputs into the change to an ELM. The actual process of the marketplace is then detailed before finally considering some of the benefits and issues that have arisen. From this, it is possible to identify some of the key enablers of collaborative marketplaces and the evolutionary path for the case example. The combination of these findings should enable RQ4 to be answered.

7.4.1 Motivations

In considering the motivations behind the adoption of the collaborative ELM, the same criteria are used as outlined in Chapter 6. Table 7.2 presents these again, and highlights whether they apply to the case study. As the research is interested in the rationale for forming such an ELM, it naturally looks at the motives from the market maker (i.e. shipper)'s perspective. However as carriers are essential parts of an ELM, their motivations will also be examined. As well as the generic motives examined in Chapter 6, in Case E there are unique motivations introduced by the collaborative activities between shippers, and by the adoption of advanced functionality in the marketplace. These unique motives are discussed hereafter.

From the shippers' perspective, economic and service motives have been highlighted as the most important factors throughout this study. In terms of economic motives, the factors that are influential can be formed into two clusters. Those relating to risk and critical mass represent generic motives that are likely to be true with any collaborative marketplace. In this case, real time tracking and tracing function is built into the system. This requires significant investment from carriers. One shipper's transaction volume is not sufficient to attract carriers into the system. However, between three shippers, they are able to reach a critical size of physical delivery and transaction volume for the marketplace. Given the size of both financial and time investment, it is important for companies to be able to protect themselves against the risk of failure. The co-ownership ensures the even spread of investment and risks. The alignment between shippers also ensures an affordable access to superior technology. In this case, it is the real time tracking and tracing feature enabled by sophisticated wireless communication, telematics and web technologies.

Motive Type	*Motivation factor for Case E ELM participation*	*Case E*				
		S1	S2	C1	C2	C3
Economic	Maintain control of order-to-delivery process	•	•			
	Productivity and efficiency improvement via process automation, improved visibility and quick information exchange	•	•	•	•	•
	Resource utilisation and cost reduction e.g. via effective scheduling and routing	•	•		•	•
	Secure market competitiveness	•	•	•	•	•
	*Pool of complementary resources	•	•			
	*Reach a critical size ('critical mass')	•	•			
	*Network optimisation, economy of scale and scope of logistics operations	•	•			
	*Risk, infrastructure and expenses sharing	•	•			
	* Access to superior technology	•	•			
Relational	Reduce uncertainties and opportunism in the supply chain	•	•	•	•	•
	Desire to coordinate and collaborate in exchanging information and conducting transactions	•	•	•	•	•
	Build strong bond to 'lock in' key partners, or seek greater commitment	•	•			
	Eliminate communication complexities	•	•	•	•	•
Service	Delivery performance and customer service improvement, as well as lead time reduction	•	•	•	•	•
	Reliability and responsiveness via improved flexibility and adaptability	•	•	•	•	•
	Uniform visibility of pipeline information across companies	•	•			
	Real time communication and visibility	•	•		•	•
	Information richness leads to continuous improvement	•	•		•	•
	*Ability to comply with strict customer requirement	•	•	•	•	•
Community	Knowledge sharing and market intelligence gains	•	•			
	Desire to impact on an industry sector as a whole, and promote industry specific standards	•	•			

Key: S1 = Shipper 1, S2 = Shipper 2, C1 = Carrier 1, C2 = Carrier 2, C3 = Carrier 3

Table 7.2 Summary of Case E motivations
(Source: Author)

The second cluster relates to companies retaining control, having access to complementary resources, and network optimisation. As all the three manufacturers have totally outsourced their transport to their third party logistics providers (i.e. carriers), it is important for them to retain their control of deliveries given transport is such an important element in customer service and supply chain cost. This need is further enhanced by the current challenges/trends facing transport and logistics management in the FMCG industry. These trends have had a great impact on the supply chain observed both through this research and from previous studies, for example:

- Centralised manufacturing: while companies enjoy lower sourcing and production cost, logistics management suffers from higher transport costs, longer lead times, less flexibilities, and stiffer inventory requirements (Hoek, 1997; Lee, 2004).
- Increasing demand for delivery excellence from customers: the FMCG industry is one typical example of this. The introduction of Efficient Consumer Response (ECR) and Continuous Replenishment (CR) practices lead to smaller and more frequent orders (Kurnia and Johnston, 2003). The introduction of shelf-ready packages, the emergence of new distribution channels (e.g. convenience delivery), and increasing demand for on-time delivery with rigid delivery windows all exert significant pressure on delivery management (Wang *et al.*, 2007).
- Introduction of Factory Gate Pricing: since 2000, there has been a growth in Factory Gate Pricing, which has seen FMCG retailers take control of their inbound networks (Potter *et al.*, 2007). This has put greater pressure on suppliers to reduce transport costs. Network collaboration consequently enables further efficiencies and control of this distribution network remains with the supplier, i.e. the manufacturers.
- Promotions: promotions introduced by manufacturers or by retailers are one of the major reasons for the peaks and troughs of transport demand, and these also put pressures of warehouse and transport planning and operations (Gottorna, 1998).

Under such conditions, inefficient transport operations are common problems facing many companies. Giannopoulos (2004) indicates that greater potentials lie in economically organised networks, and a multitude of coordinated transport operations. Shippers should look beyond their own supply chains, and try to identify synergies between them to achieve both economy of scale and scope in transport management.

To cope with the aforementioned issues and challenges in a dynamic environment, the need to proactively rather than reactively manage all necessary logistics provision and execution has become more urgent than before. The shippers in Case E felt there to be an urgent need to streamline their logistics activities, have complete visibility of real time information for decision making and build flexible system configuration and connectivity with different business partners to explore potential synergies. Only by doing so could they be able to deliver economically customised solutions and meet the diverse demands of customers. In this case, collaborative ELM is seen as one of the potential business models to fulfil such needs. However, given the potential conflicts between shippers, the complex information flows to/from the ELM, and lack of mature collaborative ELM business models in practice to use as benchmark, it is important for shippers to work together to utilise each company's resources and expertise in logistics and IT management for successful adoption of an ELM and its subsequent diffusion.

There is a close link between the relational and service motives. The key factor with relational motives is to provide accurate and timely information both to the shipper and the relevant transport providers. This information can then be used to respond to the impact of uncertainty within the supply chain, as this is the key to maintaining customer service. The ability to deliver the correct products on time and in full is critical in the FMCG supply chain, as the suppliers are often subject to stiff penalties if they fail to achieve this (Towill, 2005). However, there is often conflict between shipper and retailer in terms of delivery performance. On many occasions, they do not agree with each other regarding whether a particular delivery is on time or not. Further, in order to gain higher delivery on time performance, game playing behaviours have been found on the carrier's side in that transport managers sometimes try to manipulate the delivery data in order to reach a higher performance target. This was confirmed during interviews with the transport manager from Shipper 1. Even the key account manager from Carrier 1 admitted that this issue seems to be common in the UK's freight transport sector. Hence, there is a need to have a neutral fact of delivery status, where every party can have the same and parallel visibility of all deliveries. Accordingly, while accurate information can be used in real time to maintain service levels, once archived it can be used to deal with any disputes that may arise as to whether a load has been received on time or not.

Finally, there are the community motives for adopting a collaborative ELM. By sharing knowledge, shippers may be able to achieve competitive advantage in terms of better understanding of market intelligence and industry dynamics as a whole. The final motive particularly reflects the technology provider's reason for becoming involved. By attracting a significant volume of companies to use the system, the technology provider can attempt to make ELM requirements standard across the industry sector.

From the carriers' perspective, there are fewer motives to get involved, as in other types of ELMs discussed in Chapter 6. The most common motivational factor across the three carriers is related to 'relational motive', that is to maintain a good relationship with shippers so that they can win contracts in the future. If carriers are capable of participation in the case ELM, this capability is considered an 'order qualifier'. It will help them to gain contracts from shippers. Without this capability, they will most likely fail in any future tendering process. The second common motive across the three carriers is seeking economic gains.

While all carriers see the potential of case ELM in simplifying communication processes and hence improving operation efficiencies, there are different perceptions towards 'resource utilisation and cost saving'. The research found the different perceptions were largely influenced by a company's culture and attitude towards the use of advanced e-business technologies. Carrier 2 was very positive towards the use of the ELM case, because it had already experienced the cost saving benefits real time tracing and tracking can bring to logistics operation. It had installed a similar system within its own operation 3 years earlier before the case ELM project was initiated. According to the operations manager, they had achieved half a million pounds cost saving through the better utilisation of drivers, and reduction in administration work and insurance cost. The use of various other in-house systems to manage day-to-day operations reflected Carrier 2's strategy and attitude towards leveraging e-business technology for better efficiencies.

Carrier 1, on the other hand, did not consider cost saving and resource utilisation motives for using the ELM. Because Carrier 1 is consisted of small hauliers and only served one of the three shippers, there were less economic incentives for it to use the marketplace. A direct quote from its operations director reflected the company's mindset: 'I would rather invest in buying new trucks than use the ELM system".

Despite the fact that it was one of the biggest independent hauliers in the UK and served all three shippers, Carrier 3 was quite conservative towards the use of ELM. However, in order to remain competitive in the long term, it took this ELM initiative very seriously. The operations director and IT manager had visited two large haulage companies in the US together with representatives from Shipper 2, in order to understand the potential benefits for the company. After the visit, the management team thought that participation in the case ELM project would not bring short-term gains, as they did not view the real time tracing and tracking function as necessary for deliveries within the UK. The operation director commented, "US hauliers can benefit from real time tracking because they have a large geographical coverage and it takes days to complete a delivery. So it is important to know where consignments are. But this might not be the case in the UK as most deliveries can be done within a day." The conservative mindset was also reflected by the fact that Carrier 3 still manually scheduled all deliveries, even though it handled a huge volume of deliveries with various shippers. However, Carrier 3 did believe that the case ELM system could bring longer-term benefits to the company.

7.4.2 Resources

Shippers do not need to invest in the system infrastructure, as this is borne by the technology provider. This ELM adopts a PAYG pricing model, in other words, the shipper will pay per consignment. Annual consignments for individual shippers vary between 100,000 to 150,000 trips. It costs each shipper around £30,000 per year for running costs. In addition, for shippers, the ELM is a stand-alone system, hence there is no need for direct system integration with in-house enterprise systems at the initial stage. The browser-based access also means that a low level of training is sufficient before customer service staff can use the system.

As regards carriers, there is no charge for them to use the ELM, and a linkage with their in-house systems can be developed free of charge as well. Small carriers can manually input scheduled delivery information using the browser-based access. However, they need to buy telematics equipment to fit onto vehicles. Once the vehicles are tagged, the real time tracking and tracing function can be enabled. Where a carrier has already installed this equipment, all which is required is a link to the

ELM. But for those carriers who do not have telematics fitted to their vehicles, this means investing, and the unit price per vehicle ranges from £300 to £600. The study found this to be the major barrier for carriers to join the ELM. The running costs of downloading the data vary, since they depend on data volume and transmission method. According to both the technology provider and carriers, the data transmission costs around £10 per month per tag. For a carrier with 250 trucks, it would cost around £30,000 per year. Therefore, the running cost is also a considerable figure for carriers. Training drivers on how to use telematics was also considered a barrier by carriers, as drivers may be reluctant to learn and feel under threat of being watched.

The set up cost is the biggest investment for the technology provider. Major effort has been put into the project for software development. Once the system is alive, there will be incremental maintenance cost. In the case example, the technology provider developed the ELM using spare capacity within its existing infrastructure (such as server/databases). Further investment may be needed if the transaction volume exceeds current capacity in the future.

7.4.3 Project implementation

Process

A simple overview of the whole process is presented in Figure 7.3. The transport scheduler from each carrier uploads the daily delivery schedule onto the ELM, either manually or automatically, via a transport management system. The schedule will contain the details of each consignment, such as collection location and time, delivery point and time, and vehicle number. Each consignment has a unique reference number for the ELM to monitor its status. Once uploaded, the tracking and tracing starts to function. A Global Positioning System (GPS) tracks the motion of the vehicle (for example, every five or fifteen minutes) by sending out radio wave signals. The telematics kit fitted on the vehicle collects the latitude and longitude data from the GPS, which it then passes via a mobile communication network to the ELM for further processing. The positional data is then displayed on the ELM website using computerised mapping software. The system displays the status of each consignment through a colour coding method. It predicts and highlights any delays or exceptions.

This is achieved by setting up a geo-fence in the system around the point of collection and/or point of delivery. A geo-fence can be regarded as a "virtual boundary" that triggers an alarm or signal when crossed by a vehicle. For example, when a vehicle crosses the geo-fence when arriving at the point of delivery, the time is recorded as the real arrival time. This is then compared against the scheduled time to indicate whether this delivery is on time or not. By defining a geo-fence around the area, a user-defined alert can be set up and will automatically be sent to the relevant person via email or SMS. Finally, the system produces performance reports like punctuality and turnaround time for management use.

There is great potential to use the ELM for joint scheduling and deliveries, or identifying the back haulage opportunities, either by carriers or shippers. However, currently the case ELM deploys only three basic functions: real time tracking and tracing, exception alerts and performance reports. In the future, according to project managers from Shipper 1 and Shipper 2, more advanced functions may be added if current functionality sustains performance and fulfils different participants' needs.

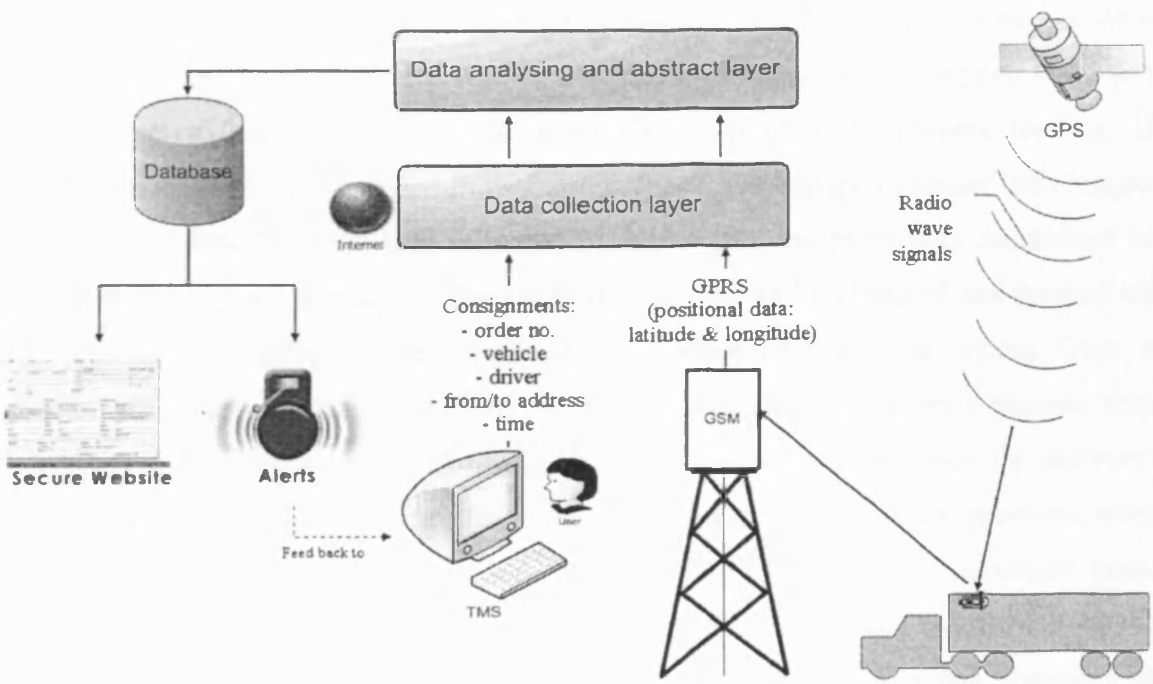
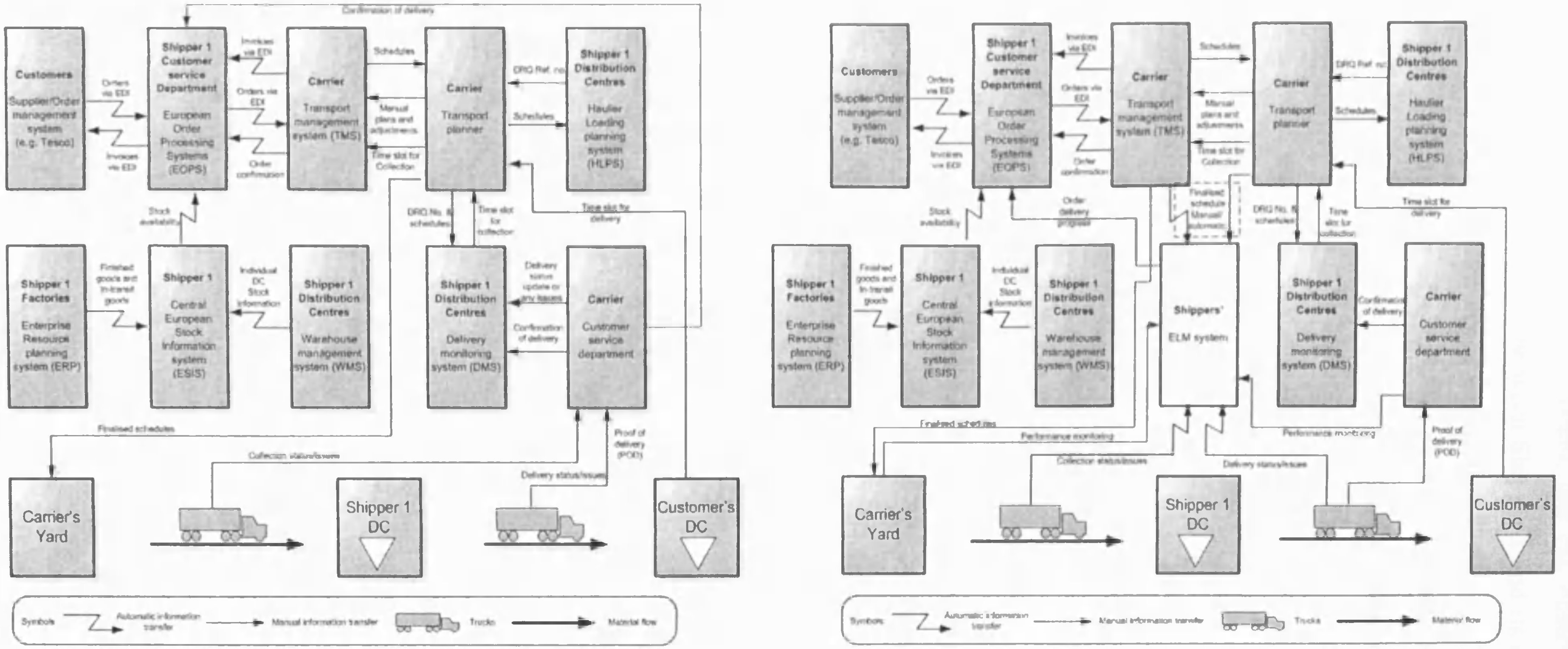


Figure 7.3 Simplified schematic overview of the case ELM
(Source: Author)

The exchange of information flows between shipper and carrier can be seen in Figure 7.4. This diagram is based on the process mapping conducted with Shipper 1 and Carriers 1, 2 and 3. As the information flows between shipper 1 and the three carriers are largely the same, the 'carrier' in the diagram represents all three carriers. Diagram 7.4a shows the information flows between shipper and carrier before introduction of the ELM system, while diagram 7.4b shows the post-ELM information flows.

Before the introduction of the ELM system, orders from customers were received by Shipper 1 via the EDI system. The orders were then passed on by Shipper 1's customer service to the related carrier for delivery after checking inventory availability through various in-house systems (i.e. ERP, ESIS and WMS as shown in the diagram). Upon the receipt of delivery orders, the carrier would schedule the deliveries (either manually or using optimised scheduling module in the transport management system). The transport planner would also need to log into Shipper 1's 'Haulage load planning system (HLPS) to get a Delivery Request Quotation (DRQ) number. The planner from the carrier logged into a depot and inputted the schedule for an order or some orders, then obtained a DRQ number. Using this DRQ number, the transport planner then fed it back to Shipper 1's 'Delivery monitoring system (DMS)' in order to book a time slot for pickup. In the meantime, Shipper 1's depot would receive the detailed schedule from HLPS in order to prepare loading. If products needed to be picked up from another depot, the carrier's planner then logged into another depot's HLPS and followed the same process previously mentioned to get a DRQ number...and so on. The DRQ number had to be obtained and marked on the jobs sent to hauliers, otherwise trucks could not be loaded at depots. Once a pickup time had been obtained from the shipper's DMS, the carrier's planner also needed to phone the customer concerned in order to book a time slot for delivery. Otherwise, the products may not be received by the customer. Next, products were loaded onto the trucks. The DMS recorded the time of arrival and departure time. Once the trucks had left the shipper's depot, both Shipper 1 and the carrier would have to totally rely on drivers to update the delivery progress and update Shipper 1 in the case of any unexpected occurrences or delays. Proof of Delivery (POD) was obtained from the drivers by the customer service department and used to confirm with Shipper 1 and for future invoicing use as well.



(a) (b)

Figure 7.4 a&b Information flows between shippers and carriers pre- and post- ELM
(Source: Author)

After the introduction of the ELM system, one can observe from Figure 7.4b no change in the information flows between Shipper 1 and its customers. The transport planner from the carrier still needs to use the HLPS and DMS to obtain the DRQ number and book a pickup time slot. However, a major difference is that both Shipper 1 and the carrier's customer service and operations management departments can now have real time information on each consignment at the same time. Previously, in the case of a delay, the following sequence was usually followed to check a specific consignment's delivery progress:

> Customer (request) → Shipper 1's customer service department (request) → Carrier's customer service department (request)→ Drivers (feedback) → Carrier's customer service department (feedback) → Shipper 1's customer service department (feedback) → Customer.

The use of the ELM system reduces the tracking time by providing uniform visibility to both parties. Drivers no longer need to spend time on phone calls to inform the carrier's customer service staff where the consignment is, and whether it is going to be late. Use of the ELM system also means that Shipper 1 now has much greater control of deliveries than it did before, which helps to improve its service to its customers. The sequence is now:

> Customer (request) → Shipper 1's customer service department (access ELM system) → Customer service department (feedback) → Customer

Relationships

Through implementation of the collaborative ELM, there is now a high level of horizontal collaboration between shippers. Enabled by the common interests between the shippers, the three shippers started to work together in order to pull carriers into the system. Their collaboration is focused on the share of infrastructures, as well as sharing a certain level of information, such as customer and carrier details, delivery volume, frequency and locations. Though data transparency is improved, there is still a strict boundary between shippers to protect commercially sensitive information. Each shipper only has visibility of its own consignments and so do carriers. There is also the potential for horizontal collaboration between carriers, for example, carriers can identify back haulage traffic flows within their operating areas. They can also use each other's capacity to satisfy the peak and trough demands in their daily operation. However, such activities are still limited, and occur at an ad hoc level.

The ELM has affected the relationship between shippers and carriers. While a number of benefits exist for carriers, such as increased volumes, better control of vehicles, improved visibility, and reduced administration, many carriers feel they are being forced into the ELM. There is a need to provide real time information for the shippers in the marketplace and if they do not have compatible equipment, carriers may lose out in tendering for contracts. Therefore, investment is needed in telematics equipment, yet guarantees about volumes in the long-term are not available from shippers. Therefore, such investment has greater attached risk. At the later stage of the project's implementation, negative feedback from carriers was received by all three shippers. Shipper 2 realised this problem and decided to share part of the cost with their key carriers. The other two shippers did not display the same commitment, however, they extended the contract with their carriers to cover the piloting period before the next round of tendering. This reflected the fact that shippers are increasingly aware the importance of a collaborative relationship with their carriers, as "the development of a new carrier implies a lot of intangible costs, like spending a lot of time and effort in building up the relationship, getting the system connected and educating them (carriers) to understand our business culture and policy (Transport project manager from Shipper 2)".

Of the three carriers interviewed, one had already installed telematics equipment and the other two were in the process of installing it to become compliant. The split between users and non-users of telematics before the introduction of the case ELM system was consistent with that reported in a recent survey of UK transport companies which found that 33% were equipped with telematics (Freight Transport Association, 2004). There had been little impact of participating the case ELM on the relationship with the current telematics user, i.e. Carrier 2 (who operated 150 vehicles), as there had been no significant setup costs, just a change in the method by which data was transferred from text message to the General Packet Radio Service (GPRS). Of non-users, one company (Carrier 3) was large, with over 300 trucks, and the other was collective of small carriers (Carrier 1), usually with less than 50 trucks.

Through being forced to use the ELM, tension had been introduced into the relationship with the shipper in both cases. The large carrier had to equip all vehicles, even though they might not regularly be used on flows under the control of the ELM, so as to maintain flexibility. This had had an impact on the return on investment they had achieved. The benefits for the smaller carrier beyond being involved in the ELM were less due to the size of fleet.

The change of dynamics between shippers and carriers was also examined indirectly during the interviews with the technology provider. The views interviewees from the technology provider held concurred with the findings derived from interviews with shippers and carriers. The technology provider therefore seemed to be able to provide an independent and objective perspective on the issues related to ELM adoption by both shippers and carriers and supported previous assumptions in Section 6.2, Chapter 6 that data collection mainly from technology provider was acceptable.

In addition to the reactions of carriers 1, 2 and 3, to the use of the ELM, the reactions of other carriers were examined indirectly, through an interview with Shipper 2's project manager. There were four more carriers which provided logistics services to Shipper 2. Each of the four carriers accounted for approximately 10% of Shipper 2's delivery volume. One of the carriers, according to the project manager, was very positive. It had developed a similar system a few years ago before this collaborative ELM was initiated, due to an understanding of the potential benefits such a system could bring to the company. It needed to integrate its current system with the ELM, but as Shipper 2 was willing to share the cost, there was not a big issue for it. Of the remaining three carriers, cost was still the biggest concern, but through fear of losing competitiveness, they decided to participate in the case ELM system.

In general, there were some negative feelings from carriers who were non-telematics users because of ELM implementation, but as the case project progressed, some issues were slowly being resolved and carriers were beginning to expect benefits in the long-term as the end of the pilot project approached. The change in relationship between carrier and shipper as a result of introducing a collaborative ELM is shown in Figure 7.5. Before the ELM project, the relationship between all three carriers with shippers was positive and at about the same level. During adoption of the ELM system, the dynamics between carriers and shippers changed. Carrier 1 became negative because it did not see sufficient benefit for it to join the system. Feeling as of being pushed towards the adoption, it thought shippers were 'arrogant (a comment from Carrier 1's operations director)'. After the adoption, the attitude seemed to revert to the previous positive level, mainly because it believed it would have to follow the actions of other carriers, or lose competitiveness. Carrier 3, after the benchmarking study in the US market, also became less positive since it thought that costs in the short-term would overtake the potential benefits. However, during the trial implementation, Carrier 3 realised that to remain competitive in the market in the longer-term, investment in a telematics system would be worthwhile. Hence, along with the progressed, it became more positive towards it. As regards Carrier 2, compared with Carriers 1 and 3, the relationship between itself and shippers remained relatively stable pre- and during-adoption. Because it had already equipped itself with a telematics system, it was in a better position to help shippers in the trial implementation. So a stronger positive relationship came into place because of its active involvement. Overall, this research's findings largely confirmed Yeates and Cadle's (1996) assertion that during an IS project implementation, a certain pattern of behaviours will appear; from denial, resistance, to exploration and gaining confidence.

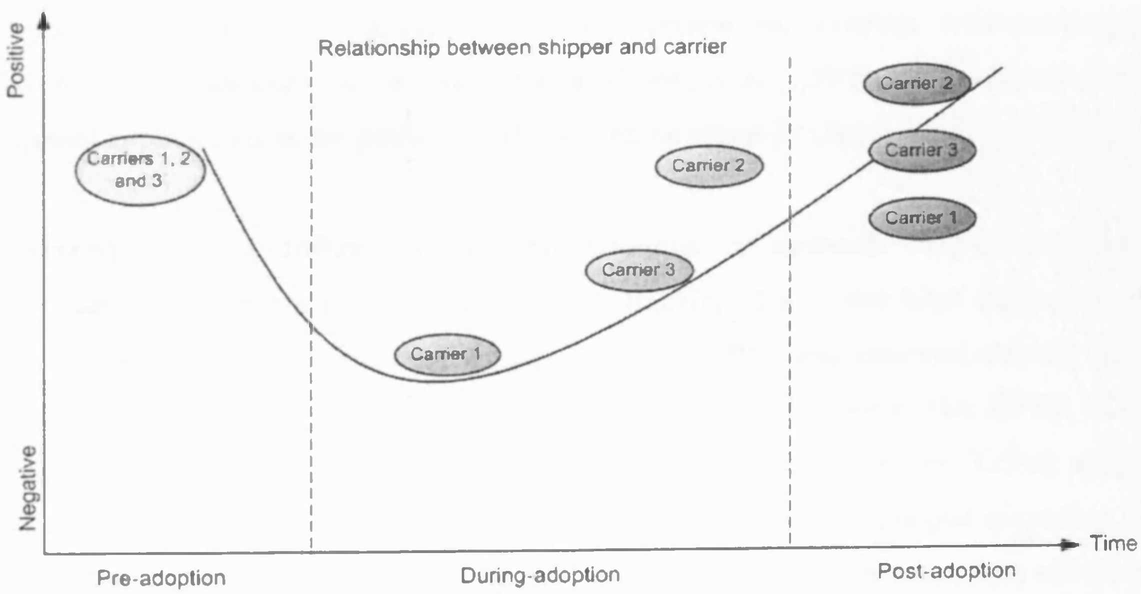


Figure 7.5 The change in relationship between carrier and shipper as a result of introducing a collaborative ELM
(Source: Author)

Technology

Since none of the shippers had sufficient technical expertise in-house, they decided to use a hosted solution, deploying the 'software as service' model. Shippers and carriers shared a single database and therefore the speed of communication was enhanced. The ELM technology provider hosted the system and was responsible for setting up different homepages for different parties. As discussed in Chapter 5, the hosted ELM has a number of advantages, including only requiring an internet connection and a browser to gain access to the system, no need to invest in server/database infrastructure, and very low fixed cost and usage-based variable costs (Lynch, 2005). Further, the research found that technology provider's technical and management capability largely influenced the project's progress. For instance, during trial implementation process, the technology provider was found unable to meet the deadline for reconfiguring the telematics system for Carrier 3, and communication was generally lacking with carriers until a problem occurred.

The majority of closed ELMs in the market only use retrospective tracking and tracing, real time tracking and tracing being a more advanced and expensive feature. Apart from the use of web technology, real time tracking and tracing requires wireless telecommunication technologies as well. Thus it is more complex and requires more technical expertise to manage. A detailed review of wireless communication deployment in industry can be found in Egea-Lopez *et al.*, (2005). An overview of its special applications in the transport industry can be found in Giannopoulos (2004).

Currently there are different wireless data transmission methods. Text messaging is popular but expensive for automatic vehicle tracking due to the high frequency of messages sent and the large data volume occurred. GPRS has emerged recently as a viable alternative and ahs been adopted in the case ELM project. The GPRS is an extension of the original global system for mobile communications (GSM) short-message service (SMS) (See, 2007). Unlike text messaging, it is charged according to the amount of data transmitted. Hence, it seems to be more flexible and cost effective than GSM, though depending on the frequency of transmissions. The GPRS also allows more information to be transmitted while the GSM is limited to 160 characters (See, 2007). Another disadvantage of using GSM SMS is that GSM channels are exclusively assigned to a single user, and charges even though a user does not have data to send. Designed mainly for voice calls, GSM has therefore been found inadequate for data transmissions in Case E ELM system where rich data information and more frequent transmissions are needed. In addition to GSM SMS, another traditional data transmission method is direct data call (known as DDC) which has been seen as a dated method of wireless data transmission. Differences between GSM, GPRS, and DDC are summarised in Table 7.3.

According to the technology provider, the cost per vehicle, if carefully controlled (for example, data amount does not exceed 234bytes per packet), can be under £2 pounds per month. As wireless communication technologies develop rapidly, it is possible that the transaction cost will become cheaper in the future. Real time communication in an ELM requires a high level of inter-operability. A central problem is that there has been a lack of data standards for information exchange. This ELM case system therefore offers valuable insights for the potential development of the industry specific data standards.

Wireless data transmission method	***Description***	***Features***
GPRS	• High speed packet data technology • Data speed increases to over 100kilobytes/second (kbps) • Multiple users can share same radio channel	• Always available • Low latency (delay) • Reliable • Charged by the amount of data
GSM-SMS	• Is limited to messages of 160 bytes in length at a speed of 9.6 kbps • Must have dedicated connections during entire call whether data sent or not	• Charged by the message • High cost for frequent messaging • High latency • Less reliable
DDC	• A direct call from one phone to another except that data is sent instead of voice messages.	• High latency • Very costly • Charged by the amount of time

Table 7.3 Summary of three main mobile communication data transmission methods
(Source: Author)

7.4.4 Impact

The above discussion had indicated that implementation of a collaborative ELM had largely changed the communication structure between shippers and carriers. Information exchange via a single platform had significantly reduced the complexity and fragmentation that had occurred in the traditional communication method. Theoretically it should be a win-win solution for both shippers and carriers. Shippers should now be able to enjoy the parallel visibility of the process of all deliveries, without the need to contact each carrier to find out delivery progress. The marketplace also provides factual delivery data for the preparation of payment to carriers. For carriers, the functionality facilitates a better control of vehicles, and improves fleet utilisation and customer service quality. However, as discussed previously, the benefit allocation is asymmetrical. The investment in telematics is a heavy burden for some carriers, especially the smaller ones. It had had a slow-down effect in exploiting the new opportunity and implementing the case ELM project. In order to incentivise carriers, two potential solutions would be: (i) that shippers provide more guaranteed volumes or contracts; (ii) to design more value-added functions that are sensitive to the needs of carriers, for example, add the real time traffic information into the system to help drivers avoid congestion via re-routing.

Customers of shippers (in the case example, retailers) can benefit from improved communication and customer service from shippers. Given that retailers exert great influence upstream of their supply chains, the three shippers had decided not to get their customers involved in the case ELM project to avoid any potential loss of power. This had made the direct collection of customers' reaction towards ELM impossible. However, an interview with Shipper 1's key account manager shed light on their reaction. Retailers generally held a neutral attitude towards involvement in the case ELM project, but welcomed the potential benefits the case ELM project might bring. For instance, improved delivery-on-time performance from carriers will lead to fewer disruptions at their depots and ensure a more seamless flow throughout to their stores.

The research also found that the shippers need to forge a closer partnership with carriers in order to facilitate a smooth and successful implementation of the case ELM system. This supports Zsidisin *et al.*'s (2007) finding that closer relationships between shippers and carriers can significantly influence carriers' willingness to commit assets to the shipper. The neutral assessment of delivery status will also help to avoid potential conflicts. The technology provider will profit from hosting the ELM by providing necessary infrastructure and maintaining the system. Based on the foregoing discussions, the costs and benefits for all participants are summarised in Table 7.4. Because it is difficult to predict future benefits, especially for carriers from using the case ELM system, the levels of costs and benefits are summarised based on the current status, rather than estimated future gains. A cost and benefit ratio is also given in order to highlight the different situation each party faces.

Costs and benefits / **Participants**		**Shippers**	**Carriers**	**Technology provider**	**Customers (receivers)**
Costs	Set up	o	ooo	ooo	None
	Running	oo	ooo	o	None
Benefits		ooo	oo	ooo	oo
Cost (C): Benefit (B) ratio		C<B	C>B	C<B	C<B
o = Low, oo = Medium, ooo = High					

Table 7.4 Cost and benefits summary – a collaborative ELM
(Source: Author)

Delivery performance

From October 2006, the case ELM project selected two carriers: Carrier 2 and Carrier 3, to monitor their deliveries via the system. Ten vehicles from Carrier 2 and 20 vehicles from Carrier 3 were equipped with GPRS telematics for trial purpose. By the end of June 2007, 1161 deliveries had been tracked in a 9-month period and their DOT performance and number of deliveries per month are calculated and are summarised in Figure 7.6.

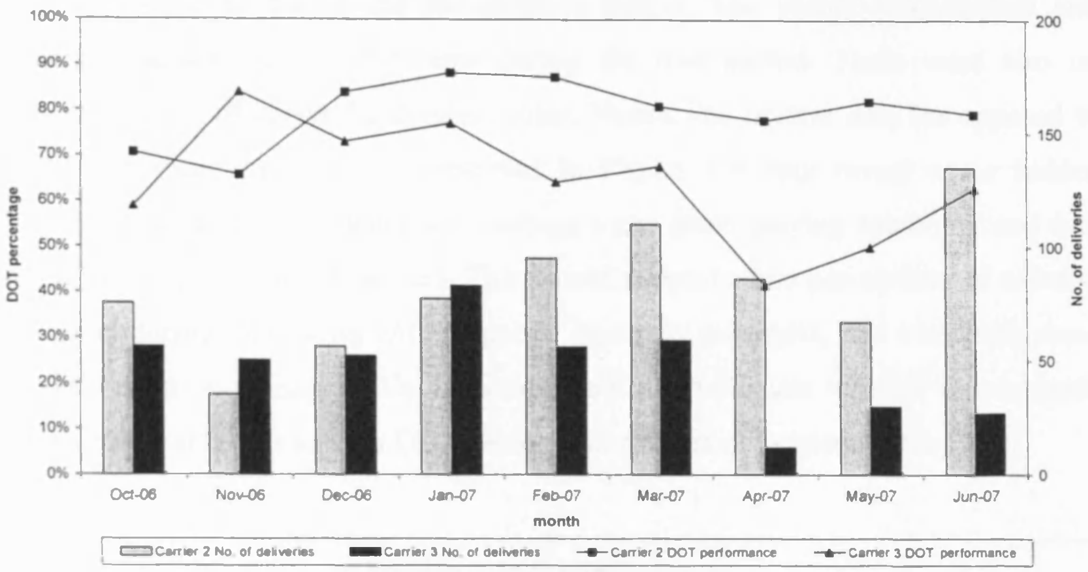


Figure 7.6 DOT performance of two carriers
(Source: Author)

Prior to the use of the ELM, both carriers' DOT performance had been consistently above 90% as confirmed by shippers and by carriers. For example, Figure 7.7 presents a 23-month delivery performance data between year 2005 and 2006 obtained from Carrier 2. It shows a consistent performance above 95%. However, interestingly, Figure 7.6 shows that during the trial, none of the carriers achieved the target level which they claimed to have achieved previously. The DOT performance target set by shippers for their carriers is usually between 90%-100%, which also reflects retailers' requirement of their shippers. Shippers have also introduced a bonus system to manage carriers. If a carrier's performance falls in the target range, it will earn up to an extra 4% of revenue as a bonus. Any performance between 80%-89% will need improvement. Performance below 80% is considered unacceptable. The performance gap revealed by Figures 7.6 and 7.7 is examined by first looking at whether there was a significant change of operating environment. For instance, questions addressed to carriers' operation managers included: was there any serious road maintenance work conducted during the data collection period; were there any changes of collection and delivery points; was there any change of transport operation procedures?

The findings suggested that although external factors like congestion could have impacted on performance, this was believed to be less significant because the operating environment and carriers' day-to-day operation procedure had remained largely the same as during the pre-adoption period. The points of collection and delivery were also largely the same during the trial period. There were also no frequent changes of driver for certain routes. Hence, the neutral data (as opposed to the data provided by carriers) presented in Figure 7.6 may reveal some hidden problems. It suggested that there was perhaps some game playing behaviour and data manipulation on the part of carriers. This would support some perceptions of existing DOT level during interviews with shippers' transport managers, and even with some carriers' operation managers. On the other hand, it challenges whether it is realistic for retailers or shippers to set a DOT performance target of between 90%-100%.

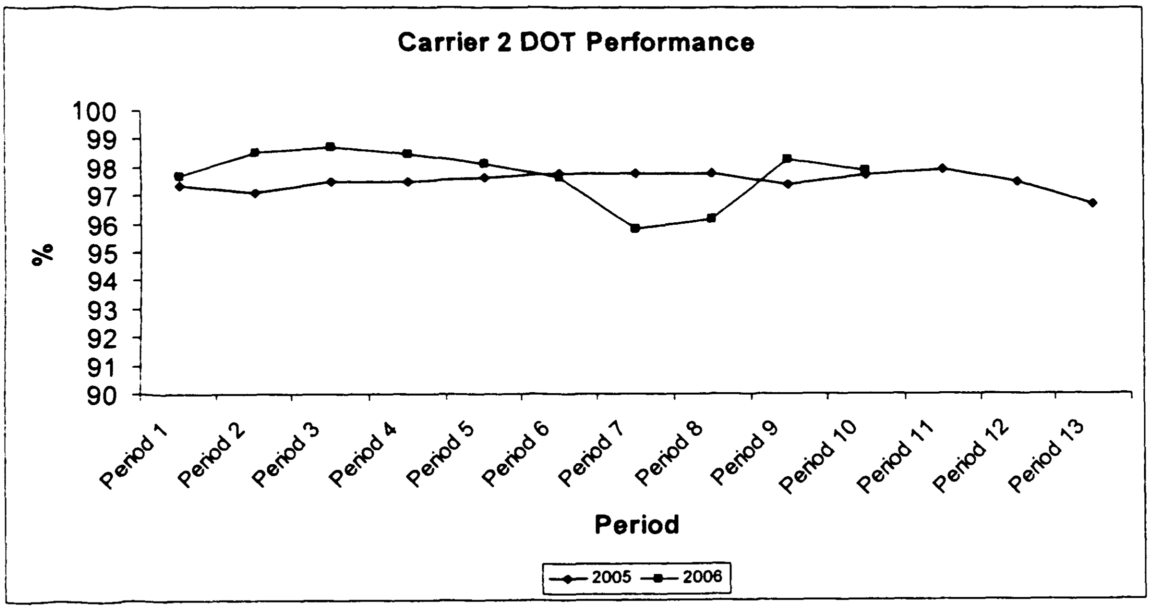


Figure 7.7 Carrier 2's own record of on-time delivery performance
(Source: Author)

Figure 7.6 also indicated that Carrier 2's performance was more consistent than that of Carrier 3, largely because Carrier 2 had already adopted the technology for several years which gave it more technical advantages. Carrier 3 had struggled during the adoption period, due to its lack of knowledge of the system and partly because not all of its 20 vehicles selected for trial purpose were used consistently during trial period. The data collected indicated that only one vehicle had been consistently used across the 9-month trial period. The frequent change of vehicles may also have influenced the delivery performance as more variability was introduced. The trend of Carrier 3's performance also coincided with the attitudinal and relationship change shown in

Figure 7.5 and may have reflected the conservative and sometimes negative perception of the ELM model observed during the interview process.

7.5 Pre-Conditions and evolutionary path

Based on the case findings discussed in previous sections, the author is able to identify a number of necessary conditions for successful implementation of a collaborative ELM model and its subsequent sustainability in the future. Table 7.5 summarises those conditions.

Aspects	*Necessary conditions*
Driving forces	• Market driven • Appropriate value propositions: operational fitness and values to all different parties need investigation. • Strong leadership and project management
Economic	• Critical mass: without this, the model cannot be sustained in the long term. • Cost and benefits symmetry: asymmetry can lead to reluctance of participation, and prohibit the adoption. • Appropriate pricing structure
Technical	• Standardisation and compatibility: basic standards are essential for interoperability. • Data security: is critical for Internet-based systems. • Shippers' ICT ability and readiness: this determines whether to build in-house or outsource. • Carriers' ICT ability and readiness: if carriers are not ready, progress can be delayed or even lead to failure. • In-house or hosted solution: the choice needs careful examination. • Third party technology provider's capability: the more complex the functions, the more important is the capability.
Relationship	• Clear definition of boundaries and data transparency • Open and trusting: power can play a significant role and sometimes even have a detrimental effect on the relationship. • Incentives to join: shippers pull in carriers
Process	• Functionality should be determined by the business needs. • Vision of long-term business needs: ensure future needs can be easily incorporated into the present ELM business model.

Table 7.5 Pre-conditions for successful implementation of a collaborative ELM
(Source: Author)

Pressure for improved supply chain performance stimulates the creation of a collaborative ELM. This is driven largely by market needs. The value proposition to the users of the ELM should be developed in alignment with the different needs and wants of all participating companies. As the collaborative ELM is normally led by shippers, it is naturally biased towards shippers' needs. However, it should take into consideration of other parties' requirements as well in order to break down any entry barriers and achieve both economies of scale and scope. Strong leadership and project management is essential to ensure the successful development and diffusion of such a business model.

With regard to the economic aspects, a critical mass for transaction volume has to be secured in order to justify the investment. With an appropriate pricing structure, an ELM can achieve organic growth in the long-term. As indicated previously, it is very important to fairly allocate costs and benefits between shippers and carriers.

Technically, the Internet-based and hosted solution provides low fixed set up cost and ease of use. However, basic standards should be developed in order to ensure interoperability and communication between different parties. Both shippers' and carriers' information and communication technology ability can influence the creation and adoption of an ELM, and can lead to the decision as to whether to develop an in-house system or use a hosted one. The expertise of a third party technology provider is a key success factor to develop tailor-made systems based on the specific needs of users.

As regards relationship issues, shippers should strive to 'pull' rather than 'push' their carriers towards their ELM. An ELM can only succeed if it is a high value system for both parties. Network optimisation needs a change of mindset of participating shippers and increased information sharing between them. Current functionality design of a collaborative ELM should incorporate the vision of future business needs, so that adding functions or modifying existing processes can be easily done.

The research also revealed that because of the limited functionality the case ELM currently offers and the rigid boundary between shippers, transport optimisation efforts are focused solely on each shipper's own supply chains. Until shippers find a way of removing the boundaries to network optimisation, the full potential of the collaborative marketplace cannot be realised. Currently, shippers are not enthusiastic about exploring this horizontal collaboration. Major reasons are that shippers do not want sensitive information like transport rate to be known by others, the complexities involved, uncertainty of savings, and the fear of potential competition.

However due to the characteristics of a collaborative ELM, it is possible to realise the potential for network optimisation in the future as follows:

- Common interests or issues should serve as the backbone for shippers to look for opportunities beyond their own boundaries, as some of the issues cannot be resolved by individual shipper alone. For example, all companies may face difficulties with deliveries to urban areas or retailers' new store formats. As shippers usually do not compete directly with each other, there is less threat and no direct conflicts between them. This means that joint activities can be done under careful management.
- The dynamic market and continuous pressure on supply chain efficiency are the driving forces behind the development of a collaborative ELM. Accordingly, there is a large incentive for shippers to work together in order to reduce the negative impact which transport brings to the environment. It needs to be pointed out that although the specific environmental implications are not identified in either the literature or case example, there are increasing concerns in this area as observed from the study of ELM Case E. Such concerns can be one of the big drivers in the adoption of a collaborative ELM.
- The complementary flows between shippers can generate joint benefits. Shippers can share the carriage and reduce the cost of transportation. For example, a shipper in Ireland finds it not cost effective to ship goods to England, while a shipper in England may find itself in need of a backhaul opportunity after its delivery to Ireland. By identifying the synergies, shippers can negotiate a better rate with their carriers or do it more efficiently by themselves. The what-if analysis of each individual shipper's delivery profile can also help to identify the triangulation (multi-lane links) opportunity. This may lead to the redesign of the distribution network, for example, the setting up a new distribution centre.

In order to achieve network optimisation, the ELM will have to go through a number of evolutionary stages. Like any business systems (re) engineering activity, a systematic approach needs to be adopted in order to gradually build up the system while minimizing the interruptions caused by changes to the current operation (Huang *et al.*, 2001). A three-stage evolutionary path is developed as shown in Figure 7.8. A step-by-step move towards the advance stage is more likely to succeed than direct adoption of Stage III given the broad scope involved and complexities of streamlining intra- and inter-company processes.

- *Stage I*: First, the case ELM needs to sustain the current business model. The objective is to utilise the ELM for the effective management of each individual shipper's own logistics and transport processes.
- *Stage II*: More functionality can be added, such as order communication, transport planning, proof of delivery, and self billing. This mainly focuses on the increased vertical integration between shippers and carriers, emphasising the efficiency of communication and core logistics activities. Shippers may share more information, such as forecasts, with its carriers. Between shippers, there may be ad hoc collaborative activities such as joint deliveries at peak demand (say, Christmas) when there is a shortage of transport supply.
- *Stage III*: the collaboration between shippers will be the more value added partnership at the strategic level. Full information sharing and visibility will enable the collaborative design of supply chains, and joint delivery scheduling and execution. Vertical collaboration between a shipper and its carriers will be at a high level as well. At this stage, carriers may get more involved in the shipper's supply chain and help to identify continuous improvement opportunities or totally redesign the order-to-delivery process, and have a similar role like a 4PL. It needs to be pointed out that as the collaborative ELM is usually biased towards shippers, it provides very limited space for potential horizontal collaboration between carriers. The author has not witnessed a collaborative ELM created by a group of carriers yet. But it could happen in the future.

Stage I (current stage)	Stage II	Stage III
ELM Limited functionality	**ELM** Extended functionality	**ELM** Full functionality
S-S • Sharing of ELM infrastructure and expenses • Limited information sharing and visibility **S-C** • Transactional integration • Limited information sharing and visibility	**S-S** • Improved information sharing and visibility • Ad hoc collaborative activities **S-C** • Operational integration • Improved information sharing and visibility	**S-S** • High level of information sharing and visibility • Strategic collaborative activities **S-C** • Strategic integration • High level of information sharing and visibility

S-S: collaboration between shippers; S-C: collaboration between shipper and carrier

Figure 7.8 Predicted evolutionary path for a collaborative ELM model
(Source: Author)

7.6 Discussion

Through the case study, in-depth insights have been gained into a collaborative ELM. By having a common system across supply chains, the complexity of communication is reduced. Technically, this type of ELM is often quite adaptable, making it easier to introduce extra members. Because a closed ELM is usually highly customised and has sophisticated functions, using a hosted solution is more likely in practice. Shippers normally do not have such capability to develop it in house. By providing extensive visibility across multiple supply chains, a collaborative ELM has great advantages to enable network optmisation across companies.

This chapter has systematically provided the answers to RQ4 raised in Section 7.1 by exploring the four objectives outlined in Section 7.1. The research findings are summarised below:

Objective 1: to understand why companies form a collaborative ELM

There are a number of reasons why companies create a collaborative ELM. Comparing the case company's specific motives against the generic ones outlined in

Table 7.2, large commonalities have been found. The case example focused largely on the economic and service aspects, driven by market needs and pressures to improve transport and logistics efficiency.

Objective 2: to investigate how it has been implemented

Through the configurations of three key elements between companies, i.e. technology, process and relationship, the ELM can be materialised and implemented successfully. However there may be some issues with regard to relationship aspects if costs and benefits are not allocated equally between shippers and carriers.

Objective 3: to examine the impacts it brings to the supply chain

Overall, the impacts on the supply chain are positive. The communication complexity between different parties is largely reduced. The streamlining of business processes between shippers and carriers improves the information visibility and order-to-delivery process efficiency. A collaborative ELM also has the potential to enable network optimisation across companies.

Objective 4: to predict the necessary conditions for successful implementation

Key pre-requisites have been highlighted in Section 7.5 in the light of research findings. Because of the complexities and the broad scope involved, a collaborative ELM will have to go through a number of evolutionary stages to achieve network optimisation. Despite having the opportunity to optimise across supply chains, most optimisation is still for individual supply chains. There is a long way to go before the full potential can be realised.

Firms should be aware that the introduction of an ELM can change the way organisations operate. Their interaction with other firms requires the integration of various functional areas within and between organisations. The participating companies of a collaborative ELM should jointly develop performance objectives and measures to guide their relationship. Otherwise disputes may not be resolved and the ELM model cannot be sustained.

7.7 Summary

The research has revealed that the 'collaborative ELM' is still in its infancy stage. It has potential for growth in optimising supply chain networks and enabling not only vertical collaboration between shippers and carriers but also horizontal collaboration between shippers and/or between carriers. The study has identified the motives behind a collaborative ELM, and demonstrated how such a system is implemented through the configurations of information system, process and collaborative arrangements. The impacts on the different participating parties have also been examined. Finally, the necessary conditions for successful implementation of a collaborative ELM and the number of evolutionary stages it will have to go through to achieve network optimisation have been identified through the research findings.

Chapter 8 Discussion and Conclusion

8.1 Chapter overview

This chapter first summarises the research findings. The research's original contributions to the extant literature are highlighted and the study limitations are identified. Finally, areas for future research are proposed and practical implications of the study findings are discussed. This chapter concludes the thesis (Figure 8.1).

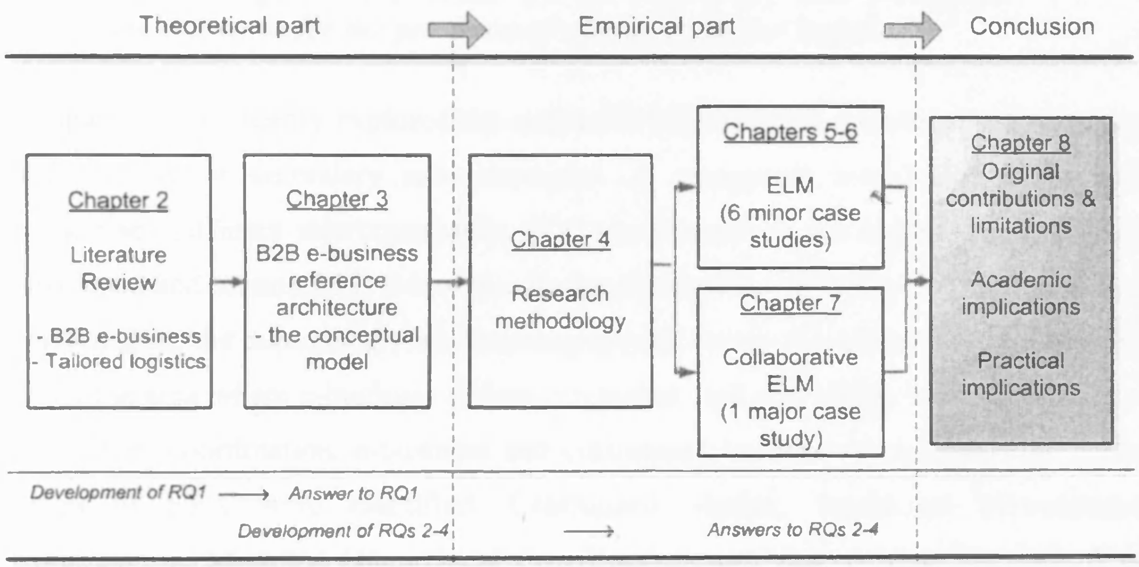


Figure 8.1 Thesis structure – discussion and conclusion
(Source: Author)

8.2 Summary of research findings

Many research studies have focused on e-business application to transport and logistics management, especially with regards to ERP system and EDI adoption (Lewis, 2001; McLaren *et al.*, 2002; Akkermans *et al.*, 2003; Botta-Genoulaz *et al.*, 2005; Thomas, 2003; Kosanke, 2005). With the rapid advances in web technologies, B2B e-business connectivity has become more flexible and less costly. This has led to a variety of emerging IOSs to co-exist in logistics practice. However, such technical advances have also created complexities and difficulties for organisations in determining what form of electronic linkage and relationship configuration should be forged with what kind of business partner(s). While there is a rich literature exploring the impact of different B2B e-business systems in practice, no study has attempted to address this issue. At the same time, logistics management has evolved from the traditional one-size-fits-all approach to tailored logistics, in order to meet the different needs of different customers. Some request more customised logistics provisions, while others' need is fairly simple. This requires a careful design of information flow within and in particular between companies. There is therefore a critical need to have an overall e-business architecture which can govern and specify the different ICC mechanisms for different logistics scenarios. This led to the development of Research Question 1:

> ***Research Question 1: What are the supporting B2B e-business architectures for the provision of effective tailored logistics?***

Chapter 3 subsequently explored the answer to RQ1 through a synthesis of literature and the use of secondary case examples. A conceptual model that traces and categorises different interorganisation ICC mechanisms in the logistics domain was developed and termed B2B E-business Reference Architecture (ERA). The model was derived from the automated manufacturing system design discipline mainly due to its being the area where e-business system originated, and also taking into consideration ideas from coordination, e-business and customised logistics disciplines. Four basic forms of ERA were identified: Centralised Market, Traditional Hierarchical Coordination, Modified Hierarchical Coordination, and Heterarchical Network. The advantages and disadvantages of each form were defined. Under Centralised Market structure, companies are coordinated by market using bidding and pricing mechanism with little collaborative relationship in place. Traditional and Modified Hierarchical coordination structures use authority and contract based procedures to coordinate, which implies there is usually a fixed structure and process between organisations. The difference between these two structures is that the former focuses largely on vertical integration, while horizontal collaboration is introduced in the latter. Utilising the Internet as a neutral platform, the Heterarchical Network emerged, emphasising a greater level of horizontal collaboration, and coordination is achieved by aligned common interests rather than via pricing or authority based mechanisms. The Heterarchical Network structure is seen to have greatest potential in enabling network optimisation beyond a company's own supply chains.

The characteristics of the four basic forms of B2B ERA were further aligned to the three tailored logistics streams being identified in Chapter 2: routine, standard, and customised. 'Centralised Market' form corresponds to 'routine' logistics, emphasising a loose relationship between shipper and carrier, and is largely price driven. 'Traditional Hierarchical Coordination' form corresponds to 'standard' logistics, where a rigid structural relationship between shipper and carrier is in place. The 'Modified Hierarchical Coordination' form eases the rigidity in the Traditional Hierarchical Coordination form and enables potential horizontal collaborative activities between shippers and carriers. It can also support a wider range of activities to be conducted between companies. It thus corresponds to 'customised logistics'. However, under this type, horizontal collaboration happens at a limited level, because it is still constrained by its embedded fixed structure of interorganisation connectivity. In order to differentiate the 'Modified Hierarchical Coordination' form from the 'Heterarchical Network' form, where proactive horizontal collaborations exist between companies, the logistics type under 'Modified Hierarchical Coordination' form is termed as 'customised logistics type I' while that under the 'Heterarchical Network' form is termed 'customised logistics type II'. Logistics provisions enabled by the Heterarchical Network form not only focus on execution, companies start to align together horizontally, and explore strategic benefits from synergies between shippers, and/or between carriers. Secondary case examples in the literature were then used in Chapter 3 to showcase the different architectures proposed.

Following development of the B2B ERA model, Chapter 3 also identified the gaps in the study of ELMs, in particular closed ELMs, which provided the opportunity to substantiate the aforementioned model and also gain in-depth insights into the closed ELM. Despite the wealth of literature on e-marketplaces, research on electronic logistics and/or transport marketplaces, is scarce. To some extent, this reflects the immaturity of closed ELM development. However, enabled by rapid developments in ICT, the use of ELMs has grown and exerted significant influence over the way transport and logistics is managed and the supply chain is structured. There is thus a pressing need for both academics and practitioners to understand how such business models can support logistics management. This led to the development of the remaining research questions: Research Questions 2-4.

Chapter 4 discussed the research methodology. While the positivistic approach dominates both logistics and e-business disciplines, the author argued that different types of research problems require different solutions in terms of research approach and choice of method. Therefore, taking into consideration the nature of the research questions raised in this research, an exploratory multiple-case study approach was viewed as particularly suitable for investigating the emerging ELM business model since such investigation would involve an in-depth study across multiple settings and different level of analysis. It would also enable an investigation of a contemporary phenomenon within its real life context. Issues related to case study research were also discussed, and the tactics adopted to deal with the issues were also presented. In total six case examples were selected, of which one case was used as a major case study, that of the Heterarchical Network type of ELM. Background information on the cases was presented, followed by a discussion of data collection and analysis techniques.

Chapter 5 focused on answering RQ2:

> ***RQ2. Of the different architectures, how does the closed ELM, as an emerging business model, function and enable the provision of tailored logistics?***

In this chapter, the operational models of three major closed ELM types were established and their impact on tailored logistics provision was examined. Three elements, namely, technology, collaboration and process, were used to structure the analysis process. A tailored logistics service provides an opportunity for a carrier to become an integral part of a shipper's business. Collaboration helps firms tailor service offerings to the specific requirements of customers by identifying their long-term requirements, expectations and preferences. This, in return, defines the scope of the process i.e. functionality of an ELM. Technology enables the desired process to be executed. Through the study of six ELM case examples, the basic foundation of a closed ELM was established. The research found that development of a closed ELM is largely shipper driven. Carriers are in a reactive rather than proactive position towards it. In terms of underlying structure, it is determined by the community leader (s)'s (mostly shipper's) strategic needs and objectives. Compared with open ELMs, the closed ones focus more on 'planning and execution', therefore, in most cases, transport rate has already been pre-defined. Operational scope varies, which is again determined by the community leader's needs and objectives. A process model was developed (Figure 5.3) from standardising and summarising the functionalities existing across the six case ELMs. The three architectures, namely, Traditional Hierarchical Coordination, Modified Hierarchical Coordination and Heterarchical Network were then translated into an ELM-specific communication analogy (Figure 5.7) and named 'private', 'shared' and 'collaborative' marketplaces for reasons of simplicity. The ELM-specific communication analogy served as an *information* model and together with the *process* model (Figure 5.3), attempting to explain the developed B2B ERA model in more detail. Vertical collaboration in all three types of ELM was generally high, due to the nature of a closed ELM being support of long-term collaboration. Horizontal collaboration degree increased from private, to shared and collaborative ELMs. Although a private ELM is the most popular one in practice, the study found that use of hosted ELMs has gained in popularity, observed in both shared and private ELMs. In terms of functionality, the private ELM focuses largely on the transactional side of activities between shippers and carriers, hence supports 'standard' logistics. A shared ELM was found to support the extended scope of process. It has special advantages in supporting global logistics where import and export as well as financial settlement features are built in as value added services. Hence, it supports 'customised logistics (type I)'. A collaborative ELM is largely configured to meet the specific needs of a consortium group. Therefore, more advanced and specific requirements are usually incorporated. It thus supports 'customised logistics (type II). Overall, the study confirmed that different architectures coexist in practice, and they support different logistics streams. This was further confirmed by a classification analysis examining the alignment of attributes from tailored logistics with attributes of case example ELMs. This validated the B2B ERA model.

Chapter 6 explored the reasons for using an ELM within supply chains, adapting the four categories developed by Standing *et al.*, (2006). This answered RQ3.

> ***RQ3. What are the reasons for using a closed ELM within supply chains?***

Motivations, barriers, as well as cost and benefits were explored in order to understand fully the rationale for a closed ELM. Shippers were mainly driven by economic gains through the use of ELMs. Carriers, on the other hand, emphasised the relational side of benefits and tried to use it to maintain long-term collaboration with shippers. External environmental factors and market competitive pressures were also driving forces. Because of advances in technology, technical barriers were not found to be significant. Rather, the collaborative arrangement between shippers, and between shippers and carriers, as well as the asymmetry of cost/benefit allocation were found to be significant barriers if not managed carefully. Cost and benefits were largely associated with the functionality of individual ELMs. However, the study indicated that common benefits across the three types of ELM were mostly execution-related with more proactive management of order-to-delivery process, improved customer service, and process efficiency and cost savings. The cost of using an ELM included both the set up costs and running costs. The set up cost depended on the design of an individual ELM, whereas with regard to the running cost; companies could either use the traditional approach in buying the software licensing fee or deploy a PAYG pricing model. Each has its own advantages and disadvantages.

The findings reported in Chapter 6 also suggested that from a 'private ELM', to a 'shared ELM' to through to a 'collaborative ELM', the motive emphasis changed from economic motivations, to relational and service motivations towards service and community ones. Consequently, the benefits gained varied from mainly process efficiency and cost saving in a 'private ELM', to customer service and process efficiency in a 'shared ELM', and towards strategic gains of proactive management and service improvement in a 'collaborative ELM'. Most significant barriers were found to be collaborative barriers in 'collaborative ELMs', largely due to the complexities introduced by both horizontal and vertical activities between participating companies. For a shared ELM to facilitate ad hoc horizontal collaborations between shippers, or carriers, the same barriers existed. These trends were found to correspond well with the proposed alignment between the three tailored logistics streams and the three different architectures supporting them. Again, this further confirmed the conceptual B2B ERA model proposed in Chapter 3.

As a 'collaborative ELM' has the potential to enable shippers to identify synergies between them, it has the potential to facilitate optimisation across companies. Motivated by this, an in-depth study was presented in Chapter 7, to explore the answer to RQ4:

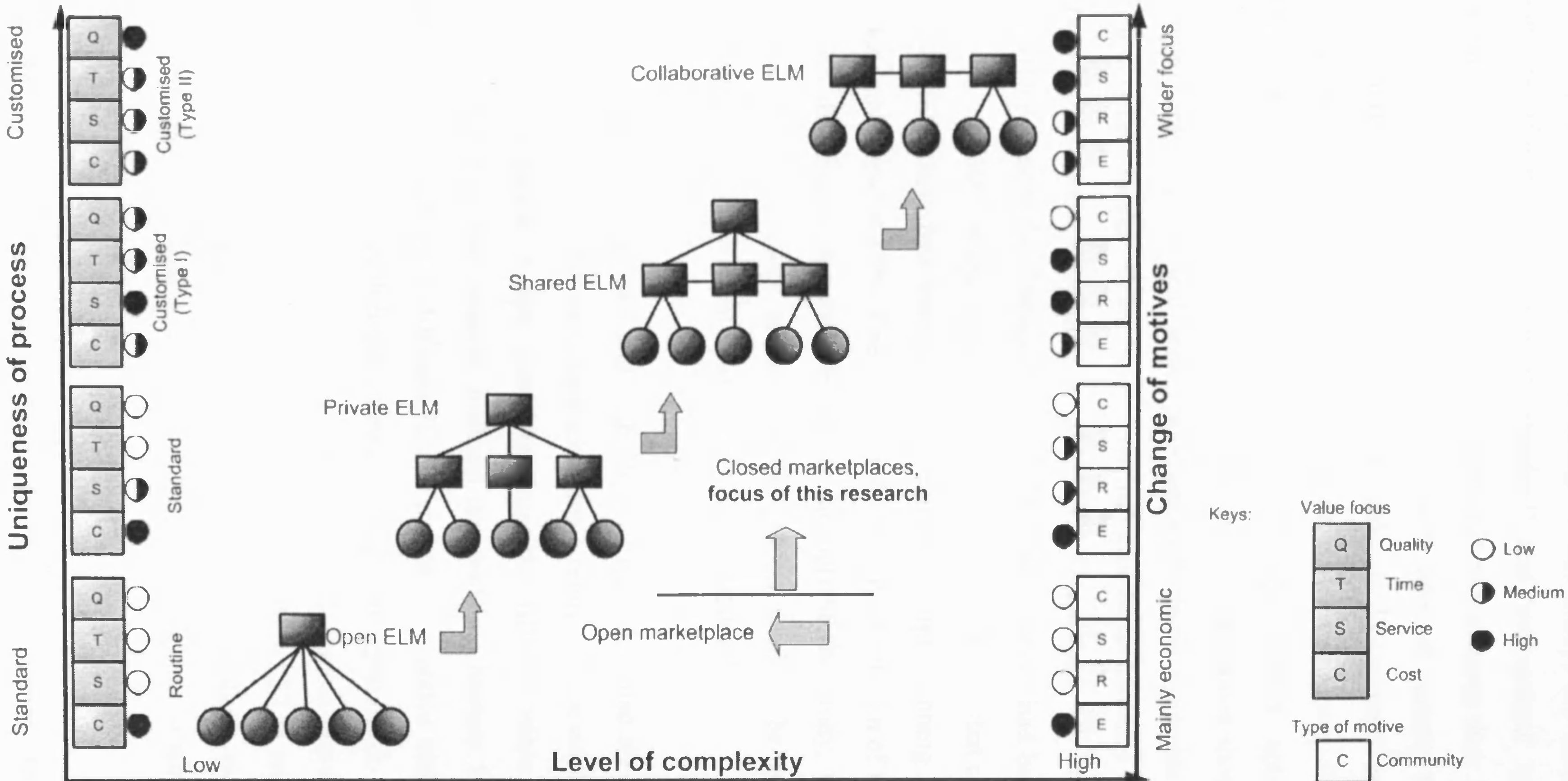
RQ4. What are the reasons for and impacts of introducing a novel type of ELM, i.e. the Heterarchical Network (Collaborative ELM)?

Through a 12-month period of study of Case E, significant insights were gained into understanding the specific rationale behind the formation of such an ELM. Comparing it with other type of ELMs, unique reasons were found for forming a collaborative ELM. Through an alliance between shippers, a critical mass for transaction volume can be secured, which is essential in attracting carriers into the marketplace and sharing risks/investment in developing the marketplace. The competitive operating environment in the FMCG industry and increasing pressures from customers also push shippers to work together to maintain market competitiveness. This was achieved via a collaborative ELM by gaining access to other companies' knowledge and resources and then fulfilling customers' strict requirements. Comprising the three leading companies in FMCG industry, Case E was also attempting to promote industry wide standard for data transfer using the telematics system. However, fewer motives are found from carriers' side. It was felt that the development of the ELM was more due to the 'shipper-push' approach rather than carriers being 'pulled' into the system. To some extent, it largely reflected the conservative attitude in the UK's freight transport industry towards the adoption of e-business technology. This type of attitude has been observed in the literature (Rabinovich and Knemeyer, 2006; Selviaridis and Spring, 2007; Sheffi, 1990).

The impact a collaborative ELM has on the supply chain was also examined after a detailed discussion of the technical, relational and process configurations of ELM system. Both negative and positive effects were found. One of the interesting findings was that of the impact of using the Case E ELM on carriers' delivery-on-time performance. The managers from shippers expected the performance to be improved, as they believed that 'being watched, carriers should performance better'. However, the results were not as expected. Pre-ELM performance was consistently over 95%, however, neither of the two carriers selected to participate in the trial achieved that level during and after the trail implementation. Although the DOT performance seems to have deteriorated, this does not imply that the use of an ELM is the cause of such deterioration. Instead, the factual performance data visible to both shippers and carriers suggested that the initial targets probably are not realistic and need to be revisited. It also implies that there could be deliberate data manipulation from the carriers' side before the ELM adoption in order to reach the target. Such behaviour has been confirmed by interviewees from both carriers and shippers. In fact, the uniform visibility is one major advantage of a closed ELM, i.e. the system can provide both shippers and carriers with factual data where performance gaps can be highlighted and targets can be revisited. Based on the study, an evolutionary path was derived to predict possible future development phases achieve network optimisation. A step-by-step move towards the advanced stage is believed to be more likely to succeed than direct adoption of the advanced stage given the broad scope involved and complexities to streamline intra- and inter-company processes. Finally, necessary conditions were identified as guidelines for successful implementation. This is important considering the complexities of a collaborative ELM.

In summary, ELMs are seen as emerging business models to facilitate the effective provision and execution of tailored logistics, where there is a need for extensive connectivity of business partners with appropriate relationship configurations. The research indicated that the 'on-demand' concept and closed ELM will continue to prosper along with the development of ICT, and especially Web-based technology. Both shippers and carriers should keep abreast of technological developments, as technical innovations are at the core of many companies' aspirations to gain logistics efficiency.

Just as companies with limited resources and capabilities should develop a portfolio of tailored logistics streams ranging from routine, standard, to customised logistics provisions, they should also develop a portfolio of B2B architectures with varying levels of information, process and collaborative configurations among the supply chain members. Such portfolio is presented in Figure 8.2.



Technology	Web-based independent system	Traditional client-serve approach with some web features	Hosted web-based system	Hosted web-based system
Process	Spot trading	Order-to-delivery execution	Order-to-delivery execution, extended scope	Order-to-delivery execution and more strategic activities
Collaboration	Many-to-many, loose relationship	One to a few, vertical collaboration	One to a few, vertical and limited horizontal collaboration	A few to a few, vertical and horizontal collaboration

Figure 8.2 Electronic marketplaces for tailored logistics
(Source: Author)

The three types of closed ELM (the focus of this study) are essential systems to support the effective provision of 'standard' and 'customised' logistics streams. Companies should use open ELMs as a speed solution to surge their logistics demand variation, and build private or shared ELMs with selected partners to gain operation efficiency and provide superior services to customers. For strategic benefits, shippers, or other parties who manage the distribution network for shippers, should explore the potential of setting up a collaborative ELM for network optimisation across companies. When the cost reduction hits the ceiling, companies should think beyond their own supply chains and seek opportunities through synergies generated from horizontal collaboration. At the time of writing this thesis (January 2008), a series of benchmarking surveys sponsored by the UK's Department of Transport had just finished (Department for Transport, 2007). The same survey had been carried out in 1997, 2002, and 2007 in the food industry. The results showed that compared to years 1997 and 2007, there had been no improvement in empty running at all. The figure remained unchanged at 18%. This clearly indicates the limitation of trying to optimise one's own distribution network. However throughout the study, the research also found that there are many practical issues which need to be resolved before a collaborative ELM can work effectively and to be sustained.

Using a simple 'low, medium and high' scale, Figure 8.2 also shows that there are different motives under different logistics value streams. These motives influence the choice of ELM, which, in turn, then determines the different value outcomes. These are derived based on the research findings reported in Chapters 5-7. One can also observe that although these different ELMs coexist in practice and have a different value focus, there is an evolutionary trend moving from open ELM, to private, shared and finally collaborative ELMs. By far, the private ELM is still the most popular type of closed system. However, as technology advances, shared ELM will be increasingly adopted. Once companies start to use the same marketplace, there will then be opportunities for horizontal collaboration. This will then encourage more companies to use the collaborative ELM.

The ELM landscape is still evolving. Different structures and functionalities distinguishing closed ELMs from trading-oriented open ELMs are emerging, but are far from being set. The data from this study suggests that closed ELMs are still in an early phase of this evolution, but have great potential in supporting the effective and efficient provisions of logistics services.

8.3 Original contributions

Through both the analytical and empirical study, the research contributes to the overall body of literature through the following contributions:

1) This research has developed a conceptual model, i.e. the B2B ERA, which traces and categorises different interorganisational ICC mechanisms. It also highlights that one-size-fits-all is unlikely to work and there should be different architectures for different logistics scenarios. The model has been validated through the study of six ELM cases. Studies in system architectures have largely focused on the technical perspective within an enterprise, with little research on the interorganisational aspect, especially in the context of tailored logistics. Other disciplines tend to use, for instance, transaction cost economics or resource based view, in explaining the choice of governance structure or use conceptual models to classify Internet based coordination mechanisms but with limitations in explaining the underlying connectivity principles and, in particular, they do not investigate the linkage of these mechanisms with tailored logistics.

2) The closed ELM has only recently emerged, hence there has been little research on such an infancy business model and there is, therefore, limited understanding towards it. Through an exploratory study, this research has established the foundations for understanding the operational models available to support closed ELMs. It provides valuable insights into the differences in structure, functionality and how they enable the provision of tailored logistics. As B2B ELMs are rapidly changing, this research can also facilitate understanding of future developments in this field.

3) Collaborative ELMs, due to their rarity in practice, have also not been studied in depth. This research provides primary empirical evidence of why and how this type of ELM is initiated and what impact it brings to the supply chain. As

a collaborative ELM has great potential in supporting collaboration across supply chains, the study contributes to our understanding of this kind and will encourage future investigation of how the full potential can be realised.

4) While many studies have attempted to categorise electronic marketplaces in different ways, according to, for example, their pricing mechanism (fixed or dynamic), stakeholder ownership (buyer-oriented, seller-oriented or neutral), or purchasing materials (manufacturing or operating), they have failed to capture the underlying fundamental structure of inter-organisational connectivity. Consequently, they have not explored in depth how ELMs are governed and controlled, and how they are used in different situations for different purposes. Adoption of information control and coordination architecture to categorise the different types of ELM enables them to do so. It guides by not only aiding understanding of the detailed operational models but also helps to identify the rationale behind adoption of a particular ELM. Previous studies, although providing useful background information have failed to provide such knowledge.

5) Different disciplines tend to study an electronic marketplace mainly from one perspective. This study has examined each type through three key aspects: process, technology and collaboration. This has provided more balanced and comprehensive insights into such business models.

8.4 Academic implications and limitations

Due to the exploratory nature of this research, a number of limitations are recognised by the author. This research explored the closed ELMs for tailored logistics using the B2B ERA typology developed. Despite the original contributions discussed above, this study focused only on ELMs initiated by the private sectors and did not incorporate ELMs initiated by governmental bodies. The operational models as well as the reasons for using these ELMs may be very different from the ones studied in this research.

The sample of six ELM case examples was also a limitation. Generalisation should be made cautiously. Apart from the major Case E, data was gathered mainly from technology providers. It is assumed that because of the independent position they hold in the supply chain, they were able to accurately capture the perceptions and issues associated with the use of closed ELMs arising from both shippers and carriers' perspectives. But there may exist potential bias or their views may not have been as comprehensive as expected. Future research should try to validate the research findings further through empirical research involving both shippers and carriers and using a large scale survey and/or more case studies.

Data collected in this study are mainly qualitative. It is largely because that participating companies (apart from Case E) were not willing to disclose commercially sensitive quantitative information such as transport rates and cost savings. It is also difficult for companies to quantify gains or losses, as in most cases closed ELMs are still at their infancy stage.

As the major study of a 'collaborative ELM' was based on a single case, one shall also caution when trying to adapt or apply the research findings to other circumstances. Nonetheless, this study is believed to present significant implications for academics to further study closed ELMs, and for practitioners seeking to develop closed ELMs for various purposes.

8.5 Future research

In line with the limitations discussed in the previous section, future research should incorporate ELMs initiated by government bodies and should try to include more quantitative data to further triangulate the research findings. Although still rare in practice, government supported ELMs will likely grow in the future given the increasing environmental concerns of freight transport issues such as carbon dioxide emissions and congestion problems. A comparative analysis of ELMs initiated by private and public sectors will provide quantifiable benchmarking insights.

Also, taking into account the increasing pressures on logistics and transport management, future research can also look explicitly at how closed ELMs can have a positive impact on the environment and society as a whole. The net effects on the environment should be more fully assessed, for example on climate change and air quality.

The research found that an ELM is extremely useful for logistics provisions in the context of global supply chains. Therefore its application to different transport modes and its potential in facilitating co-modality will merits further examination. There could also be different practices in different countries in the use of ELM. Although the cases investigated in this study include examples from UK, US, Canada and Spain, more examples from other nations should be examined in order to establish a global understanding.

The research found that interoperability in using an ELM is a major technical challenge. Promoting industry wide data transfer standardisation using telematics needs collective action. However, it seems that many companies (as evidenced in Cases A, B, C and D) will favour customised systems for their own convenience, and disregard the importance of standardisation for interorganisation integration. Case E just started with an attempt to solve the issue but there is a need for more companies and government bodies to become involved. Future research to investigate how the conflicts can be mitigated to make standardisation work is very worthwhile.

Further due to rapid technology advances, the cost of using ICT will continue to decrease. Hence, other business models are likely to emerge. For example, it is already technically feasible that companies can share a single platform for both long-term collaboration and spot trading. But why has this hybrid model not been widely accepted and adopted by companies yet? Research attempting to answer this question is also worthwhile. Meanwhile, as technologies advance, the life cycle of different types of ELM may become short. There is also a possibility that they will not remain static and evolve from one type to another. The potential evolutionary paths of certain ELMs were within the scope of study in this research. However, future research on this topic will provide useful insights and facilitate our understanding of this still immature but quickly developing business model.

Finally there tends to be different approaches adopted to achieve improved transport optimisation in different types of ELM. For example, unlike collaborative ELMs, private ELMs are often facilitated by a 4PL, and shared ELMs may be coordinated via a third party technology agency. A comparative study of such approaches can shed light on the study of ELMs as well.

8.6 Practical implications

As B2B electronic marketplaces are becoming more common in practice, decision makers in logistics can identify which structure is best suited for their particular application based on this research's characterisation. The results can also provide directions for practitioners in increasing the likelihood of successful adoption of ELMs. For the designers of ELMs, the study can be used as guidance in establishing suitable operational models that are appropriate to different parties' needs and different logistics scenarios. The research findings suggest that companies should adopt a portfolio strategy in deploying ELMs for logistics management; they can utilise open ELMs to handle the provisions of routine logistics, while build/use private, shared and/or collaborative ELMs to gain strategic benefits from better collaboration with business partners.

One tangible impact this study has already had is that its findings have been used by the DfT in producing a *Freight Best Practice Guide to ELM* due to be published sometime in 2008. It has also attracted interest from the Welsh Assembly Government. A pilot project entitled 'Pan-Wales ELM' is being undertaken by the author to facilitate potential network collaboration between shippers and carriers in the Principality.

8.7 Summary

In this final chapter, the aims of the study along with the findings and their implications have been presented. Original contributions have been summarised.

Finally academic applications and future research as well as practical implications have been discussed to conclude the thesis.

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Appendix I – ELM Multiple-Case Study Protocol

Objectives	To understand how an emergent electronic logistics network model i.e. an ELM, functions and enables the provision of tailored logistics; reasons for using an ELM within the supply chain; rationale for and impact of introducing a Heterarchical Network type of ELM
Provisional questions	1). How does an ELM work? - How is information connected, exchanged and processed? - What are the core value-added service and functions provided? - What are the key support technologies adopted? 2). What are the pre-requisites to deploy this model? - Business process (re)design - System integration - Partnership configurations - Skills, etc. 3). What are the costs & benefits, and enablers & barriers to the adoption of such ELM for different users, i.e. - Logistics service providers - Customers - Suppliers 4). How can organisations utilise an ELM model to improve their logistics performance, in particular, how does it enable tailored logistics provisions?
Activities	1) Interviews - with ELM hosting company on the technical and managerial operation details - to understand how the ELM works and what are the pre-requisites - on the issues of implementation and costs & benefits - on the performance of logistics service before and after the adoption of the ELM - If possible, with shippers and/or carriers using the ELM 2). System demonstrations 3). Company documentations 4). Archival recordd and process mapping if possible
Data analysis	Interview notes will be consolidated and coded to derive current status of practices. Process mapping will be used to depict the inter-organisational information control and coordination mechanism with information flows. Other sources of data will be triangulated with data obtained from interviews.
Major deliverables	1). Best Practice Guide for DfT by end of November 2007 2). Conference and journal papers, trade journal article 3). PhD thesis
Resources needed	**ELM hosting company** Need to establish contact within the company in order to explore the answers especially to the research provisional questions 1) and 2). Potential contact might be but not limited to:

	- operation manager dealing with day-to-day operation of ELM solution - customer service manager dealing with customers - engineer who could explain the support technologies and technical issues May need to establish contact with both shippers and hauliers in order to explore the research questions 3) and 4). Potential contacts might be but not limited to: - IT manager, logistics manager, vehicle scheduling and customer service manager from shippers - IT manager, operations manager, vehicle scheduling, and customer service manager from hauliers - Purchasing/logistics manager from customers (i.e. shippers' customers) **McCLOSM** - Support and feedback from McCLOSM team
Project Governance	R (responsible) – Yingli Wang A (accountable) – Dr. A. Potter C (consulted) – Mr. Robert Mason, Prof. M. Naim, Prof. Stefan Dimov and contact manager from case companies I (informed) – Dr. A. Glanfield, McCLOSM team
Targeted companies	Please see the following table.

Table I.1: Research Protocol
(Source: Author)

*Targeted case**	*Type of ELM*	*Uniqueness*
• TTL., UK	Traditional Hierarchical Coordination	A 4th party logistics provider (4PL) established within the European logistics sector, specialising in utilising web-technology for transportation management.
• ADJ, International with UK office	Traditional Hierarchical Coordination	One of the leading supply chain software providers with a particular focus on the retail industry.
• MBI, International with UK and Switzerland offices	Traditional Hierarchical Coordination	An international container network developed by one of the world's largest software service providers for one of the world's largest shipping companies
• FTM.com, US	Traditional Hierarchical Coordination	Owned by one of the world's leading technology service providers, designing and delivering private transport marketplaces
• NCM, U.S	Modified Hierarchical Coordination:	One of the earliest yet still successful models of its kind; it is this company which initiated and actively promoted the 'collaborative logistics network' concept (similar to an ELM).
• DSG, Ontario, Canada	Modified Hierarchical Coordination	One of the leading providers in e-logistics solutions, specialising in transportation management with two specific target customer groups: transportation/logistics providers and manufacturers, retailers and distributors. Has a global presence in 60+ countries and processes more than 2 million transactions a month.
• SG, UK	Modified Hierarchical Coordination:	Global provider of supply chain solutions. Hosts an ELM termed SSA Transportation Execution, which incorporates multiple transport modes. Also specialises in the integration of ELM with enterprise systems (e.g. ERP). Customers include Wal-mart, Exel and Unilever.
• Ticatrans, UK	Modified Hierarchical Coordination:	A medium sized software service provider based on the on-demand model, providing a platform for road transport collaborative activities within European.
• AE, Madrid, Spain	Heterarchical Network	A joint venture by a food manufacturer, technology provider and a consulting company, one of the earliest ELM models used in connecting UK transport with other European countries.
• SLK , UK (being carried out as part of McCLOSM)	Heterarchical Network	A joint venture by the alliance of three leading manufacturers; being hosted by a Technology service provider.

Note: Case names are changed to maintain anonymity and confidentiality.

Table I.2: Targeted case examples
(Source: Author)

Appendix II - Research Protocol Piloting via Industrial Workshop

1. Objective:

- Collect peers' opinions about closed ELMs, and
- Verify and refine research protocol.

2. Selection of Participants

To gain a comprehensive view of academics, government and practitioners' points of view on ELM, a total of 13 participants were selected for the focus group as given in the following table.

Position	*Type of organisation*	*Industry*	*Interests*
Supply Chain Director	Customer	Retail	Impact and potential benefits
Senior manager - Central Transport Management	Customer	Retail	Impact and potential benefits
Operations Director	Carrier	Transport	Fitness of current operation
IT Manager	Carrier	Transport	Technical prerequisites
Head of Policy on Road Transport	Government	Government	Potential benefits to the transport industry as a whole, and to both small and large hauliers
Senior Informatics Researcher	Government	Government	The adoption of informatics in transport
Operations Director	Technology provider	IT/Transport	Promotion of open standards in industry and technical development
Project Manager	Technology provider	IT/Transport	Demonstration of an exemplar closed ELM
4 Academics	University	Academics	Operational model and its impact on the supply chain as a whole

Table II.1 Summary of industrial workshop participants
(Source: Author)

3. Activities

- Introduction presentation on generic e-enabled logistics models by academics (45 minutes)
- Open discussion of key issues, trends and opportunities in transport management by all (2 hours)
- A demonstration of a closed ELM by technology provider (45 minutes)
- Open discussion and questions regarding this ELM by all (2 hours)
- Summary and the way forward by academics (20 minutes)

Appendix III – ELM Major Case Study Brief

Objective	To explore answer to RQ4, "What are the reasons for and impacts of introducing a novel type of ELM, i.e. the Heterarchical Network (Collaborative ELM)"
Provisional questions	1). How does the model work? - How is information connected, exchanged and processed? - What are the core value-added service and functions provided by this ELM? 2). What are the prerequisites to deploy this model? - Business process (re)design - System integration - Partnership configurations - Skills, etc. 3). What are the costs & benefits, and enablers & barriers to the adoption of this ELM for different users, i.e. - Logistics service providers - Customers - Suppliers 4). How can organisations successfully implement a collaborative ELM?
Activities	It is planned to collect data in the following ways: 1) Process mapping - to understand how Case E ELM works and what are the prerequisites - to document the detailed processes 2) Interviews - with manufacturers on the issues of implementation and cost & benefits - with selected hauliers on the issues of implementation and cost & benefits - with customers on the performance of logistics service before and after the adoption of case ELM 3) Time series analysis - to compare the product delivery performance before, during and after the implementation of case ELM - to quantify the behaviour of the supply chain 4) Small scale questionnaire (optional) - to identify the critical success factors
Data analysis	Interview notes will be consolidated and coded to derive current status of practices, process mapping will be used to depict the inter-organisational information control and coordination mechanism with information flows, and quantitative data will be analyzed to compare pre-and post-adoption performance. Triangulation of the above mentioned findings will be carried out to achieve more valid results.
Major deliverables	1). A report documenting key findings 2). As a foundation for further potential minor case studies 3). Conference and journal papers 4). As input to PhD thesis

Relevance to beneficiaries	For the technology provider, the company can benefit by obtaining a complete picture of what might be the potential issues and problems from both shippers and carriers when using the ELM. Consequently, these can be taken into account the current operation to improve the service and attract new customers to the business. Furthermore the company can leverage the best practices available in practice which will be included in the report to enhance its own performance. For manufacturers and hauliers, this research provides an independent view of current operation and recommends tools and techniques for further improvement; For McCLOSM, this research explores an emergent logistics model in depth and contributes to the development of knowledge in the e-logistics domain. Cross-learning is an additional benefit for the industrial partners.
Resources needed	**Technology Provider** Need to establish contact within the company in order to explore the answers especially to research provisional questions 1) and 2). Potential contact might be but not limited to: - engineer dealing with day-to-day operation of CASE E ELM SYSTEM model - engineer responsible for customers services - manager in marketing function **Manufacturers and carriers** Also need to establish contact with manufacturers and hauliers in order to explore research provisional questions 3) and 4). Potential contacts might be but not limited to: - IT manager, logistics manager, vehicle scheduling and customer service manager from manufacturers - IT manager, operations manager, vehicle scheduling, and customer service manager from hauliers - Purchasing manager from customers (i.e. manufacturers' customers) **McCLOSM** - Support and feedback from McCLOSM team
Project Governance	R (responsible) – Yingli Wang A (accountable) – Dr. A. Potter C (consulted) – Mr. Robert Mason, Mr. Derek Beevor, Prof. M. Naim, Prof. Stefan Dimov I (informed) – Dr. A. Glanfield, McCLOSM team
Schedule	Please see the project Gantt Chart attached. Initial data collection period: plan to spend 2-3 days a week with each company over 6-8 weeks during May and June 2006 Second data collection period: plan to take 1 day a week with each company over 4 weeks during October 2006 as a follow up

Table III.1 Major case study brief
(Source: Author)

Project Gantt chart

Work module	Activities	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	May-07
1	**Literature review**	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2	**Project setup and research design** - Project brief and timescale - Buy-in from 3 manufacturers +logistics service providers		■	■												
3	**Major Case Study**		■	■	■	continous observation						■	■	■	■	■
3.1	**With technology provider, investigate the technical aspects of the ELM:** Functionality, supporting technology, investment, skill and infrastructure requirements, system integration, architecture				■											
3.2	**With shippers (3 manufacturers), investigate the operational and managerial aspects of the ELM** Rationale, project management, expected outcomes, investment, cost/benefits, collaborative relationship, problems/issues				■	■	■	■							■	
3.3	**With Carriers (3 carriers), investigate the operational and managerial aspects of the ELM** Perceptions, expected outcomes, investment, cost/benefits, technical capability, collaborative relationship, problems/issues								■	■	■	■				
4	**Minor case studies (5 ELMs):**															
4.1	Case companies' recruitment		■	■	■	■	■									
4.2	Functionality, supporting technology, investment, skill and infrastructure requirement, system integration, architecture, target markets, process and relationship configurations							■	■	■	■	■	■			
5	**Data analysis and synthesis of findings**				■	■	■	■	■	■	■	■	■	■	■	■
6	**Wrap up**														■	■

continous observation

major interview time slots

Appendix IV – Interview Guide

____________________(Company Name)

Interviewee:	(name and title)	
Interviewer:	(name)	
Date and time:	Place:	(location)
Objectives:		

1. **Company background**
    a. History, business nature and strengths, target markets, strategy
    b. Size of business, key customers and business partners, annual turnover
    c. Organisational structure
2. **Opportunities and challenges**
    a. Current issues faced by management team
    b. Any constraints on business operation and development
    c. Potential opportunities to develop business
3. **Pre-ELM business operation model**
    a. The way of working with your customers (e.g. shippers) and other business partners, including relationship management and level of collaboration
    b. Process flows: customers interface & how orders are planned and executed
    c. Current performance measures and performance level
    d. Intra and inter-company information systems e.g.
        i. In-house TMS systems being used
        ii. Level of integration with business partners
4. **Post-ELM business operation model**
    a. A system demonstration:
        i. functionalities, supporting technology
        ii. any other alternatives in existence
    b. Cost structure and pricing model
    c. Issues and problems during adoption, boundaries such as roles and responsibilities
    d. Impacts of the change (both positive an negative)
    e. Cost and benefits, motivations & barriers, e.g. how much investment is needed to join the ELM regarding money, personnel and infrastructure, system modification?
    f. Progress to-date
    g. Relationship with the technology providers, and shippers (for carriers), with carriers (for shippers)
    h. Future outlook

Appendix V – Covering Email to Company Research Participants

Dear Sir or Madam

We have recently secured funding from the Department for Transport (DfT) in the UK to undertake research into electronic logistics marketplaces (ELMs). The aim is to produce a Best Practice Guide for companies as to how they can use ELMs to improve the efficiency of their supply chains, including understanding the technical and managerial requirements. Examples of other guides produced by the DfT can be found at http://www.freightbestpractice.org.uk. We will also be looking to produce academic publications on the research.

An important element of the guide is to provide case studies on the impact of ELMs on example supply chains. Therefore, we would like to explore the possibility of your company becoming involved in the project. We have particularly selected [Company Name] because [specific reasons, for example the company is recognised as one of the leading ELM providers in North America, providing a good example of international best practice]. In terms of commitment, we would be looking to conduct a number of face to face interviews with key personnel to understand both the technical, process and managerial aspects of using ELMs. System demonstration supported by company relevant documentations would be also greatly appreciated.

Cardiff University Innovative Manufacturing Research Centre has a leading reputation for logistics research in the UK and we have successfully collaborated with companies in a range of industrial sectors. If necessary, we would be willing to sign a confidentiality agreement to protect commercially sensitive information.

We look forward to hearing from you in due course. Should you wish to discuss any of the above in more detail, our contact details are below. More information on CUIMRC can be found at http://www.cuimrc.cardiff.ac.uk.

Yours sincerely,

Yingli Wang

Appendix VI – Interview Summary

Case	*Nature*	*Interviews schedule*	
		Date	***Focus***
CASE A	4PL	14.09.2006	3 interviews with Technical Director o Overview of functions o System demonstration o Prerequisites to deploy o Cost and benefits o Future development With Transport Planning Manager and Operation Manager (2 persons) o Planning process, horizontal and vertical optimisation o Current issues and challenges o Customer relationship management
		10.10.2006	With Operation Director o Overview of business operation model o Target customers and industry o Unique selling points o Future development
CASE B	Technology provider	18.10.2006	With Product Manager o Overview of functions, target customers and industry o System demonstration o Prerequisites to deploy o Cost and benefits o Future development
		31.10.2006	Attend Transport Event Workshop o To understand the technical strengths of the company o To gather the issues raised by customers o To disseminate research findings to industry
CASE C	Technology provider	04.06.2006	With Regional customer manager o Overview of ELM solution and history of development o Customers' profile o Unique selling points
		19.01.2007	With Sales Director o Overview of company and solutions provided o Target customers and industry o Unique selling points o Future development
		16.02.2007	Web Meeting with Product Manager o Overview of functions o System demonstration o Prerequisites to deploy o Cost and benefits o Future development
CASE D	Technology provider	11.10.2006	With Sales Director and sales coordinator (2 persons) o Overview of company and solutions provided o Target customers and industry o Unique selling points o Future development

		14.11.2006	With Product Manager and Market Director (2 persons) o Overview of functions o System demonstration o Prerequisites to deploy o Cost and benefits o Future development
CASE E	Shipper 1	21.06.2006	Introductory meeting with Project Manager and Customer Service Manager (2 persons) o Rationale behind the ELM initiative o Research questions and boundary o The way forward
		13.09.2006	With Project Manager o Overview of the Company operation and Customer Service function o Project progress, cost and benefits
		20.02.2007	With 7 staff in different distribution functions, and 2 in sales and marketing; 9 interviews conducted in total o Understand the operational and strategic issues within company o Sales forecast & supply planning o Transport scheduling / Warehouse Management o Inbound logistics & ex-factory logistics o Carriers management o Distribution systems o Distribution costs o Impact of ELM project on current operation o Future outlook
		22.03.2007	With National account manager o Challenges and issues in key account management o Category management and demand planning o Promotions o Impact of ELM project on current operation o Future outlook
		27.03.2007	With Supply chain development manager o Supply chain challenges and issues o Perception of ELM project on current business o Reactions from customers o Future outlook and other initiatives
		17.04.2007	With project manager o Progress with three shippers o Progress with carriers o Future actions/plans
	Shipper 2	29.05.2007	With Outbound logistics innovation project manager o Company's background and supply chain challenges o Shipper 2's way of managing its carriers o Perception and progress on case ELM system, o Other alternative system demonstration and future development
	Carrier 1	07.11.2006	With Transport Schedulers (2 persons) o Process mapping o In-house IT system and system integration with shippers o ELM project progress and impact
		30.01.2007	With Operation Director o Overview of business operation model o Progress and concerns regarding ELM project o Future development

	Carrier 2	12.12.2006	With Customer Development Manager and IT Manager (2 persons) o Overview of company operation o Link with customers o In-house IT system and system integration with shippers o ELM project progress and impact o Cost and benefits
	Carrier 3	22.11.2006	With Operation Director and IT Manager (2 persons) o Overview of company operation o Customers relationship management o In-house IT system and system integration with shippers o ELM project progress and impact o Cost and benefits
	Technology provider	01.06.2006	With Company Operation Director o Review of current trends and issues in transport industry o System demonstration o Establish research agenda
		01.06.2007	With Technical Project manager and database engineer (2 persons) o Progress to-date o Discussion of carriers' performance o Problems that have occurred and best practices if any o Future outlook
		14.06.2006	With Technical Project Manager and his team (4 persons) o Detailed overview of how this ELM functions o Technical requirements o Cost to join o Future function development
CASE F	Technology provider	18.10.2006	With Product Manager o History of how the model was initiated o Evolution path o Functions & system demonstration o Problems and issues observed o Current stage and future development
	Shipper	01.12.2006	With Project Manager o History of how the model was initiated o Evolution path o Functions o Problems and issues experienced o Performance of current solution
Total number of interviews		36	
Total number of people interviewed		47	
Total number of workshops		1	

Table VI.1 Interview summary
(Source: Author)