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A Framework to Assist SMEs in Implementing E-Procurement Applications

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By

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Abstract

The importance of small and medium-sized enterprises (SMEs) to the economy is widely accepted. In addition to this, their characteristics of flexibility, lower costs, specialist products, responsiveness, innovation, localisation and high quality of services have been widely acknowledged.

Nowadays, "Electronic procurement (e-procurement) has a far greater potential for cost savings and business improvement than online retailing or enterprise resource planning systems (ERP), and will permanently and fundamentally reform the way we do business in the future" (Neef, 2001). However, the adoption of e-procurement in SMEs is far behind their counterparts - the large corporations. As a result, it is essential to assist SMEs with the adoption of e-procurement to reach their full potential.

In order to improve e-procurement adoptions in SMEs, several obstacles have been identified from the SME perspective, including limited expertise in procurement improvements and supply chain management, limited resources (e.g. skilled personnel, financial and technical capabilities, etc.), less business channels and opportunities, and lack of strategic frameworks for e-procurement implementations.

In this respect, when SMEs attempt to deploy e-procurement technologies, it is fundamental for them to obtain adequate and effective external support from both their supply chain partners (i.e. buyers and suppliers) and intermediate organisations (e.g. governments, consultant companies, distributors, wholesalers, retailers, banks, academic institutes, etc.).

In this research, case study method is utilised on the basis of qualitative research. Four case studies are deeply investigated. In the end, a holistic framework is established with a new way of thinking about how SMEs can obtain effective external support for efficient implementation of e-procurement applications across their relevant supply chains. To implement the framework, a new approach is applied and includes the identification of key players, their characters, roles, responsibilities required and

relationships formed based upon e-procurement projects. Meanwhile, the challenges have been identified when SMEs form relevant collaboration networks upon related e-procurement projects.

Acknowledgements

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I would like to thank Prof. Dennis Kehoe, without whom I would not have the opportunity to start this research journey or get involved in four e-procurement projects as case studies of this research. I would like to thank Dr. Dong Li for his great help and guidance when I did thesis correction. I would like to thank Dr. Paul Drake for his support and valuable advice.

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Chapter 1 Introduction

1.1 Introduction

The aim of this chapter is to present an overview of the research work contents of the thesis. The chapter begins with a summary of the research background, followed by the questions which led to the formation of the research objectives. The chapter then identifies the expected research benefits of the project. A summary of the research approach is presented as well as an overview of each chapter is provided.

1.2 Research Backgrounds

Procurement is a topic that is central to the concept of supply chains and it is recognised as being of strategic significance to organisations in the supply chain (Knusden, 2003; Oliver & Maringanti, 2007). The significance of procurement is evidenced by its evolving positioning and roles including the following three acknowledged trends (1) from an internal operational activity to a significant process connecting businesses across the supply chains, (2) from an operational activity to a strategic function crossing business boundaries across the supply chain, and (3) from an independent activity to an inclusive, integrated approach to managing relationships across the supply chains (Cooper et al, 1997; Porter, 2004; Bowersox, et al, 2002; Oliver & Maringanti, 2007). Clearly, procurement has become a supply chain concept rather than an activity that is internal to individual organisations.

Nowadays, "Electronic procurement (e-procurement) has a far greater potential for cost savings and business improvement than online retailing or enterprise resource planning systems (ERP), and will permanently and fundamentally reform the way we do business in the future" (Neef, 2001). It has been defined by Min and Galle as "...business-to-business purchasing practice that utilizes electronic commerce to identify potential sources of supply, to purchase goods and services, to transfer payment, and to interact with suppliers". Commonly, e-procurement will impact several aspects of businesses, such as:

- Cost savings;
- Manufacturing collaboration;
- Business trust and strategic partnership;
- Business integration;

- International business opportunities;
- Business process improvements.

Nowadays, many large corporations have adopted e-procurement into their businesses and consequently obtained a great deal of benefits through e-procurement adoption. Although many small and medium-sized enterprises (SMEs) have been aware of the significance of e-procurement and involved in many e-procurement projects, the adoption of e-procurement within SMEs has been identified as much behind their counterparts, large corporations. Indeed, most of SMEs still has still difficulties on why and how to adopt e-procurement into their businesses.

Indeed, the importance of SMEs to the economy is widely accepted, in terms of both the employment opportunities they create and their impact on the national and local economy. In addition to this, their characteristics of flexibility, lower costs, specialist products, responsiveness, innovation, localisation and high quality of services have been widely acknowledged (Rothwell, 1986, Chaston et al, 1999; Massey & Walker, 1999; Stokes & Wilson, 2006). In this sense, it is essential to assist SMEs with the adoption of e-procurement to reach their full potential.

In order to facilitate e-procurement adoption in SMEs, several obstacles have been identified from the SME perspective. These include (O'Regan, et al, 2005; Sharma et al, 2005; Sharma and Bhagwat, 2006; Bhagwat and Sharma 2006):

- Lack of skilled personnel;
- Lack of financial and technical capabilities;
- Lack of business cooperation and integration with business partners;
- Lack of expertise in e-procurement technologies;
- Lack of a strategic framework for e-procurement implementations.

In this respect, when SMEs attempt to deploy e-procurement technologies, it is fundamental for them to obtain adequate and effective external support from both their supply chain partners (i.e. buyers and suppliers) and intermediate organisations (e.g. governments, consultant companies, distributors, wholesalers, retailers, banks, academic institutes, etc.).

Meanwhile, in order to decrease the potential risks relating to SMEs' e-procurement projects, clustering of multiple organisations has been recognised as a way of improving procurement

management in the supply chain. Porter (1998) defined clusters as "a critical mass of companies in a particular location, whether it is a country, a state, a region or even a city" (Porter, 1998). This definition of clusters identifies the core characteristic of 'physical proximity'. Such physical co-location enables participant organisations gain cost efficiencies from procurement activities as a result of supply chain co-ordination (Anderson, 1994; DeWitt et al., 2006). Other studies have identified the benefits of clusters to include improved economies of scale, increased efficiency as a result of proximity to other supply chain partners, co-production with other cluster members and reduced business risk (Manning & Baines, 2004; Searle & Pritchard, 2005; Frisillo, 2007). The potential for economies of scale relating from aggregated procurement has been suggested to be particularly attractive to SMEs which do not typically possess significant buying power (Adebanjo & Michaelides, 2010).

Karaev et al. (2007) argued that clusters do not necessarily have physical proximity with the rapid growth of the information and communication technologies (ICTs). Indeed, ICT enables virtual links and has led to the development of e-clusters, which are based on the notion of 'digital proximity' as opposed to physical proximity' (Cecil et al., 2004). The definition of e-cluster was given by Brown and Lockett (2001) as "digital enterprise communities enabled by one or more intermediaries and are based on a new type of electronically enabled inter-organisational systems". The benefits of e-clusters have been identified to include increased efficiency, cost savings, improved customer relations, better communications and co-ordination, inventory reduction and shorter cycle times (Romano et al., 2001).

1.3 Research Questions

Key questions to be answered in this research are:

- Is there a need for a holistic framework that enables a structured approach to be used, in order to support and enhance knowledge for SMEs seeking strategic and practical e-procurement adoption?
- Is there a need for external support for SMEs attempting to implement e-procurement applications?
- How do SMEs obtain effective support from external organisations if required?
- Which components does the framework need to take into consideration?

- Is there a need for a methodology to be deployed when SMEs implement e-procurement applications?

These questions help to establish research objectives and require more in-depth investigation.

1.4 Research Objectives

In order to obtain answers to the above research questions, a set of objectives have been defined. These are:

- To review the relevant literature on five major areas, i.e., SMEs, procurement and supply chain management, e-procurement development and implementation, and e-procurement technologies.
- To analyse three case studies on how SMEs in the aerospace sector implement e-procurement applications with external support.
- To develop a holistic framework that provides a knowledge base for developing and implementing e-procurement applications whilst integrating the thematic areas identified above.
- To validate the framework with case study four from a different industrial sector from the three case studies.

1.5 Thesis Overview

This thesis is divided into 8 chapters.

Chapter 2 is divided into five parts covering the existing literature. The first part discusses the concept of procurement management and highlights the significance of procurement in supply chain management. The second part is relevant to SMEs and discusses their classifications and inherent features. The third part reviews the technologies utilised in e-procurement adoption. The fourth part explores the current research on e-procurement development and implementation, and consequently discusses the need of external support on e-procurement adoption. The final part investigates the existing frameworks and methodologies to facilitate e-procurement adoption in businesses.

Chapter 3 describes the research methodology that was employed to achieve the objectives. This begins with an overview of research types, followed by the methodology selected for this research. The rationale for selecting each case study is presented and finally the research design applied to this project is detailed.

Chapter 4 presents three case studies in the aerospace sector. Based on the research methodology adopted, each case study is investigated in depth from various angles, including previous procurement, strengths and weaknesses of supply chains, new procurement, and impacts of adopted e-procurement systems.

Chapter 5 undertakes a series of cross-case analyses, based upon the three case studies presented in Chapter 4. These analyses are focused on several perspectives examined in each case study in Chapter 4.

Chapter 6 introduces the framework in detail, including the methodology utilised to develop the framework, the applicability of the framework, the components, and the implementation stages.

Chapter 7 applies the framework developed in Chapter 6 into a case study in the food sector. The components of the framework are then validated through the case study.. More insights are discussed to add to the framework so that the framework is by more generic in its application.

Chapter 8 summarises the research findings and the contribution to knowledge. The limitations of the research are examined and suggestions for future work are outlined.

1.6 Chapter Summary

This chapter has provided an overall introduction to this thesis. It provides an introductory background to the principles of this research and maps out the basic origins. The need for this research is identified from a business perspective and a set of pertinent research questions is raised. Research objectives are also identified in this chapter.

Chapter 2 Literature Review

2.1 Introduction

Small and medium-sized enterprises (SMEs) play a significant role in the world economy. They are a fundamental source of entrepreneurial skills, innovation, and employment. Thereby, it becomes more and more necessary and important to support SMEs to explore more business opportunities under present turbulent and rapidly changing competition environment.

As being an unavoidable and important business function, procurement is significant to any business, irrespective of its size and sector (Newman, 2005). "Since it is located at the beginning of the value chain, any ripples created here will be echoed right across the supply chain" (Oliver & Maringanti, 2007). Although it has been overlooked for a long time, the role of procurement has been turned to the strategic bedrock of any company, especially for SMEs.

With the rapid growth of information and communication technologies (ICT), particularly the Internet, a revolutionary way to run business has been prevalent, and tends to getting mature over a decade. Under such circumstance, many opportunities have emerged for SMEs through taking advantages of the benefits of the Internet (Zheng et al, 2004). Amongst all popular technologies, as being capable of enabling and streamlining the entire procurement cycle, e-procurement has been identified as having the biggest potential for SMEs to, such as finding new business partners, benefiting from closer integration into the value chains of large companies, saving transaction costs, and strengthening bargaining powers against large companies, etc. (Cavinato & Kauffman, 2000; ABI, 2003; OGC, 2005; Oliver & Maringanti, 2007).

This chapter presents a review of literature, focusing on five areas:

Part one reviews procurement and supply chain management (SCM) on several issues, namely, definitions and relevant terms of procurement, the evolution of procurement, the role of procurement in SCM, and the fundamentals of procurement.

Part two reviews SMEs from four areas, such as the importance to the economy, inherent features, and strengths and weaknesses of SMEs. In each area, more detailed aspects are examined.

Part three reviews e-procurement technologies in certain areas, e.g. electronic data interchange (EDI), and web services.

Part four reviews the adoption of e-procurement in SMEs. It mainly focuses on eleven sub-areas, including definitions of e-procurement, the associations with e-business and e-commerce, e-procurement and procurement, evolution of e-procurement models, categories of e-procurement models, the benefits and challenges of applying e-procurement to SMEs, and external support to SMEs on e-procurement adoption.

Part five investigates the frameworks and methodologies which have been widely regarded as mature in e-procurement implementation. Specifically, the SCOR (supply chain operations reference model) and PRINCE2 (projects in controlled environments) frameworks are thoroughly examined in terms of their applicable scope, contents, and their strengths and weaknesses in application.

2.2 Procurement in Supply Chain Management

There are numerous studies in terms of procurement and supply chain management. Supply chains have existed ever since business has been conducted to bring products and services to the consumers. Supply chain management can be described as the chain linking each element of the manufacturing and supply process from raw materials to the end user, encompassing several organisational boundaries (Scott & Westbrook, 1991; New & Payne, 1995; Oliver & Maringanti, 2007). In this sense, procurement can be deemed as a part of the supply chain.

This section explores the concepts relating to procurement from a supply chain perspective. It contains four sub-sections to examine various aspects of procurement, such as its definitions, evolution, roles and fundamentals.

2.2.1 Definitions of Procurement

Although there is a variety of terms defined what procurement is, they may overlap, to some extent. A set of definitions of 'procurement' and 'purchasing' is examined as follows.

Oliver and Maringanti (2007a) observed that many researchers applied a classic definition of procurement – to buy materials of the right quality, in the right quantity from the right source delivered to the right place at the right time at the right price. In this case, procurement is regarded as a commercial activity incurred in organisations.

Lysons and Farrington (2006) stated that "procurement is a process of obtaining goods or services in any way, including borrowing, leasing and even force or pillage". In this respect, procurement is regarded as a commercial process, rather than a commercial activity, for an organisation. This wider and more accurate concept was gained through the recognition of procurement increasing.

Moreover, some researchers suggested the concept of 'procurement' moving from 'organisational buying' to 'organisational supplier management'. This concept indicates that 'procurement' concerns the aspects "rationalising the supplier base and selecting, coordinating, appraising the performance of and developing the potential of suppliers and, where appropriate, building long-term collaborative relationships" (Lysons & Farrington, 2006). Such concept transformation was a consequence of increasing recognition on

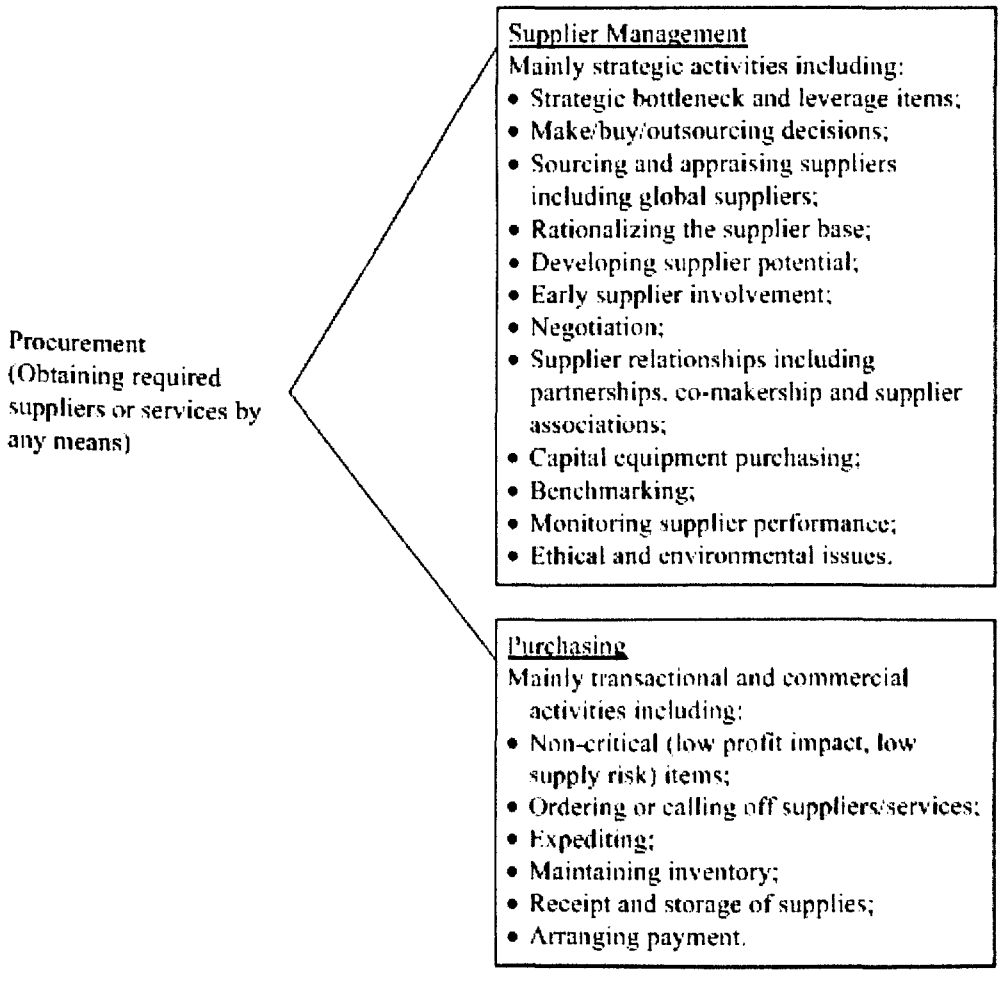
'procurement', which implies that a more strategic and cross-functional meaning has been added into the core of 'procurement'.

Furthermore, Lamming (1985) suggested treating 'purchasing' as external resource management. He noted that "the new strategic function will probably not be called purchasing – that is much too limited a word. The connotations of purse strings and spending money have no relevance to the setting up and management of strategic interfirm relationships. This task is concerned with ensuring the correct external resources are in place to complement the internal resources. Perhaps 'external resource managers' is a term that future purchasing managers will adopt" (Lamming, 1985). Van Weele (2005) introduced the concept of 'external resource management' into his definition of 'purchasing' as "the secure management of the company's external resources in order to run, maintain and manage the supply of goods, services, capabilities and knowledge for the company's primary and supportive activities". However, they both defined the 'external resources' merely covering tangible goods and relative services, but not placing human resources as 'external resources' (Lysons & Farrington, 2006). Nowadays, the concept of 'external resources' has been expanded to contain both tangible and intangible goods and relative services, such as tangible products, human resources, business connections, information, the strengths of well-known brands, etc.

The British Chartered Institute of Purchasing and Supply (CIPS) gave a relatively composite definition of 'purchasing' as "the process undertaken by the organisational unit that, either as a function or as part of an integrated supply chain, is responsible for procuring or assisting users to procure, in the most efficient manner, required supplies at the right time, quality and price and the management of suppliers, thereby contributing to the competitive advantage of the enterprise and the achievement of its corporate strategy" (Lysons & Farrington, 2006).

It has been also discussed about the differences and relationships between 'procurement' and 'purchasing'. Many researchers agree that 'procurement' is a more accurate term than 'purchasing' and contains the activities belonged to 'purchasing'. Meanwhile, the relationship between 'procurement', 'supplier management' and 'purchasing' was investigated by Lysons and Farrington (2006), presented in Figure 2.1.

Figure 2.1: The relationship between procurement, supplier management and purchasing



Source: Lysons, K. and Farrington, B. (2006), *Purchasing and Supply Chain Management*, 7th edition, Pearson Education Limited: Chapter 1, pp.8.

However, Day (2002) pointed out that "no definition can wholly incorporate the demands placed on a procurement team's set of skills, and any definition on procurement is open to criticise".

In summary, various definitions about 'procurement' are given. According to the argument made by Day (2002), none of them can cover all aspects and details required in procurement activities because each of them has specific points focused. Nevertheless, from a supply chain perspective, these definitions show the significance of procurement concerning the following issues:

- The relationships between procurement and organisations;
- The relationships between procurement and inter-organisations;
- The relationships between procurement and supply chain management.

As a result, it is essential to examine 'procurement' in a wider and broader way, and concern several areas: (1) the evolution of procurement, (2) the roles of procurement in supply chain, (3) direct and indirect procurement, (4) traditional procurement processes, and (5) key features of traditional procurement. Each of them is investigated in subsequent sub-sections.

2.2.2 Evolution of Procurement

From a historical point of view, procurement is a very ancient activity; however, "it was only in the latter half of the twentieth century that the importance of efficient purchasing was widely recognised and even later when its strategic aim – as opposed to operational significance – was acknowledged with an emphasis on procurement processes, relationships and performance rather than on products" (Lysons & Farrington, 2006).

In order to draw a clearer picture of procurement, various researchers identified distinctive stages of its evolutionary paths. Syson (1992) recognised three stages in accordance with the changing focus of procurement: (1) clerical routine activity, (2) commercial activities and cost savings, and (3) proactive strategic function. Morris and Calantone (1992) also identified three stages, basically with similar contents and functions contained in each stage defined by Syson, but differentiated the terminologies for each stage: (1) clerical, (2) asset management and profitability, and (3) core-strategic function. In addition, Table 2.1 presents another three sets of evolutional stages of procurement.

Table 2.1: Different evolutional stages for procurement

Researchers	Stages	Definitions and Characteristics
Stannack & Jones (1996)	Stage1: Product-centred purchasing	Product-focused – concerned with the five 'rights', which concentrate exclusively on the purchasing of tangible products and outcome dimensions by means of which this product can be described and mentioned.
	Stage2: Process-centred purchasing	Product-focused – moves beyond a concern with outcomes and begins to measure the process via which the outcome is delivered.
	Stage3: Relational purchasing	Process- and relationally-focused – expanded to include purchaser-supplier relationships and how these might be used to manage the quality and nature of the supplier.
	Stage4: Performance-centred purchasing	Focused on best product management methods. Employs an integrated methodology to manage relationships, processes and outcomes. Jointly resources this methodology with suppliers.
Reck & Long (1998)	Stage1: Passive	Definition: Purchasing function has no strategic direction and primarily reacts to the requests of other functions. Characteristics: • High proportion of time on quick-fix routine operations; • Functional and individual communications due to purchasing's low

		visibility; • Supplier selection based on price and availability.
	Stage2: Independent	Definition: Purchasing function adopts the latest purchasing techniques and processes, but its strategic direction is independent of the firm's competitive strategy. Characteristics: • Performance based primarily on cost reduction and efficiency disciplines; • Coordination links are established between purchasing and technical disciplines; • Top management recognises the importance of professional development; • Top management recognises the opportunities in purchasing for contribution to profitability.
	Stage3: Supportive	Definition: The purchasing function supports the firm's competitive strategy by adopting purchasing techniques and products, which strengthen the firm's competitive position. Characteristics: • Purchasers are included in sales proposal teams; • Suppliers are considered a resource, with emphasis on experience, motivation and attitude; • Markets, products and suppliers are continuously monitored and analyzed.
	Stage4: Integrative	Definition: Purchasing strategy is fully integrated into the firm's competitive strategy and constitutes part of an integrated effort among functional peers to formulate and implement a strategic plan. Characteristics: • Cross-functional training of purchasing professional and executives is made available; • Permanent lines of communication are established with other functional areas; • Professional development focuses on strategic elements of the competitive strategy; • Purchasing performance is measured in terms of contribution to the firm's success.
Jones (1999)	Stage1: Infant	Fragmented purchasing
	Stage2: Awakening	Realization of savings potential
	Stage3: Developing	Control and development of purchasing price/negotiation capabilities
	Stage4: Mature	80/20 recognised; Specialist buyers; Cost reductions; Commencement of supplier base management.
	Stage5: Advanced	Devolution of purchasing; Strong central control; Supply chain management

Sources:

- Stannack, P. and Jones, M. (1996), *The Death of Purchasing Procedures*, PSERA.
- Adapted from Reck, R. F. and Long, B. (1998), 'Purchasing a competitive weapon', *Journal of Purchasing and Materials Management*, Vol. 24, No. 3, 1998, pp.2-8.
- Jones, D. M. (1999), 'Development models', Supply Management, 18 March, 1999.

Accordingly, these diverse views on the evolution of procurement represent the following:

- The focus of procurement has been changed, from product-centred, to process-centred, to relation-centred, to entire organisational performance-centred.

- The roles of procurement have been changed, from commercial activities, to commercial processes, one of organisational functions, and one of organisational and even supply chain strategies.
- The relationships between procurement and other elements across supply chains have been changed, from independent role to promote organisational performances, to supportive role to strengthen organisational or even supply chain's competitive positions, to integrative role to formulate and implement strategic plans for organisations and supply chains.

2.2.3 Roles of Procurement in Supply Chain Management

First of all, "every business, irrespective of its size and sector, are involved in some form of buying and selling" (Oliver & Maringanti, 2007). In other words, procurement is an unavoidable and significant business function to any organisation, although it has been overlooked merely as a backwater or repetitive function for a long time.

There are data to support the importance of procurement. For example, a study made by AT Kearney on European and North American manufacturers found that in 1985, 30% of the total manufacturing cost stemmed from purchased material and services. In 1995, the figure rose to 55%, and for 2005, it was estimated to rise to 85%, which turns procurement into a very indispensable business function to any organisation (Knusden, 2003). Consequently, the series of data indicates that the role of procurement has become more and more important to organisations.

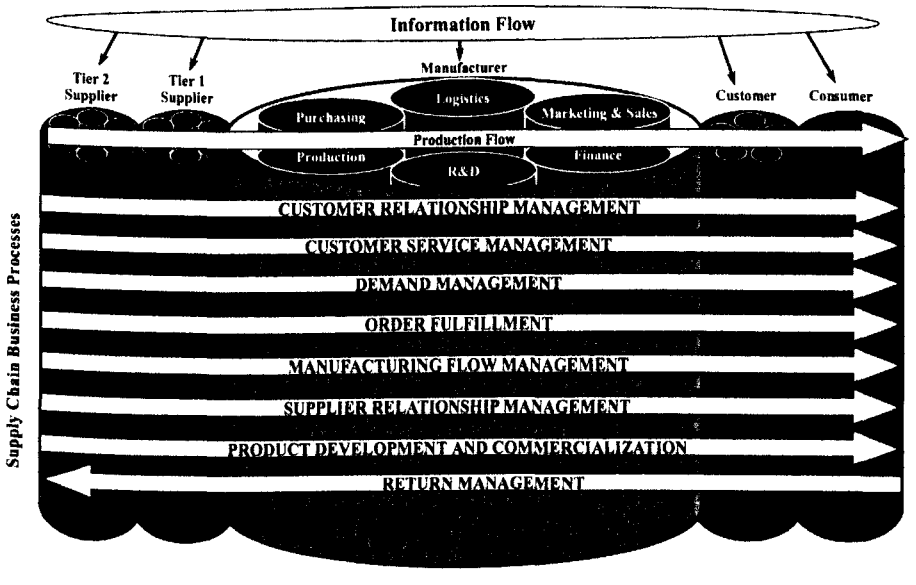
Additionally, the role of procurement in supply chain management can be identified in several models proposed by researchers. Here, several representative models are collated together to explore the role of procurement in supply chain management, which is identified by a variety of researchers, such as:

- Integrated supply chain management model (Cooper et al, 1997);
- The value chain model (Porter, 2004);
- Generalized supply chain model (Bowersox, et al, 2002); and
- Procurement classification model (Oliver & Maringanti, 2007).

Cooper et al. (1997) established an integrated supply chain model with eight supply chain management (SCM) processes originally postulated by the International Centre for Competitive Excellence (Figure 2.2). They examined procurement from an integrated supply chain perspective, and identified the functions of procurement as follows:

- Dealing with internal businesses to acquire external resources across the supply chains;
- Being part of essential commercial processes within organisations;
- Being one of significant organisational functions;
- Possessing importance information as part of the information flow involved across the supply chains.

Figure 2.2: Supply chain management: integrating and managing business processes across the supply chain



Source: Cooper, M., Lambert, D.M., Pagh, J. (1997), 'Supply chain management: more than a new name for logistics', *International Journal of Logistics Management*, Vol. 8 No.1, pp.10.

Overall, based on their model (Cooper et al, 1997), the role of procurement was regarded as an essential internal business function to link external activities across the supply chains.

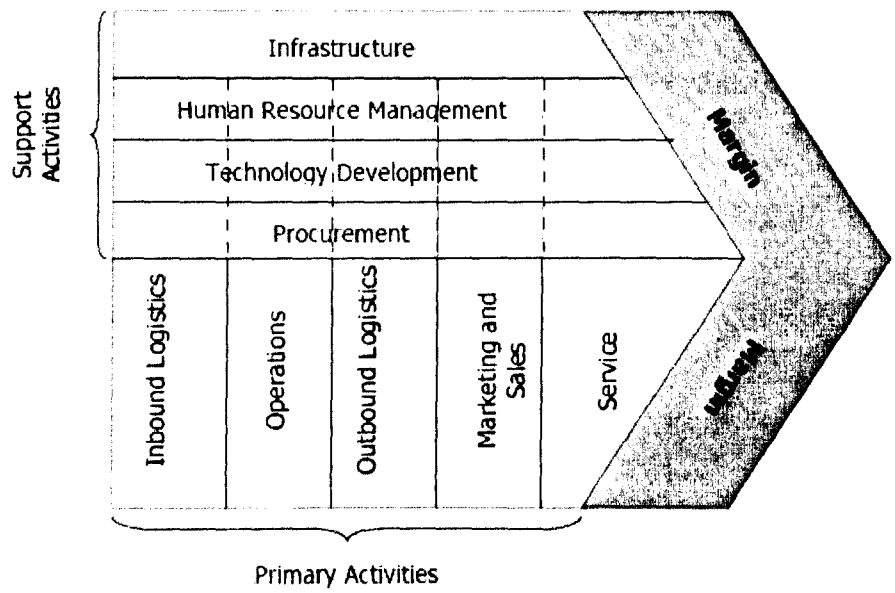
In Porter's value chain model (Figure 2.3), He identified the functions of procurement as follows (Porter, 2004):

- It is a supportive activity, and embedded within each of five primary activities.
- It contains all activities involved in acquiring resource inputs to the primary activities, including the purchase of raw materials, consumables, machines from external

vendors, and even suppliers from intermediate vendors (e.g. consultant companies, etc.);

- It supports the primary activities to obtain profit margins for an enterprise;
- The 'linkages' (or, interactions) between procurement and the interdependent parts of the value chain – both internal and external – are joined together, in which means the efficiency and costs incurred via procurement activities will affect the other elements on the value chain.

Figure 2.3: Porter's value chain model



Source: Porter, M. E. (1985), *Competitive Advantage*, Free Press, 2004, pp.3.

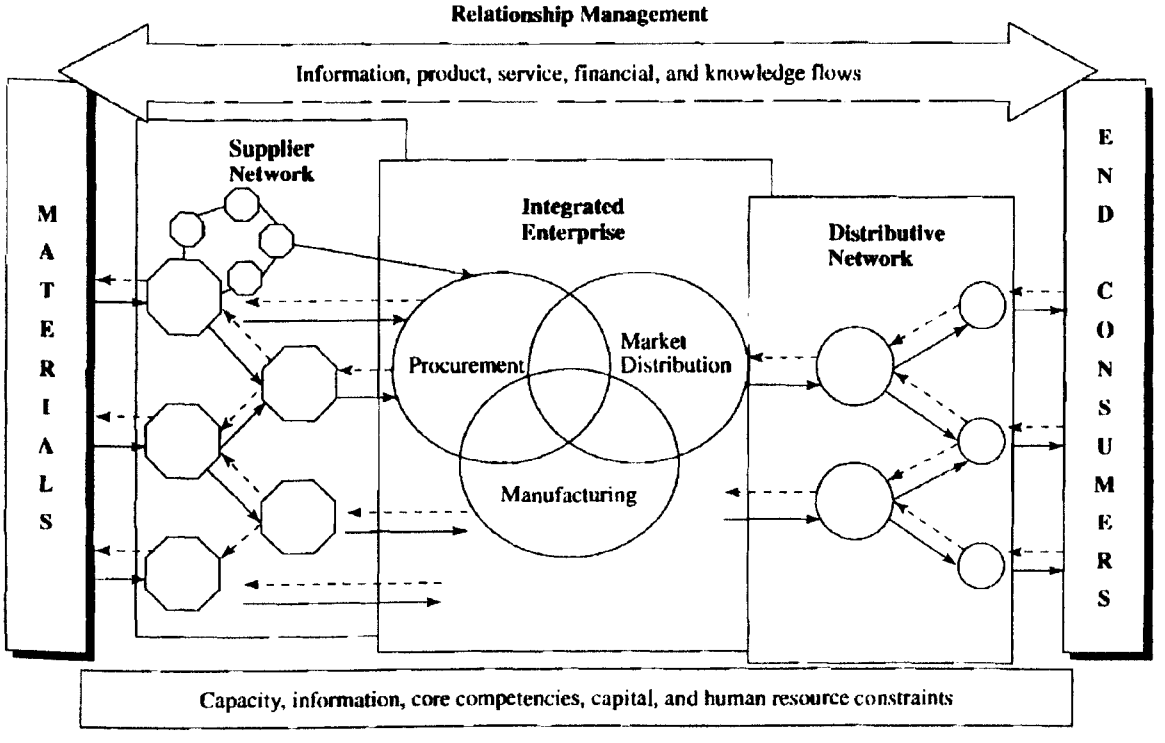
Overall, based on his model (Porter, 2004), the role of procurement was deemed as a supportive activity facilitating internal and external businesses across the supply chains.

In addition, Bowersox et al (2002) established an integrated supply chain model (Figure 2.4), from a logistics aspect. They identified the functions of procurement as follows:

- Being one of the three significant logistics functions within supply chains;
- Being responsible for procuring and arranging inbound movement of materials, parts, and/or finished inventory from suppliers to manufacturing or assembly plants, warehouses, or retail stores;
- Conveying fundamental message across the integrated value-creation process.

Overall, based on their model (Bowersox et al, 2002), the role of procurement was thought as a significant logistics function within supply chains.

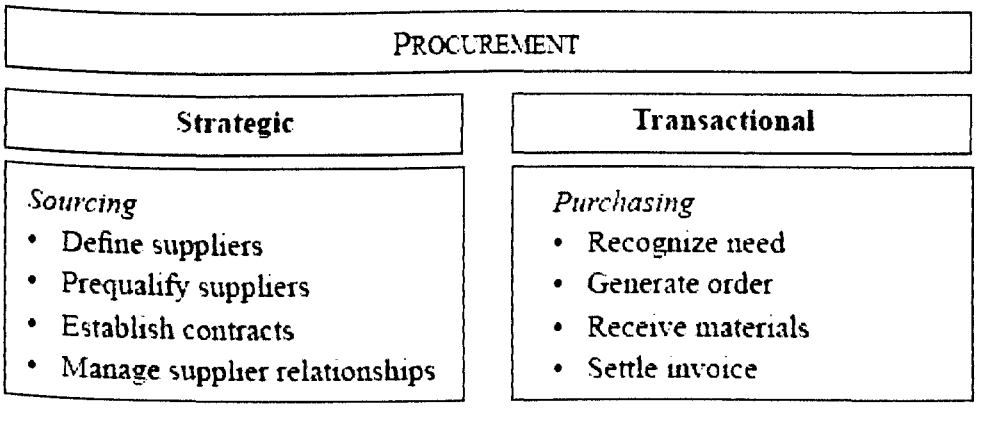
Figure 2.4: Bowersox, et al's generalised supply chain model



Source: Bowersox, D. J., Closs, D. J., Cooper, M. B. (2002), *Supply Chain Logistics Management*, McGraw-Hill Companies, Inc., New York: Chapter 1, pp.6.

Oliver and Maringanti (2007) presented a procurement classification model (Figure 2.5). Their model indicates that procurement contains strategic and transactional activities across the supply chains. Therefore, the role of procurement was defined as dealing with both transactional and strategic activities across the supply chains.

Figure 2.5: Procurement classification model



Source: Oliver, S., and Maringanti, K. (2007), 'Application of Web Services in the Context of E-Procurement: An SME Foci', *E-Procurement in Emerging Economies: Theory and Cases*, USA: Idea Group Publishing, 2007, pp.268.

In summary, there have been three major changes on the roles of procurement: (1) from internal commercial activities to significant process connecting internal and external businesses across the supply chains, (2) from operational activities to strategic functions crossing business boundaries across the supply chains, and (3) from independent activity to integrative strategy in relation to relationship management across the supply chains.

As a result, these changes indicate a more holistic concept to be necessarily formed, so that the significance of procurement can be more realised, the operational features of procurement can be more functioned, and hence the potential of procurement can be more obtained. Therefore, it is fundamental to observe more details relating to procurement, such as its different categories, traditional processes involved and the relevant key features.

2.2.4 Fundamentals of Procurement

2.2.4.1 Categories of Procurement: Direct & Indirect

"Traditionally, procurement has been broken down into two major categories: indirect and direct" (Neef, 2001).

In general terms, direct procurement describes the materials involved in the manufacturing supply chain and directly related to the production of finished goods. One fundamental feature of direct materials is that they are central to running business of a company. As Neef (2001) addressed, "direct materials tend to be purchased in large volumes, and depending on the level of sophistication of a company's forecasting and planning capability, are, at least to purchasing specialists, fairly predictable in name, if not in exact amounts". Also, direct materials can account for up to 60% to 80% of the total procurement expenditure in a manufacturing company, with far fewer procurement transactions (between 20% and 40% by volume) of the company (Neef, 2001; Oliver & Maringanti, 2007).

Typically, indirect procurement accounts for 60% to 80% of all purchasing transactions, whilst roughly about 20% to 60% of the total revenue of a typical company (Neef, 2001; Oliver & Maringanti, 2007). Compared with direct materials, indirect materials contain the commodities or services that do not result directly in finished goods of a company. Alternatively, they can be classified as goods which aid in the running of the business.

Moreover, there are two major sub-categories of indirect materials: (1) operating resource management (ORM), and (2) maintenance, repair and operations (MRO):

- ORM is usually used to describe the ordinary office products and services that organisations need to purchase to support routine jobs, such as, office supplies, furniture, forms, travel services, computers, and alike. They are not mission-critical, which means that they can be bought at any period with off-contract suppliers as they can be substituted easily.
- MRO materials, on the contrary, are generally mission-critical overhauls or maintenance items to business as they include crucial parts for the various manufacturing equipment which can be utilised to perform the actual production.

2.2.4.2 Traditional Procurement Processes

A typical organisation's approach to procurement is summarised by Neef (2001), containing four major sub-processes: (1) selecting goods process, (2) the requisition process, (3) waiting for approval process, and (4) creating the purchase order process. A general description of each process is listed in Table 2.2.

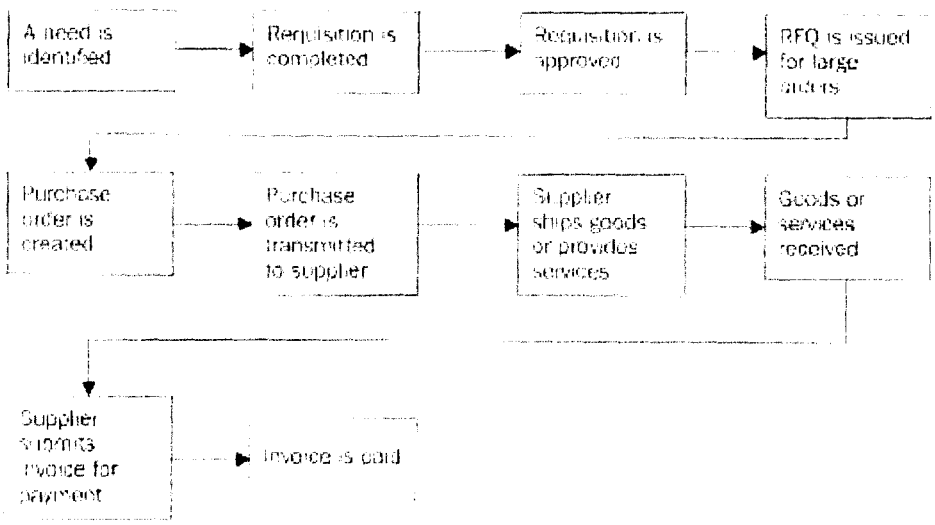
Table 2.2: Traditional procurement process

Process	Descriptions
Select goods	Today most companies still have shelves filled with well-thumbed (and often out-of-date) paper catalogues provided to them by the vendor. These are available only to those with direct access (usually central purchasing) and often require multiple calls and semi-confused conversations between users and the purchasing specialist, and then many other calls to the several suppliers in order to resolve issues on price, availability, and delivery times.
The requisition process	Except for those companies whose central purchasing department has direct links to a supplier through EDI, the requisition process is still paper-based, usually with multiple copies of requisition forms sent through internal mail to various managers within the approval chain. Approving managers seldom know if the vendor is "on-contract," or how the purchase will be affected by volume discounts.
Waiting for approval	In many companies, the approval process then follows two paths: technical and financial, with expensive or unusual items moving up a chain of multiple sign-offs, often with long delays and many explanatory phone calls. I recently worked with a financial services company that was examining its procurement process and that had seven layers of sign-offs for approval of items over $500 for both the technical and the financial sides. The average time for approval for high-cost items was three weeks, but could easily run into months.
Creating the purchase order	Once final approval has been given, central purchasing collects the paperwork and the information is transferred—by hand—to a purchase order form and then usually faxed to suppliers. This is generally accompanied by further phone calls to confirm receipt. Copies are sent to shipping and receiving and accounting and finance, and then filed with various department managers.

Source: Neef, D. (2001), E-Procurement: From Strategy to Implementation, Prentice Hall, Inc.: Chapter 2, pp.29-31.

In addition, when examining the location of procurement departments in any organisation, it usually follows a familiar pattern with separate procurement departments spread within the overall organisation, within different functions (e.g. manufacturing, sales, etc.). That is, traditional procurement process is usually ongoing in several departments within an organisation. A more activity-based traditional procurement process was established by Heywood et al (2002), to demonstrate the routine tasks involved on the operational side of a traditional procurement life cycle, as shown in below Figure 2.6.

Figure 2.6: Activity-based traditional procurement process



Source: Heywood, B. J., Barton, M., and Heywood, C. C. (2002), *E-procurement managing successful e-procurement implementation.*

Furthermore, in order to cut off the complexity of activity-based traditional procurement process, Lysons and Farrington (2006) divided traditional procurement activities into three phases: (1) the identification phase, (2) ordering phase, and (3) post-ordering phase, which are shown in below Table 2.3.

Table 2.3: Three phases of traditional procurement process

Phase	Major Targets & Steps
Identification	Notification of the need to purchase. Two options for processing identification by: • Either a requisition issued by the stores, stock control or a potential user; • Or a bill of materials issued by the drawing office, production control or equivalent department.
Ordering	On receipt, the requisition or bill of materials will be checked by the buyer for accuracy, conformity to specifications and purchase records to ensure whether the purchase is a 'rebuy' or a 'new buy' request. Two options for processing ordering: • Either the item is a standard 'rebuy' request: In this case, a repeat order may be issued if the item has been previously purchased from a

	satisfactory supplier at an acceptable price. • Or the item is a 'new buy' request: In this case, the following steps will be involved: (1) Enquiries or requests for quotation (RFQs) will be sent to possible suppliers, accompanied by additional, such as drawing, specifications and so on that will enable them to submit a quotation; (2) Quotations will be received in response to the requires and details of price, quality, delivery, tool costs and so on and terms of business compared; (3) When quantities are substantial and quality and/or delivery of great importance, further negotiation with suppliers – including an evaluation of their capacity to undertake the order – may be required; (4) A purchase order will be issued to vendor that gave the quotation, amended where necessary by subsequent negotiation, that was most acceptable. A copy of the order will be retained in the purchasing department; (5) An order acknowledgement should be required from the vendor. On receipt, the acknowledgement should be examined to ensure that the order has been accepted on the terms and conditions defined by the buyer or as subsequently agreed between the parties and then filed.
Post-ordering	In this phase, the following steps are involved: (1) It may be necessary to expedite the order to ensure that delivery dates are met or to expedite delivery of overdue orders. (2) An advice note, notifying that goods have been dispatched or are ready for collection, will be issued by the supplier. (3) On receipt, the goods will be checked for quantity by the stores. What matters of quality or specification are involved, they will be examined by the inspection department. If satisfactory, a goods received note will be completed and copies sent to the purchasing department. If not satisfactory, the purchase department will be notified so that the complaint can be taken up with the supplier. (4) An invoice for the value of the goods will be received from the supplier. This will be compared with the purchase order and goods received note. If satisfactory, the invoice will be passed to the accounts department for payment. (5) On completion, the order will be transferred to a completed orders file.

Source: Lysons, K. and Farrington, B. (2006), *Purchasing and Supply Chain Management*, 7th edition, Pearson Education Limited: Chapter 6, pp.183-185.

2.2.4.3 Key Weaknesses of Traditional Procurement

Based on the investigations on traditional procurement processes (section 2.2.4.2), several weaknesses have been identified and categorised into labour intensiveness and inefficiencies. Lysons and Farrington (2006) summarised the inefficiencies as follows:

- A sequence of non-value-adding clerical activities in organisations;
- Excessive documentation – for a new buy purchase, a minimum of seven different documents (requisition, enquiry, quotation, order acknowledgement, advice note, goods received note and invoice) will be involved, with expensive copying for purchase department records and information to other departments;
- Excessive time in processing orders both internally and externally;
- Excessive cost of purely transactional activities.

It therefore indicates the need of facilitating and innovating traditional procurement, bringing more benefits to individual and even collective organisations so that they can strengthen their competitive advantages in current increasingly changing business world.

2.3 Literature about SMEs

Interest in small and medium-sized enterprises has increased enormously in recent years. This phenomena "has been paralleled with an equally large increase in research on this form of economic activity" (Curran & Blackburn, 2001).

It is widely acknowledged that SMEs are regarded as an underlying foundation of the economy. For example, SMEs generate lots of employment opportunities for the economy. Many large firms were grown out of SMEs. Under nowadays globalisation circumstances, the collaborations between large firms and SMEs are quite significant, because SMEs are deemed as a strong and primary supply basis of large firms. Moreover, SMEs are characterised as heterogeneous in many respects, in that they are capable of providing specific goods and services which can greatly meet diverse customers' demands. In this sense, it is necessary to evaluate SMEs from many aspects, such as its importance and inherent features. As a result, a relatively comprehensive picture of SMEs is outlined. Therefore, several strengths and weaknesses of SMEs are summarised, indicating that it is critical to assist SMEs to reach their full potentials with effective external support.

This section is organised around the following structure: (1) the importance of SMEs to the economy (section 2.3.1), (2) inherent features of SMEs (section 2.3.2), (3) strengths and weaknesses of SMEs (section 2.3.3).

2.3.1 Importance of SMEs to the Economy

Basically, the importance of SMEs is presented in five aspects, including an underlying backbone to the economy, a primary contribution for generating employment opportunities, infancies of many large firms, a consolidated supply base of many large firms, a major channel to provide diverse and heterogeneous goods and services.

In terms of the role as underlying foundation to the economy, there is much data as strong proof or evidence based on a variety of studies concerning SMEs. In Europe, there are more than 20 million enterprises by 2004, providing 122 million jobs ('Europe' here comprises 19 countries: the 15 EU members in 2003, plus Iceland, Liechtenstein, Norway and Switzerland. It thus excludes countries in the 2004 enlargement and candidate countries for future EU enlargement) (Observatory of European SMEs, 2002). In Table 2.4 below, it illustrates the

growth in the numbers of SMEs in the UK from 1980 to 2004. The number of SMEs stabilised at 3.7 million for the rest of the decade till 2001; whilst, the number rises from 2002 to 2004.

Table 2.4: Number of SMEs in the UK (1980 - 2004)

Year	1980	1990	1995	2000	2001	2002	2003	2004
Number of firms (millions)	2.4	3.7	3.7	3.7	3.7	3.8	4.0	4.3

Source: SME Statistics for the UK, Small Business Service, 2005.

In regard to the contribution to employment opportunities, Stokes and Wilson (2006) suggested that "the increase in small firms and in self-employment in the UK has subsequently been greater than in many industrialized nations as the contribution of small firms to both employment and output in the UK still lagged behind that of leading economies such as the USA, Japan and Germany".

In Table 2.5 below, it presents the share of total employment and turnover by SMEs in the UK. In 2004, over 95 per cent had fewer than 10 employees. Over 70 per cent of the total, or 3.1 million businesses, had no employees at all, representing the increasingly large number of one-person businesses. Micro firms of less than 10 employees accounted for nearly one-third of employment in the private sector and 23 per cent of turnover. Those employing under 50 people accounted for over 10 million of the 22 million jobs in the UK private sector (47 per cent of non-government employment) and 37 per cent of turnover. In total, SME firms employing less than 250 people now contributes 58 per cent of employment and over 50 per cent of turnover in the UK (Bannock & Daly, 1994).

Table 2.5: Profile of the UK business population, 2000, 2003 and 2004 (unit: %)

Size (No. of employees)	No. of businesses			Employment			Turnover		
	2000	2003	2004	2000	2003	2004	2000	2003	2004
None	69.6	71.3	72.8	13.5	14.6	15.7	7.4	7.9	8.1
1-9	25.3	23.9	22.7	16.7	16.9	16.7	15.4	15.6	14.6
10-49	4.1	4.0	3.7	13.3	14.7	14.4	14.4	14.9	14.2
50-249	0.6	0.6	0.6	11.4	12.0	11.7	13.9	14.0	14.3
250+	0.2	0.2	0.2	44.9	41.8	41.5	48.8	47.6	48.7

Source: SME Statistics for the UK, Small Business Service, 2001, 2004, 2005.

Moreover, Stokes and Wilson (2006) observed that the employment in the USA was still more concentrated in larger companies than the European coverage and Japan, with approximately around 49 per cent of its workforce in large companies in the USA while

Japan has only 26 per cent. In Japan, 56 per cent of people worked in firms of less than 100 employees, close to the European average, but more than in the USA and in the UK. As well, in most parts of the world, the small business population was continuing to grow in importance.

In terms of being infancies of many large firms, there are many studies examining the relationships between large firms and SMEs from a historical perspective. It is obvious that many large firms were grown out of SMEs when looking back their histories. For example, Takeuchi (1999) identified that Japanese success in the last quarter of the twentieth century largely rely on the largest concentrations of SMEs in the manufacturing sector in Japan. In the UK, Markets and Spencer was initially opened as a small stall in open market in the city of Newcastle. In addition, there are lots of famous international corporations grown out of SMEs, such as GM, Ford, Pizza Hut, and so on.

With regard to the relationships between large firms and SMEs, many researchers claim that SMEs can be regarded as a consolidated supply base of large firms (Quayle, 2003; Boeck, et al, 2009). For example, under current globalisation circumstances, the economies of scale are essential in international commerce, which is one of the major advantages characterised by large firms; whereas, globalisation brings the threat to SMEs because they lack the leverages, such as, the economies of scale, brand loyalties, and so on. Nevertheless, Berry (2007) argued that "globalisation may also increase the importance of keeping the SME sector strong since its role in providing subcontractors for large corporations". As a result, the collaboration between large firms and SMEs is fundamental in international commerce, and largely depends on subcontracts to sustain the relationships between the two parties.

In terms of the heterogeneous nature, it is one of inherent features of SMEs, and also one of major reasons why SMEs can survive under current increasingly changing environment. It is very rare to see that SMEs can be strangled by the monopolisation of large firms in many respects (Berry, 2007).

In a summary, it is essential to reach the full potential of SMEs because of their significance to the economy. Also, a more comprehensive understanding of SMEs is to be established through examining various aspects of SMEs, such as their classifications, inherent features, advantages and disadvantages, and external supports to them.

2.3.2 Inherent Features of SMEs

As explored earlier, it is essential to investigate the inherent features of SMEs themselves. Perhaps, "the most prominent characteristic of SMEs in the UK is the numerical dominance of businesses that have no, or very few, employees" (Institute for Employment Studies, 2005). Indeed, apart from being small, many other features of SMEs have been identified by numerous researchers, business practitioners and government policy makers.

This section utilises the findings upon a number of surveys to outline the inherent features of SMEs, focusing on four aspects:

- Profiles of owners/managers;
- Organisational size;
- Business growth;
- Creativity and innovation.

Furthermore, on the basis of these features of SMEs, the next section summarises their strengths and weaknesses, indicating that SMEs do need external support, especially when they initiate their procurement improvement and carry out corresponding e-procurement projects.

2.3.2.1 Profiles of Owners/Managers of SMEs

The age of the owners/managers of SMEs has been considered by researchers when examining the backgrounds of those who run SMEs. For example, Curran and Burrows found that there are two age-windows for self-employment and owner-management: the first is in the age group from 35 to 50, and the second after normal retirement at 65 (Curran & Burrows, 1988). Meanwhile, they addressed that three fundamental conditions (i.e. experience, stable background, and capital assets) determine that the owners/managers of SMEs are more likely to come with middle-age – over 40 per cent of the self-employed are in the 35-50 age range. Subsequently, age is significant and beneficial to the owners/managers of SMEs, because it makes sense for people to spend a certain range of time to collect the information and skills necessary to exploit opportunities in a specific industrial sector (Shane, 2003), and establish sufficient "credibility when it becomes necessary to transmit that information to other people in the course of obtaining resources or building organisations" (Freeman, 1982).

Education is another widely area attracting researchers' attentions. Traditionally, the owners/managers of SMEs were deemed as more capable of practical activities, however, lack of formal educational qualifications. In the research conducted by Stokes and Wilson (2006b), they found that the Bolton Report supported this view by suggesting that small businesses owner-managers were less well educated than the average in the population. Moreover, Stokes and Wilson (2006b) addressed that "this educational gap seems to have narrowed significantly, with changing attitudes towards small business and the growth of knowledge-based small enterprises in the services sectors". Overall, although there is not a clear correlation between education and the success of SMEs, the researchers do suggest that education is particularly significant to the owner/managers of SMEs, in that they are more likely to exploit opportunities if being better educated (Bates, 1995; Shane, 2003).

Except for the above all inherent features of the owner/manager of SME, the 'entrepreneurship' possessed by the owner/manager of SMEs is another popular topic in SME research area. Basically, from a large quantity of surveys, the owners of SMEs are mostly believe they work harder, earn more money, and are happier than if they worked for a large company. Behind the self-acknowledgement of the SMEs' owners, Miller (1983) recognises the key elements of entrepreneurship including risk-taking, pro-activity and innovation. However, Slevin and Covin (1990) argued that the three elements are not sufficient to ensure organisational success. Instead, they addressed that "a successful firm not only engages in entrepreneurial managerial behaviour, but also has the appropriate culture and organisational structure to support such behaviour". In particular, five traits or personality characteristics, known as 'big five' personality dimensions, have been put forward as important influences in entrepreneurship, and include the need for achievement, the need for autonomy, the locus of control, risk-taking and self-efficacy (Vecchio, 2003; Stokes & Wilson, 2006).

Further, Zimmerer and Scarborough (2005) summarised the benefits of entrepreneurship of the owner of SMEs, such as:

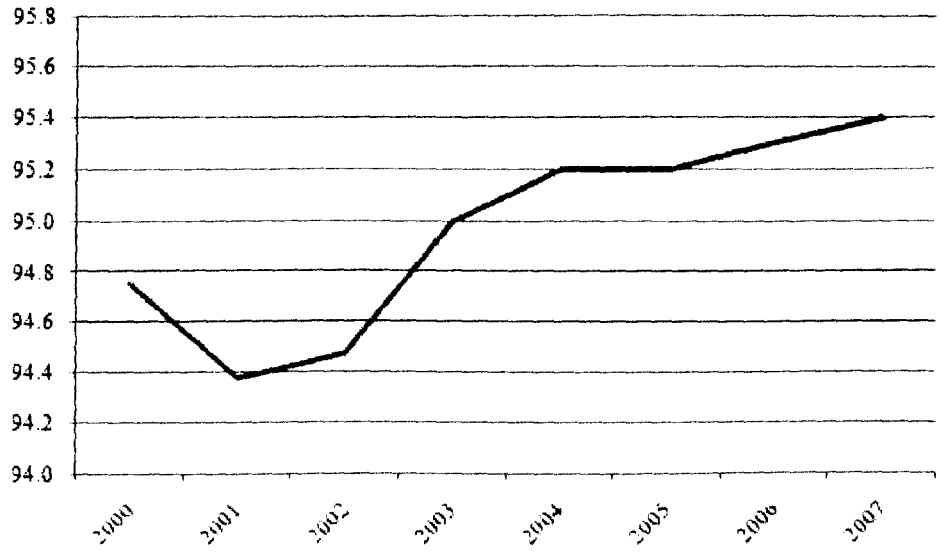
- Opportunity to create own destiny;
- Opportunity to make a difference;
- Opportunity to reach the full potential of the organisational owner;
- Opportunity to reap impressive profits
- Opportunity to contribute to society and be recognised for the owner's efforts;
- Opportunity to do what the owner enjoys and have fun at it.

In short, the owners/managers of SMEs are characterised as entrepreneurship which are mainly represented as the form of personal passions, motivations, innovations, and the preference on applying theoretical principles into the practices. Partly, these key profiles lead SMEs to dominate a country's new and fast growing industries (Berry, 2007). On the contrary, these key profiles might also take SMEs to suffer from higher failure and exit rates than large firms (Berry, 2007). Therefore, it is critical for SMEs to receive external supports, either from government or SMEs themselves.

2.3.2.2 Organisational Size of SMEs

This is a quite popular area examined by researchers and government departments. The Institute for Employment Studies (2005) published that 71 per cent of total sample businesses have no employee and 24 per cent have 1-9 employees. The data collected by the Department for Business Innovation and Skills presents a tendency that the organisational size has a tendency to become smaller with no or very a few employees exclusive the owners and partners of SMEs in the UK from 2000 to 2007, presented in Figure 2.7.

Figure 2.7: The percentage of enterprises with up to nine employees (2000 - 2007): UK



Source: Department for Business Innovation and Skills, SME Statistics 2000 to 2007, UK.

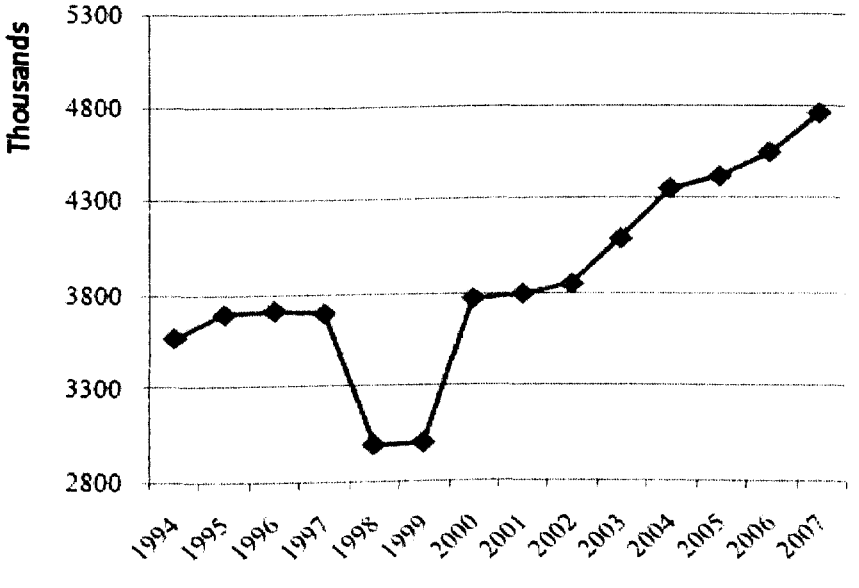
In summary, the organisational sizes of SMEs are getting more and more condensed. This tendency indicates not only the increasing requirements for the internal employees of the organisations but also the urgent need of external support to the organisations.

2.3.2.3 Business Growth of SMEs

This is another popular, which covers four sub-areas: (1) the number of SME organisations, (2) the business employment/populations employed by SMEs, (3) the business growth rate of SMEs, and (4) the main obstacles to achieving business success.

In terms of 'the number of SME organisations', it has been steadily increasing in most developed countries. For example, the Department for Business Innovations and Skills observed that the number of SMEs has increased from 3.6 millions in 1994 to 4.8 millions in 2007 in the UK (Figure 2.8). More importantly, the total number of SMEs has occupied around 94.3% to 95.4% in the overall businesses in the UK, which elucidates SMEs as a fundamental backbone to the entire economy in the UK (Department for Business Innovations and Skills, 1994 to 2007 SME statistics).

Figure 2.8: The number of small businesses in the UK (1994 to 2007)



Source: Department for Business Innovation and Skills, SME Statistics 1994 to 2007, UK.

With regard to 'the number of business employment' employed by SMEs, it has tended to increase, and has great impact to the health of entire economy in the UK, as being the major channel to provide job positions. The Department for Business Innovations and Skills observed that the number of employees in SMEs has increased from 9.1 millions in 2000 to 10.3 millions in 2007 in the UK (Department for Business Innovations and Skills, 2000 to 2007 SME statistics).

In terms of 'the business growth rate' of SMEs, the findings upon many studies indicate that it is still weaker than large corporations. The Institute for Employment Studies (2005) recognised two trends popular in SMEs: one is that the larger the business, the more likely it is to aim to grow in the next two to three years; and the other is that the anticipated growth correlated negatively with age of the business, which shows the younger businesses are much more likely to anticipate to grow (see Table 2.6).

Table 2.6: Proportion of businesses that aim to grow their business over the next two to three years

	All firms		Firms with employees only			
			Employment size			
Proportions who said...	All	Without employees	With employees	Micro 1-9	Small 10-49	Medium 50-250
Aim to grow the business	44%	39%	56%	54%	65%	77%
Will not grow the business	56%	61%	44%	46%	35%	23%
Unweighted N =	*8,640*	*1,430*	*7,210*	*2,900*	*2,889*	*1,421*

	Firms with employees only								
	Industrial sector (grouped SICs)				Proposing growth in next 2 or 3 years		Age of business		
Proportions who said...	Primary AB	Pro-duction CDE	Cons-truction F	Services G-O	Yes	No	<4 years	4-10 years	10 plus years
Aim to grow the business	39%	60%	42%	58%	100%	0%	76%	65%	48%
Will not grow the business	61%	40%	58%	42%	0%	100%	24%	35%	52%
Unweighted N =	*228*	*1,476*	595	*4,911*	*4,517*	*2,693*	*465*	*1,826*	*4,919*

Source: Institute for Employment Studies, *Annual Survey of Small Businesses: UK*, 2005.

Note: 0% = no cases observed.

Base: All businesses; unweighted N = 8,640.

With regard to the 'main obstacles to business success', The Scottish SMEs observed five biggest obstacles to SMEs business success: (1) taxation, VAT, PAYE, National Insurance, business rates (13 percent of employers), (2) competition in the market (12 percent of employers), (3) regulations (11 percent of employers), (4) cash flow (9 percent of employers), and (5) the Economy (7 percent of employers) (IFF Research Ltd, 2006).

Moreover, the Small Business Research Trust, a research community in the UK, announced that the barriers to business growth are cited consistently as taxation, employment regulations and business rates (SBRT, 2007: Quarter 2):

- In particular, for micro businesses, taxation is the most prominent concern, followed by late payment/bad debt. A significant change for micro businesses since the last quarter is an increasing concern over banks/finance.
- For small businesses, employment regulation has moved to the top as the main barrier to growth, then taxation.

Overall, the business growth of SMEs is generally viewed as slower than large firms, although they have more growth potential than large firms. However, many obstacles, such as taxation, market competition, the economy, investment/financing, and regulations, have prohibited the development progress of SMEs, indicating that it essential to provide relevant support to SMEs on tackling these obstacles.

2.3.2.4 Creativity and Innovation in SMEs

As to creativity and innovation in SMEs, it represents a learning process for SMEs. As many researchers addressed, learning is important to small business survival, innovation and profitability (Chaston et al, 1999; Massey & Walker, 1999). In particular, the learning process amongst SMEs is actually varying from the way in large corporations (Kearney, 1998; Hawke, 1999; Breen & Bergin-Seers, 2002).

Indeed, Stokes and Wilson (2006) addressed that "the small firm is seen as playing an important role in the innovation of new products and processes". They argued that large firms have an advantage in capital intensive, concentrated industries where substantial resources and converging technologies are present; whereas, smaller firms have the advantage in emerging industries with high levels of innovation. Indeed, SMEs are often regarded as being more innovative than large firms owing to their flexibility and willingness to try new approaches and technologies (Rothwell, 1986, Stokes & Wilson, 2006).

Basically, the creativity and innovation of SMEs are chiefly represented as the form of staff training, the utilisation of information and communication technologies (ICTs), and the innovation in products and processes.

With respect to the 'staff training', it is normally an effective and active way for SMEs to conduct their learning practices, which might lead to creativities or innovations in SMEs. Explicitly, this form of creativity and innovation contains many informal modes happening in

the workplace, e.g. discussions with product representatives, attending seminars organised by external supporters, gleaning knowledge from new staff or borrowing approaches learned from their business competitors, and so forth (Kerr & McDougall, 1999). The Institution for Employment Studies (2005) reported that the larger size of SME organisation, the more frequent of staff trainings; meanwhile, the longer of small business sustaining, the more frequent of staff trainings.

In terms of the 'utilisation of ICTs', it includes the 'use of internet technology' and the adoption of e-business or e-commerce. OECD (2004) observed that the average level of adopting advance ICTs amongst SMEs is still lower than large firms, and that the volume of Internet sales by SMEs is far below those of larger firms. In brief, the main issue of most SMEs was still at a stage where establishing a Web site or adopting e-commerce. Moreover, OECD (2004) stated that "smaller firms may have fewer incentives to integrate their business processes than larger firms". In addition, the Institute for Employment Studies (2005) reported that: (1) over 77% of small businesses use computers, (2) about 66% of small businesses use the Internet, (3) amongst the usage of the Internet: about 94% usage on email, 64% on online purchasing, and 62% on business website. In short, the larger size the SME organisation, the more likely they use ICTs to facilitate their businesses.

In regard to the 'the innovation in products and processes', a range of studies provide data evidence. For example, the Institute for Employment Studies (2005) observed that there were 26% of small businesses introducing some kind of new or improved product or service in 2004, and around 15% of small businesses introducing some kind of new process way of working in 2004. As a result, the larger size of SME organisation, the more capabilities they have to try and apply new approaches and technologies to improve their original ways of operations. With the business growth, the longer of SME business sustaining, the lower frequency of upgrading their business operational modes.

Overall, a summary can be made here: the creativity and innovation in SMEs remain at high level; however, it may take more time and resources for SMEs to adopt e-business strategies, in particular the adoption of B2C and B2B electronic commerce in SMEs will still be lagged behind large firms. Consequently, the creativity and innovation in SMEs, especially on the process innovation, are supported by ICTs and carried out on electronic networks.

2.3.3 Strengths and Weaknesses of SMEs

According to the previous section about inherent features of SMEs, this section investigates the strengths and weaknesses of SMEs.

The strengths of SMEs are summarised as follows (Ritchie and Brindley, 2000; Macqueen, 2004; Noori and Lee, 2006):

- Flat and quick responsive organisational structure;
- Personalised management with little devolution of authority;
- Flexibility and adaptability to changes;
- Lower costs and specialised products;
- High quality of products and services;
- High innovation rate in products and processes.

The weaknesses of SMEs are summarised as follows (O'Regan, et al, 2005; Sharma et al, 2005; Sharma and Bhagwat, 2006; Bhagwat and Sharma 2006):

- Lack of skilled personnel;
- Limited power in resource allocation and lobbying;
- Severe resource limitations in terms of management and manpower, R&D, technical support, finance, marketing, etc.;
- Limited channels in terms of business cooperation and integration;
- Limited power in influencing the markets;
- Open and vulnerable to external environments.

In summary, it is essential to reach full potential of SMEs through combining both their own strengths and external supports.

2.4 E-Procurement Technologies

As discussed in previous sections, inefficiencies existed in traditional procurement has greatly hindered the development of many organisations. Thus, a more innovative and efficient solution became more and more necessary to cut off these inefficiencies. Under this circumstance, the concept of inter-organisational system (IOS) was utilised to better facilitate the communications and cooperation between organisations.

"Before the advent of the Internet, organisations were using electronic data interchange- (EDI) based IOS to share data with trading partners" (Pani, 2007). Further, he addressed that Inter-organisational Information System (IOIS) build on common EDI standards to design and deploy different functionalities that interconnect multiple organisations. In this respect, Pani claimed that IOIS can be viewed as an application-enabled prototype for facilitating procurement between organisations.

With the rapid evolution of information and communication technologies (ICT), particularly the Internet-based technologies, new technologies have been developed, such as web services. Web services have been defined and standardized by the World Wide Web Consortium (W3C).

2.4.1 Inter-Organisational Information Systems (IOIS)

An IOIS is defined as a computer and communication infrastructure, crossing company boundaries and enabling information sharing (Cash & Konsynski, 1985). In 1966, Kaufman predicted that computer networks would improve coordination between organisations and radically alter traditional billing and payment procedures, which already presents an early interest in IOIS (Kaufman, 1966). In 1982, Barrett and Konsynski used the term IOIS for the first time. Since then, a number of studies on this issue, not only theoretical, but also empirical, have been carried out. The below Table 2.N, it lists various IOIS classifications made by a variety of researchers.

Table 2.10: IOIS classifications

Author(s)	Classification Criteria	Typology
Barrett and Konsynski (1982)	Intensity of organization's participation	Remote I/O node; application processing node; multi-participant exchange node; network control node; integrating network node
Bakos (1987)	Value chain perspective	Two dimensions: functional structure and location of value-adding process
Malone, Benjamin, and Yates (1987)	Transaction cost economics	E-market and e-hierarchy
Choudhury (1997)	Transaction cost economics	E-monopolies, e-dyad, and multilateral IOIS
Johnston and Vitale (1988)	Competitive advantage and innovation	Dimensions are: business purpose; relationship between the sponsoring organizations and other participants; and information functions performed by the IOIS.
Benjamin, deLong, and Scott Morton (1990)	Transaction cost economics	Two dimensions: e-market versus e-hierarchies and routine transaction versus task support
Kumar and van Dissel (1996)	Interdependence among organizations	Networked IOIS, pooled information resource IOIS, and value/supply-chain IOIS
Hong (2002)	Role linkage and system support level	Resource pooling, operational cooperation, operational coordination, and complementary cooperation
Riggins and Rhee (1998)	Level of information shared	Intronets and Supranet

Source: Adapted from Pani, A. K. (2007), 'Perspectives from IOIS, EDI, and Channel Management: Research Issues in E-Procurement', E-Procurement in Emerging Economies: Theory and Cases, USA: Idea Group Publishing, 2007, pp. 5.

Overall, the major function of IOIS has been identified as facilitating technology-based cooperation across organisations (Bakos, 1991). Further, Oliver and Maringanti (2007) indicated that IOIS basically enables two firms to exchange business-related documents in some pre-agreed proprietary format. However, as processes evolved, EDI technologies rise, as a variant of IOIS.

2.4.2 Electronic Data Interchange (EDI)

2.4.2.1 Definition of EDI

The US National Institute of Standards and Technology (1996) defined EDI as "the computer-to-computer interchange of strictly formatted messages that represent documents other than monetary instruments." This definition emphasizes that the formatted messages (e.g. business orders, shipping data, etc.) are transferred between computers of two parties (e.g. business partners).

Putte et al (2003) pointed out the common definition that "EDI is the transfer of business data between computer applications using a mutually agreed standard to describe the data contained in the message."

2.4.2.2 EDI Standards

EDI began in United States around 1968, when two companies started exchanging point-to-point information between their computers via private telecommunication networks (Bergeron & Raymond, 1992). Many EDI message standards are developed and established over the latest two decades. Nowadays, the four major EDI message standards are:

- ANSI ASC X12 - US standard
- EDIFACT - standard recommended by the United Nations, used mainly in Europe
- UNTDI - UK retail standard
- ODETTE - European automotive industry

There are also others EDI message standards, such as HIPAA, VICS, VDA, UCS, etc. (Putte et al, 2003).

2.4.2.3 The Advantages and Disadvantages of EDI

A number of advantages of adopting EDI have been widely acknowledged, such as the following:

- Minimization of paper use (Putte et al, 2003);
- Reduction in lead times as buyers and suppliers work together in a real-time environment (Armstrong & Jackson, 1991; Lysons and Farrington, 2006);
- Improved inventory management (Putte et al, 2003);
- Facilitation of global purchasing using international standards (Lysons and Farrington, 2006);
- EDI tends to promote long-term buyer-supplier relationships and increase mutual trust (Lysons and Farrington, 2006).

However, a range of disadvantages of adopting EDI have been discussed by many researchers as well, such as the following:

- Expensive cost to implement EDI into organisations (Khazanchi, 1995; Presutti, 2002; Lysons & Farrington, 2006);
- Inflexible method to transmit mostly cumbersome and static business data between organisations (Lysons & Farrington, 2006);

So far, the organisations adopting EDI technology are mostly large firms. Johnston and Mak (2000) addressed that "in traditional EDI systems, only 20% of suppliers, by number, who account for 80% of transaction value, participate and thus a large proportion of suppliers, usually SMEs, remain outside the EDI". Overall, although EDI technology is embedded with many advantages to business, it is still regarded as a cost-intensive technology with competing standards, high-entry barriers and lack of suitability for real-time transactions, especially not suitable for SMEs (Oliver & Maringanti, 2007). Additionally, EDI is still one of major ICTs utilised to facilitate procurement transactions in SMEs because of its advantages (European Commission, 2008). Meanwhile, with the growth of the Internet, web-based EDI has become more and more popular in SMEs.

2.4.3 Web Services

Prior to Web Services, there are two major previous standards, i.e. the Common Object Request Broker Architecture (CORBA) defined by the Object Management Group (OMG), and the Microsoft technology Distributed Component Object Model (DCOM), which attempt to enable software components written in multiple computer languages and running on multiple computers to work together. In this sense, Oliver and Maringanti (2007) addressed that "web services are an evolution of the previous attempts by the industry like CORBA and DCOM".

2.4.3.1 Definitions of Web Services

W3C (2004) defined Web Service as "a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards".

Also, Cerami (2002) gave a definition of web services that "is any service that is available over the Internet, uses a standardized XML messaging system, and is not tied to any one operating system or programming language. Although not required, web services should also be self-describing via a common XML format and discoverable via a simple find mechanism".

Additionally, Guruge (2004) gave another definition of web services as "Web-oriented software component methodology that deals with modular, self-contained, self-describing, reusable software components whose public interfaces are described using XML. They are an enabling technology for providing applications with software functionality in a standardized form from within an enterprise or from third-party service providers".

Comparing the above three definitions, the first one made by W3C has been used pervasively as the most standard definition of web services. It contains not only the characteristics of web services, but also the technologies supportive of web services. However, the other two definitions have limitations – both of them are centred merely on the characteristics of web services.

2.4.3.2 Characteristics of Web Services

As to the characteristics of web services, Guruge identified ten quintessential features. Meanwhile, he claimed that "at least six, or possibly seven, can be explicitly attributed to four key enabling technologies—namely, XML, SOAP, WSDL, and UDDI" (Guruge, 2004). Table 2.8 lists the ten quintessential characteristics of web services.

Table 2.8: The characteristics of web services

Web Service Characteristic	Made Possible By
Modular	—
Self-contained	—
Self-describing	WSDL
Self-advertising	UDDI
Uniquely addressable	Internet protocols (e.g., DNS)
XML-centric	XML
Standards based	XML, SOAP, WSDL, and UDDI
Platform independent	XML and SOAP
Programming language agnostic	XML and SOAP
Amalgamative in mix-and-match	

Source: Guruge, A. (2004), *Web Services: Theory and Practice*, Elsevier Digital Press: pp.19-21.

2.4.3.3 XML

"Extensible Markup Language, abbreviated XML, describes a class of data objects called XML documents and partially describes the behaviour of computer programs which process them" (W3C, 2008). XML was standardized by the W3C at the beginning of 1998.

As being the foundation of Web services, XML not only provides the description, storage, and transmission format for data exchanged via Web services, but also is used to create the Web services technologies that exchange the data (Newcomer, 2003). The XML syntax used in Web services technologies specifies how the data is generically represented and transmitted, and how the services are published and discovered (Newcomer, 2003). "Web services implementations decode these various bits of XML to interact with the various applications and software domains underneath the services" (Newcomer, 2003).

2.4.3.4 WSDL

WSDL (Web Service Description Language) is "a language for describing Web services. WSDL describes Web services starting with the messages that are exchanged between the requester and provider agents. The messages themselves are described abstractly and then bound to a concrete network protocol and message format" (W3C, 2004). It defines the high-level functionality of a web service, and describes web services based on XML grammar (Guruge 2004). WSDL contains six major elements: definitions, types, message, portType, binding, and service. (Cerami, 2002a)

As a consequence, the major contribution of WSDL to web service is identified that "the implementations behind the web services can be anything, as long as both the service sender and receiver agree on the standard of WSDL" (W3C, 2004).

2.4.3.5 UDDI

According to the definition given by Guruge (2004), UDDI (Universal Description, Discovery and Integration) is "a standard for web-based, electronic directories that contain detailed information about businesses, the services they provide (including Web services), and the means for utilising these services".

In terms of the purpose of the UDDI registry, it provides a way for people to find and use a set of services after the web service is set up (Newcomer, 2002). In other words, the UDDI, similar to White Pages or Yellow Pages for web services, establishes an industry consortium to create and implement a directory of web services. Therefore, the UDDI registry accepts information describing a business, including the web services it offers, and allows interested parties to perform online searches and downloads of the information (Newcomer, 2002). In a case when a service requester does not know the exact business name or wants to compare several service providers' terms and conditions, the need for a generic search and discovery mechanism becomes more urgent. In this case, the UDDI registry offers such a mechanism, which leads to it acting as a significant element to the ultimate success of Web services. Shortly, UDDI resources can be regarded as part of the web services architecture and infrastructure.

2.4.3.6 SOAP

"SOAP (Simple Object Access Protocol) provides a standard, extensible, composible framework for packaging and exchanging XML messages. SOAP defines an XML-based messaging framework: a processing model and an extensibility model. SOAP messages can be carried by a variety of network protocols; such as HTTP, SMTP, FTP, RMI/IIOP, or a proprietary messaging protocol." (W3C, 2004) Newcomer (2003) addressed that SOAP provides a common data transfer protocol for effective networked communication with the world's premier data representation format XML and world's premier network World Wide Web, SOAP.

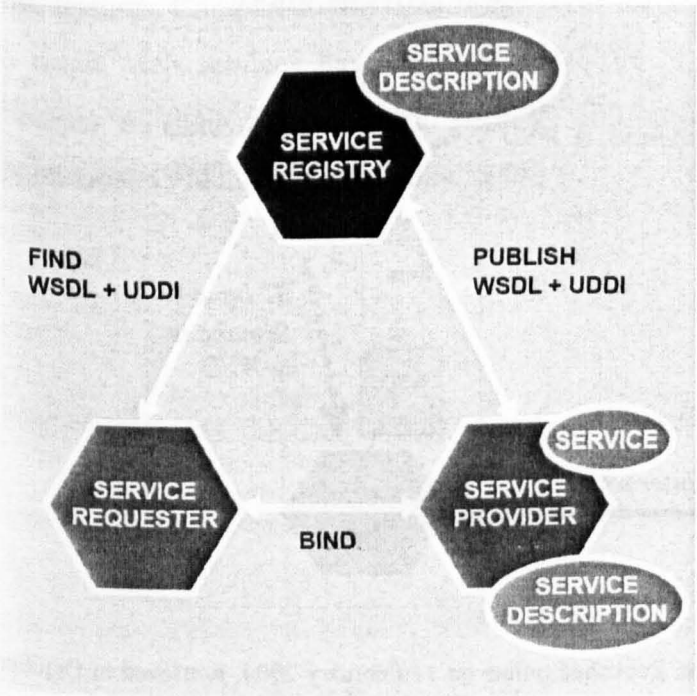
SOAP provides an envelope container for an XML message. A SOAP envelope can be carried by kinds of transport systems. The most common protocol to transfer SOAP messages is to use HTTP, and you could also use other protocols: SMTP, FTP, IBM MQ, JMS, etc. A SOAP message can be transferred directly from the SOAP sender to the SOAP receiver, or through any other SOAP intermediaries. A SOAP message includes SOAP header within the directive system-level information used to manage or secure the message, and SOAP body, which contains message payload, e.g. purchase order, which will be sent to target application. The structure of SOAP message is defined by WSDL description. SOAP message has two different structures: Document-style and RPC-style. Document-style SOAP message supports

very loosely coupled communication between two applications, whereas RPC style SOAP message supports more tightly coupled communication. (Manes, 2003)

2.4.3.7 Web Services Architecture

Gottschalk et al (2002) demonstrated the relationships between the core web services technologies and components, based on the basic web service architecture established by W3C (2002), as shown in Figure 2.9. This figure describes Web services in terms of a service-oriented architecture. The basic web service architecture includes three roles: the service provider, the service requester, and the service registry and three operations: publish, find, and bind. A service provider creates a Web service and its WSDL service description and then publishes the service with a service registry based on a standard called UDDI specification. Once a Web service is published, the service may be found by any service requester via the UDDI interface. The service description and the service's URL (uniform resource locator) will be provided to service requesters through the UDDI registry. The service requesters then will be able to use the service description and the service's URL to directly bind to the service and invoke it (Gottschalk et al, 2002).

Figure 2.9: The relationships among the core web services components

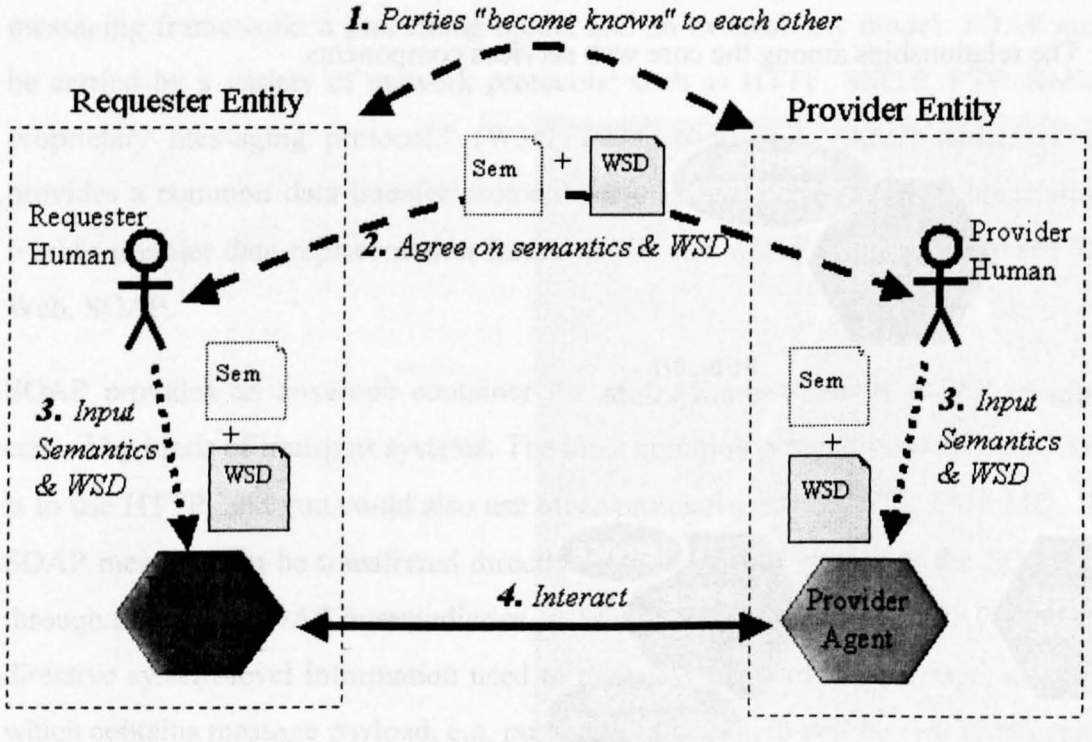


Source: Gottschalk, K., Graham, S., Kreger, H., and Snell, J. (2002), 'Introduction to Web services architecture', *IBM Systems Journal*, Vol. 41(2), pp.168-177.

A Web service, as an abstract notion of functionality, is implemented by a concrete agent. The agent is the actual piece of software or hardware which sends and receives messages. The general process of engaging and using a web service is clearly illustrated by W3C (2004), as shown in Figure 2.10 below:

1. The service requester and service provider entities become known to each other.
2. The service requester and provider entities agree on the web service description and web service semantics that will govern the interaction between the requester and provider agents;
3. The service requester and provider agents realize service description and semantics;
4. The service requester and provider agents exchange messages, thus performing some task on behalf of the service requester and provider entities.

Figure 2.10: The general process of engaging a web service



Source: W3C (2004), Web Services Architecture, Published online on 11 February 2004, Retrieved in Octob 2009, Web site on http://www.w3.org/TR/ws-arch/: Chapter 1, pp.9.

2.4.3.8 Benefits of Web Services

Web services technologies are much simpler and easier, comparing with middleware technologies. "Any application, written in any language, running on any platform, can communicate using Web Services" (Manes, 2003). Since 2000, Microsoft, IBM and Ariba jointly submitted initial Web Services specifications to the W3C, Almost all major vendors have been working together for Web Services infrastructure, technologies, interoperability and security.

The benefits of Web Services are listed as follows (Manes, 2003; Oliver & Maringanti, 2007):

- Better and easier for just-in-time integration;
- Increasing opportunities of cooperation and collaboration of buyers and suppliers;
- Saving time and cost by cutting development time;
- Increasing revenue by enabling their own business services as Web services available to their business partners and potential service requesters;
- Providing a set of standard Web APIs for accessing it, particularly beneficial for business integrations;
- Providing a programmatic interface to a business service that you license using the software-as-a-service business model.

With the growth of the Internet, web services have become more and more pervasive. In particular, it has attracted much attention from SMEs because of its cost-saving and easy-to-use features. Compared with EDI, the expense on adopting web services is much cheaper. As a result, web services have become the future of e-procurement applications for SMEs, because of their facilitation of business interactions beyond independent organisations' boundaries (Vitkauskait& Gatautis, 2008).

2.5 Adoption of Electronic Procurement in SMEs

Electronic procurement (e-procurement) can be regarded as the B2B (business-to-business) procurement and sale of products and services through the Internet as well as other information and networking systems, i.e. EDI (electronic data interchange) and ERP (enterprise resource planning). It has been recognised as a revolutionary way to do business in future and having a far greater potential for cost savings and business improvement than online retailing or ERP (Neef, 2001a).

Commonly, it has been identified that e-procurement will impact several aspects of businesses, such as (Gueritz, 2001; Neef, 2001; Pearcy & Giunipero, 2008):

- Cost savings;
- Manufacturing collaboration;
- Business trust and strategic partnership;
- Business integration;
- International business opportunities;
- Business process improvements.

However, the adoption of e-procurement in SMEs has been found to lag far behind their counterparts - the large corporations.

This section explores the details of e-procurement from five aspects, including its definition, the linkages with e-business and e-commerce, the connections between e-procurement and procurement, its evolution journey, various categories of e-procurement models, the benefits and challenges of e-procurement to SMEs, and external support to SMEs relating to e-procurement adoption.

2.5.1 Definition of E-Procurement

The definition of e-procurement was given by the Chartered Institute of Purchasing and Supply (CIPS) as "using the Internet to operate the transactional aspects of requisitioning, authorizing ordering, receiving and payment processes for the required services or products" (Lysons & Farrington, 2006). Also, Lysons and Farrington (2006) recognised that the focus of e-procurement is pointed out by CIPS as devolving buying to local businesses, and

covering several areas within buying process, such as, requisition against agreed contract, authorization, order, receipt, and payment. Several other definitions of e-procurement given by various researchers, as listed in below Table 2.9.

Table 2.9: Various definitions of e-procurement

Authors	Definition of E-Procurement
Carabello (2001)	E-procurement technology is defined as a technology designed to facilitate the acquisition of goods by a commercial or a government organisation over the Internet.
Presutti (2002)	E-procurement is a technology solution that facilitates corporate buying using the Internet. It has the power to transform the purchasing process because it pervades all of the steps identified by the supply manager.
ITRG (2002)	E-procurement is an Internet/intranet-based purchasing application or hosted service that streamlines buying and trading with partners, maximizes trade efficiency across the entire supply chain, and provides strategic e-commerce capabilities.
Chaffey (2004)	E-procurement is an electronic integration and management of all procurement activities including purchase request, authorization, ordering, delivery and payment between a purchaser and a supplier.
Oliver & Maringanti (2007)	E-procurement is a collective term for a range of e-business software solutions which utilise the latest information and communication technologies (especially the Internet), that can be employed to automate the internal and external processes associated with strategic sourcing and purchasing, which includes catalogue search, item requisition request, approval, purchase order, delivery, receiving, payment, identification of sourcing opportunities, supplier evaluation, negotiation, and contract.
Podlogar (2007)	E-procurement deals with the linking and integration of inter-organisational business processes and systems, and commences with the automation of the requisitioning, the approval purchase order management, and accounting processes through an Internet-based protocol.

Although various definitions were given, several common features of e-procurement can be summarised as follows:

- It is a form of technology to facilitate procurement behaviours by governments or private companies;
- It is an internet-based solution to break the boundaries of independent organisations, and integrate them through procurement activities;
- It is a collective term for a range e-business or e-commerce software solution.

As a result, it is necessary to examine the linkages among e-procurement, e-business and e-commerce (section 2.5.2), as well as the connections between e-procurement and procurement (section 2.5.3).

2.5.2 Linkages among E-Procurement, E-Business and E-Commerce

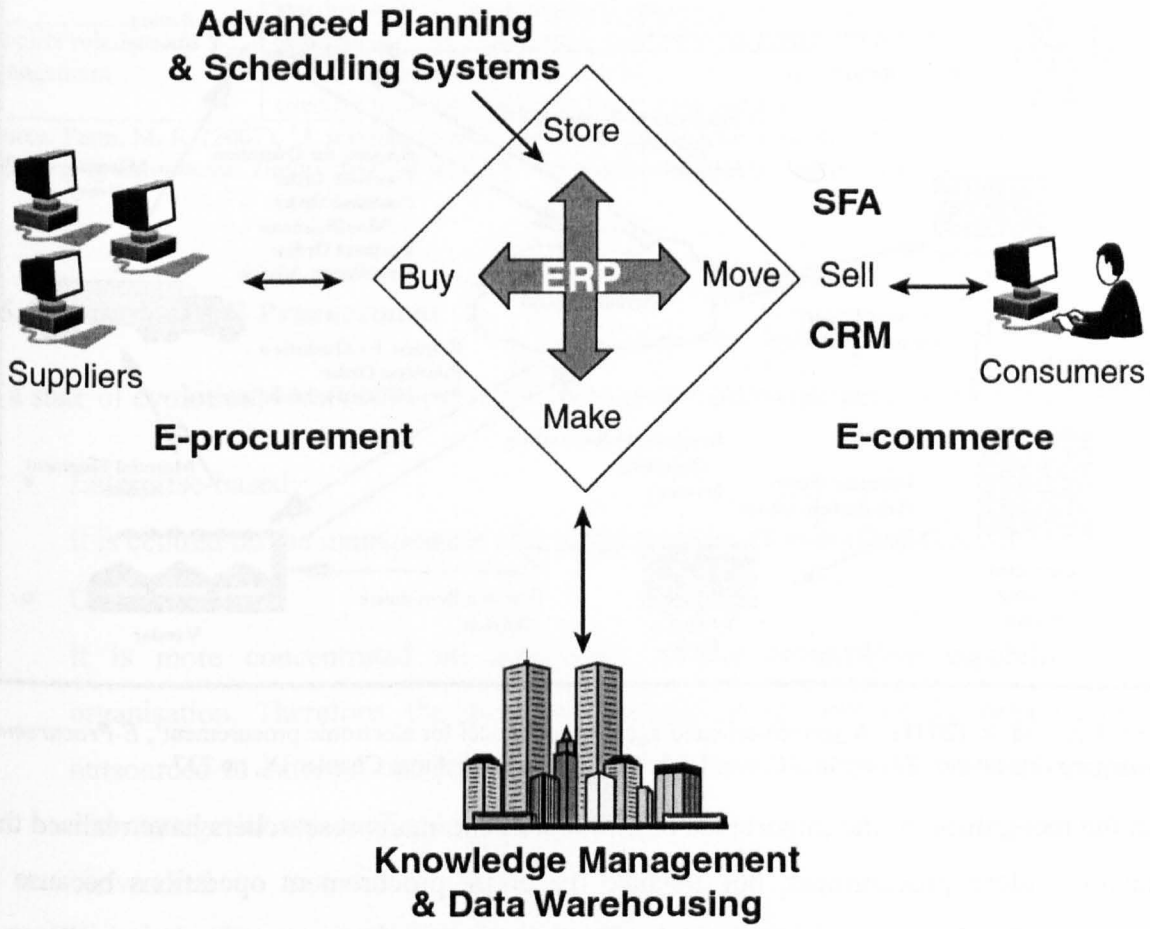
E-business is described as "when a business has fully integrated ICT into its operations, potentially redesigning its business processes around ICT or completely reinventing its business model ... e-business, is understood to be the integration of all these activities with

the internal processes of a business through ICT" (DTI, 2000). Commonly, the consensus of e-business is the utilisation of information and communication technologies (ICT) in support of all the activities of business.

E-commerce is defined as "the exchange of information across electronic networks, at any stage in the supply chain, whether within an organisation, between businesses, between businesses and consumers, or between the public and private sector, whether paid or unpaid" (Cabinet Office, 1999). Indeed, Lysons and Farrington (2006) pointed out that e-commerce is more concerned with buying and selling behaviours via the Internet. In this sense, e-commerce is usually regarded as a subset of e-business, although the two terms are often used synonymously (Lysons & Farrington, 2006).

Nowadays, e-procurement has been regarded as an innovative and revolutionary generation of e-business/e-commerce software based on the Internet (Neef, 2001; Papazoglou & Ribbers, 2006). In particular, the emergence of e-procurement makes it possible and easy to integrate various e-business/e-commerce systems utilised across the supply chains, which is one of major limitations of e-business systems such as manufacturing resource planning system (MRP II), ERP, advanced planning and scheduling system (APS), customer relationship management system (CRM), and so forth. The Figure 2.11 depicts the linkages between e-procurement and various e-business/e-commerce systems. Eventually, a single and extended enterprise-system approach becomes possible with utilisation of e-procurement.

Figure 2.11: Components of collaborative fulfilment and an integrated e-business strategy



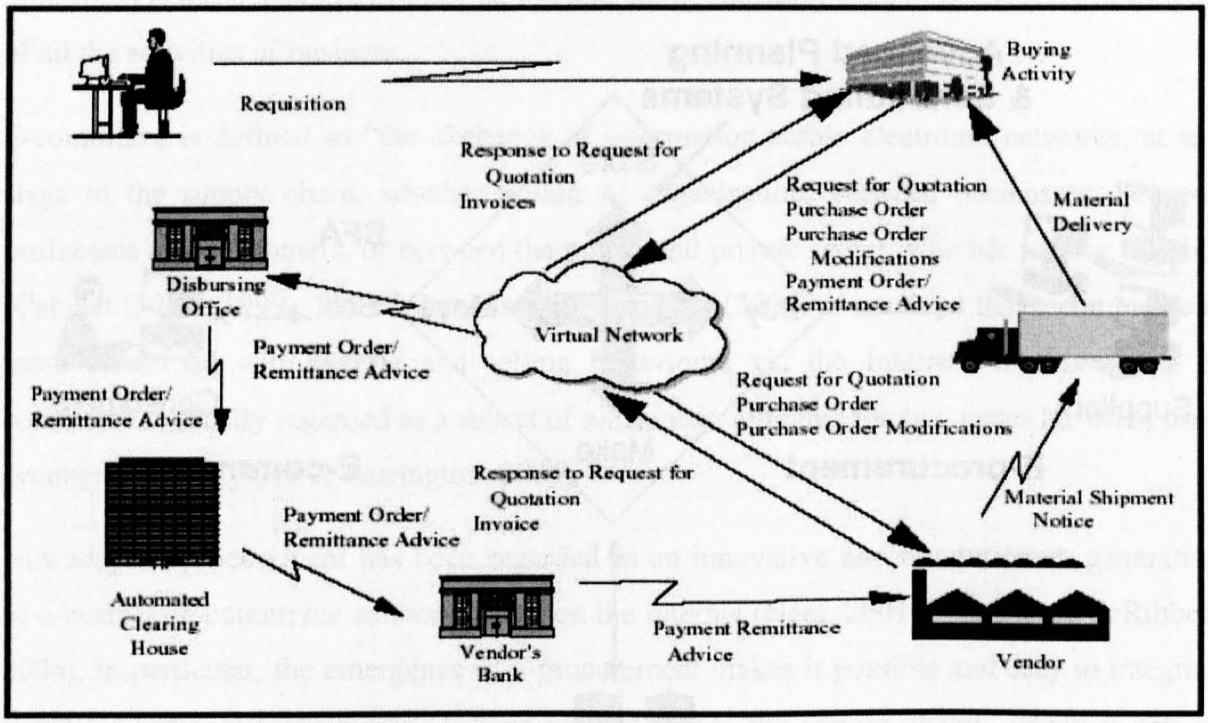
Source: Neef, D. (2001), E-Procurement: From Strategy to Implementation, Prentice Hall, Inc.: Chapter 1, pp.10.

2.5.3 Connections between E-Procurement and Procurement

According to the definitions of e-procurement (section 2.5.1), e-procurement is considered as an electronic tool to facilitate procurement processes and activities across the supply chains. Patra (2007) identified a process cycle model of e-procurement, shown in Figure 2.12 below. In this model, he divided an e-procurement cycle into five phases as follows:

- Procurement requisition
- Sourcing
- Negotiating
- Transaction
- Supplier relationship management

Figure 2.12: E-Procurement process cycle



Source: Patra, M. R. (2007), 'A service-oriented agent-based model for electronic procurement', *E-Procurement in Emerging Economies: Theory and Cases*, USA: Idea Group Publishing: Chapter IX, pp.237.

With the recognition of the importance of e-procurement, many researchers have realised that it cannot replace procurement, but enhance the entire procurement operations because e-procurement has become a strategic tool of organisations and even supply chains (Oliver & Maringanti, 2007; Sharan, et al., 2009).

Therefore, with the identification of traditional procurement processes and activities (section 2.2.4.2), a connection between e-procurement and procurement has been established, as presented in Table 2.10.

Table 2.10: Connections between e-procurement and procurement

Phases in an E-Procurement Cycle	Key Related Procurement Activities
Procurement requisition	This involves identification of the procurement needs of an organisation that may be triggered through a human decision-making process or semi- automated through a software system such as enterprise resource planning (ERP).
Sourcing	The objective of this phase is to locate potential suppliers and business partners who can facilitate procurement of intended items or services. Activities in this phase include: request for information (RFI) on items/services such as description, price, availability; and shipment particulars; request for quotes (RFQ); and evaluation of offers based on information received through RFI/RFQ as well as historical data about suppliers, possibly from a supplier relationship management application (SRM).
Negotiating	This phase involves negotiation, possibly with a number of potential suppliers short-listed from the previous phase. The content of negotiation could relate to price,

	terms, and conditions. The outcome of this phase is the selection of one or more suppliers who would finally execute the purchase order
Transaction	Once decision is made on the supplier(s), the rest of the activities follow a workflow starting with purchase approval, placing of order, order fulfilment, and payment.
Supplier relationship management	Additionally, an organisation may maintain a database of suppliers reflecting their quality of service, trustworthiness, and other relevant information, which can be used for decision-making in future procurements.

Source: Patra, M. R. (2007), 'A service-oriented agent-based model for electronic procurement', *E-Procurement in Emerging Economies: Theory and Cases*, USA: Idea Group Publishing: Chapter IX, pp.236-237.

2.5.4 Evolution of E-Procurement

In a state of evolution, Neef (2001) claimed three major e-procurement models, such as:

- Enterprise-based

  It is centred on the management and control within an individual company.
- Outsourced

  It is more concentrated on improving internal competitive capabilities of an organisation. Therefore, the non-core products or services of the organisation are outsourced to external companies, reducing a great deal of costs in both operational and managerial aspects for the organisation.
- Networked

  It is possible to establish a collaborative business network which enables an evolutionary way to run business, and thus brings more benefits (i.e. profits, business trust, etc.) to the overall business network.

Kalakota and Robinson (2001) identified another set of e-procurement models, in terms of the degree of collaboration within trading partners, as presented in Table 2.11.

Table 2.11: Comparison of various e-procurement models

Table 6.1 **Comparison of various e-procurement models (Kalakota and Robinson[2])**

Trading model	*Characteristics*
EDI networks	▪ Handful of trading partners and customers ▪ Simple transactional capabilities ▪ Batch processing ▪ Reactive and costly value-added network (VAN) charges
Business-to-employees (B2E) requisition applications	▪ Make buying fast and hassle-free for a company's employees ▪ Automated approvals routing and standardisation of requisition procedures ▪ Provide supplier management tools for the professional buyer
Corporate procurement portals	▪ Provide improved control over the procurement process and let a company's business rules be implemented with more consistency ▪ Custom, negotiated prices posted in a multisupplier catalogue ▪ Spending analysis and multisupplier catalogue management
First-generation trading exchanges: community, catalogue and storefronts	▪ Industry content, job postings, and news ▪ Storefronts: new sales channel for distributors and manufacturers ▪ Product content and catalogue aggregation services
Second-generation trading exchanges: transaction-orientated trading exchanges	▪ Automated requisition process and purchase order transactions ▪ Supplier, price and product/service availability discovery ▪ Catalogue and credit management
Third-generation trading exchanges: collaborative supply chains	▪ Enable partners to closely synchronise operations and enable real-time fulfilment ▪ Process transparency, resulting in restructuring of demand and the supply chain ▪ Substitute information for inventory
Industry consortia: buyer and supplier led	▪ The next step in the evolution of corporate procurement portals

Source: Kalakota, R., and Robinson, M. (2001), E-business 2.0, 2nd edition, Addison Wesley: pp.310.

With the degree of maturity of e-procurement facilitating actual procurement, Davila et al (2002) gave four specific e-procurement models (Table 2.12 below). Accordingly, these models illustrate a basic journey that e-procurement could follow to eventually comprehensively and profoundly embrace actual procurement activities and process.

Table 2.12: Four basic e-procurement models

E-Procurement Model	Description
E-procurement software	Any Internet-based software application that enables employees to purchase goods from approved electronic catalogs in accordance with company buying rules, while capturing necessary purchasing data in the process. The employee's selection of a good for purchase from a supplier catalog is automatically routed through the necessary approval processes and protocols. E-procurement software investment may take several forms, including purchase of a software package from a third party technology provider (e.g., Ariba, CommerceOne), use of an e-procurement system embedded in an Internet market exchange, subscription to e-procurement software hosted and supported by an application service provider (ASP), or development of a proprietary in-house system.
Internet market exchanges	Web sites that bring multiple buyers and sellers together in one central virtual market space and enable them to buy and sell from each other at a dynamic price that is determined in accordance with the rules of the exchanges.
Internet B2B auctions	Internet B2B auctions are events in which multiple buyers place bids to acquire goods or services at an Internet site. There are a variety of e-auction formats. The two most popular auction formats are the Dutch auction (where the sellers control the minimum bid and prices move upward from the minimum bid) and the reverse auction (where buyers post "requests for quotations" and sellers bid the price down). A major benefit of auctions is that they enable organizational buyers to identify the best offer from an expanded base of potential suppliers from around the world. Sellers benefit by obtaining access to bid for business on a level playing field rather than attempting to obtain business based on networks of personal relationships. Auctions also provide sellers a ready market for the anonymous sale of excess inventory. Web sites such as freemarkets.com, purchasepro.com, fastparts.com, and sorcity.com, among others, can enable the e-auction process.
Internet purchasing consortia	Internet service that gathers the purchasing power of many buyers to negotiate more aggressive discounts. Some organizations aggregate buying power for manufacturing inputs (such as FOB.com), while others perform similar functions for indirect goods (such as BizBuyer.com).

Source: Davila, A., Gupta, M., and Palmer, R. J. (2002), *Moving Procurement Systems to the Internet: The Adoption and Use of E-Procurement Technology Models*, Social Science Research Network, Online Access on http://papers.ssrn.com/sol3/papers.cfm?abstract_id=323923.

In summary, although various researchers gave diverse e-procurement models, they have a common vision that procurement processes and activities across the supply chains will be enhanced with the support of e-procurement technology with its growth.

2.5.5 Categories of E-Procurement Models

Nowadays, there are a variety of e-procurement models established by different researchers as well as business practitioners. In general, these various e-procurement models can be divided into two major categories: (1) procurement process, and (2) ownership.

2.5.5.1 Category of Procurement Process and Activities

In this category, the e-procurement models are divided based upon the processes involved in procurement. Therefore, a series of e-procurement models are identified (Lysons & Farrington, 2006; Oliver & Maringanti, 2007):

- E-requisitioning: this model contains the activities involved in procurement requisition;
- E-catalogue: this model facilitates the functions relating to catalogues;
- E-approving: this model facilitates the activities relating to hierarchical approval process;
- E-sourcing: this model facilitates the processes of identifying new suppliers for a specific category of procurement requirements;
- E-tendering: this model facilitates the processes of sending requests for information and prices to suppliers and receiving the responses of suppliers;
- E-auction: this model facilitates the bidding processes of goods, services and work. Generally, with this model, sellers offer goods or services to buyers with a structured process for price setting and fulfilment;
- E-reverse auction: this model facilitates the reverse bidding process. Generally, with this model, buyers place goods or services they wish to buy and price they are willing to pay while suppliers compete to offer the best price over a prescribed time period;
- E-ordering: this model facilitates the processes and activities relating to ordering;
- E-invoicing: this model facilitates payment process;
- E-contracting: this model facilitates the activities relating to contracts management;
- E-reporting: this model facilitates the activities relating to generating procurement documents.

Each model in this category covers a set of activities involved in a specific part of procurement processes. For example, Ariba Corporation offers various e-procurement systems in terms of different procurement processes.

2.5.5.2 Category of Ownership

A series of e-procurement models in this category are presented in Table 2.13 below. Unlike any other information system, e-procurement usually includes two or more organisations (Pani, 2007). Thus, the proprietary of the e-procurement system determines the corresponding ownership.

Table 2.13: Various e-procurement models from an ownership perspective

Authors	E-Procurement Models
USHER (2002)	• Buyer-centric: with this model, the buying organisation implements software to support its procurement processes, obtains catalogue data from its contracted suppliers, and aggregates the catalogue data into a single internal catalogue for the use of its purchasing officers. With this model, the buyer is at the hub with suppliers connected at the end of the spokes; • Seller-centric: with this model, the seller is at the centre of the hub, with buying organisations connected at the spokes. Buyers use the supplier's system, accessible over the Internet, to browse the supplier's catalogue and place orders. This space in the marketplace has been largely the domain of business-to-consumer selling, although increasingly business-to-business trading is occurring on these sites; • E-marketplace: with this model, a third party is at the centre of the hub, with buying and selling organisations trading with each other through the common marketplace. The marketplace hosts supplier catalogues, and provides electronic transaction capabilities of varying sophistication to buyers and suppliers.
Chaffey (2004)	• One-to-many (sell-side @ supplier site): trade via supplier's web site; therefore, there is only one supplier and many buyers based on this model; • Many-to-one (buy-side @ buyer site): trade via buyer's web site; therefore, there are many suppliers and only one buyer upon this model; • Many-to-many (neutral exchanges): trade via intermediary web site; therefore, there are many suppliers, as well as many buyers upon this model.

Source:

- USHER (2002), *E-Business Adviser Handbook*, Version 2, USHER Project, 30 November 2002, Web site on http://www.usherproject.org.uk/support/hb/HBs27v2.pdf: Section 2.7.
- Chaffey, D. (2004), *E-business and E-commerce Management: Strategy, Implementation and Practice*, 2nd edition, Pearson Education Limited: Chapter 7, pp.287-314.

In addition, Pani (2007) claimed that "sole ownership is never the best form of ownership for an electronic network with the expansion of e-procurement into businesses". Instead, the joint ownership is rather recommended, reducing the potential risks of solo ownership (Pani, 2007; Oliver & Maringanti, 2007). In particular, e-procurement systems are the linkages of multiple organisations, joint ownership can greatly encourage business integration. However, some researchers argued that joint ownership may bring more difficulties because more time and

effort will be in need to balance the percentage of ownership between the different participant organisations.

2.5.6 Benefits and Challenges of E-Procurement to SMEs

Several researchers identified that e-procurement will contribute into several areas to SMEs (Neef, 2001; Office of Government Commerce, 2002; Chan & Lee, 2003; ABI, 2003; NEPP, 2004; Oliver & Maringanti, 2007):

- Cost savings in procurement expenses;
- Web presence to access potential suppliers and buyers;
- No geographical limit;
- Quick payment to decrease potential financial risks for SMEs;
- Potential business opportunities to enable strategic procurement;
- Automated and simplified procurement process with shortened procurement life cycle;
- Procurement integration to enable manufacturing collaboration and even overall business integration;
- Procurement collaboration to facilitate business trust and strategic partnership to form.

Although there are many benefits of e-procurement to SMEs, the challenges and barriers related to the adoption of e-procurement among SMEs and the corresponding solutions is still an under-researched area (Oliver & Maringanti, 2007). According to the findings of the relevant studies, several researchers realised that the adoption of e-procurement to SMEs is not in tune with the expectations (MacGregor & Vrazalic, 2005; Oliver & Maringanti, 2007). MacGregor and Vrazalic (2005) gave a summary on the barriers to e-business/e-commerce adoption among SMEs, as shown in Table 2.14.

Table 2.14: Summary of the inhibitors to e-business adoption amongst SMEs

Barriers to E-Business Adoption	Related Literature
• High cost of e-business implementation; Internet technologies are too expensive to implement	Iacovou et al. (1995), Quayle (2002), Purao & Campbell (1998), Lawrence (1997), Riquelme (2002), Van Akkeren & Cavaye (1999)
• E-business is too complex to implement	Quayle (2002)
• Small businesses require short-term return on investment and e-business is a long-term investment	Lawrence (1997), McGowan & Madey (1998)
• Organisational resistance to change because of the fear of new technology amongst employees	Lawrence (1997), Van Akkeren & Cavaye (1999)
• Preference for and satisfaction with traditional manual methods, such as phone, fax, and face to face	Lawrence (1997), Venkatesan & Fink (2002), Poon & Swatman (1999)

• Lack of technical skills and IT knowledge amongst employees; lack of computer literature/ specialised staff	Quayle (2002), Lawrence (1997), Riquelme (2002), Van Akkeren & Cavaye (1999), Iacovou et al. (1995), Chau & Turner (2001)
• Lack of time to implement e-business	Walczuch et al. (2000), Lawrence (1997), Van Akkeren & Cavaye (1999)
• E-business is not deemed to be suited to the way the organisation does business, or the way our clients do business	Hadjimonolis (1999), Iacovou et al. (1995)
• E-business is not deemed to be suited to the products/ services offered by the small business	Walczuch et al. (2000), Kendall & Kendall (2001), Hadjimonolis (1999)
• E-business is perceived as a technology lacking direction	Lawrence (1997)
• Lack of awareness about business advantages / opportunities that e-commerce can provide	Iacovou et al. (1995), Quayle (2002)
• Lack of available information about e-business	Lawrence (1997)
• Concern about security of e-business	Quayle (2002), Purao & Campbell (1998), Riquelme (2002), Van Akkeren & Cavaye (1999), Poon & Swatman (1999), Hadjimonolis (1999)
• Lack of critical mass among customers, suppliers and business partners to implement e-business	Hadjimonolis (1999)
• Heavy reliance on external consultants (who are often considered by small business to be inadequate) to provide necessary expertise	Lawrence (1997), Van Akkeren & Cavaye (1999), Chau & Turner (2001)
• Lack of e-business standards	Tuunainen (1998)

Source: MacGregor, R. C., and Vrazalic, L. (2005), A basic model of electronic commerce adoption barriers: A study of regional small businesses in Sweden and Australia, Journal of Small Business and Enterprise Development, Vol. 12(4): pp.510-527.

In addition, many researchers observed that the uptake of e-procurement in SMEs is quite low. For example, Hauser (2000) found out that a majority of suppliers in the supply base are SMEs because of their common role as suppliers for dominating manufacturers. However, a study conducted by Davila et al (2002) reported that users' e-procurement technologies can acquire goods over the Internet from only 15% of the supply base, which mainly constitutes of SMEs, indicating that a lot of SMEs has been involved in e-procurement procuring of large companies.

In summary, it is necessary to investigate more on the benefits and challenges of e-procurement to SMEs under the turbulent and rapidly changing business environment.

2.5.7 External Support to SMEs relating to E-Procurement Adoption

Following the investigation on the importance of SMEs (see section 2.3) and the benefits and challenges of e-procurement to SMEs (see section 2.5.6), they imply that external support to SMEs is essential when they carry out e-procurement projects. Consequently, this section investigates two major areas relating to external support to SMEs:

- Who are external supporters to SMEs?
- What are offered to SMEs by external supporters?

2.5.7.1 External Supporters

Many studies emphasize on the significance of external advice and consultancy to SMEs. Over the last twenty years, numerous researchers gradually suggest external assistance can have a substantial impact on new venture start-ups, survival, and performance (Chrisman & Katrishen, 1994; Nahavandi & Chesteen, 1988; Pelham, 1985; Robinson, 1982). Bennet and Robson (1999) addressed that "external advice and consultancy has increased rapidly since the mid-1980s".

This emergence of external assistance to SMEs is owing to a variety of changes, such as, the increased demand for specialist services that may be difficult to supply in-house, the innovation of new products that has created new markets for external suppliers, and increased outsourcing of activities formerly undertaken in-house (Howells & Green, 1986; Kutscher, 1988; Perry, 1992; O'Farrell et al, 1993; Bennet & Robson, 1999).

With respect to external assistance, there are a wide range of external services providers, including not only private but also public organizations. Bennet and Robson (1999) identified two general categories, i.e. private and public, according to the available connections of SMEs. Under the two general categories, they gave sub-categories, for example, in private category, there are five sub-groups: (1) accountants and lawyers, (2) banks, (3) business friends and relatives, (4) customers and suppliers, and (5) consultants; in public category, different government associations play the major role to give advice or helps to SMEs in terms of different period, accordingly, these government associations include (1) Enterprise initiative, (2) Business link, (3) the training and enterprise councils (TECs) and local enterprise companies (LECs), (4) Enterprise agencies, and (5) the remaining public sector agents.

Additionally, Breen and Bergin-Seers (2002) stated five groups of external services providers: (1) government agencies and departments, (2) educational institutions, (3) quasi community organizations, (4) industry associations, and (5) private operators (e.g. accountants, lawyers, and consultants).

Further, according to a survey on SMEs carried out by Cambridge Centre for Business Research in 1997, they categorized six categories fully covering the wide range of external sources to SMEs: (1) Professional specialists (i.e. accountant, lawyers, banks), (2) Professional generalists (i.e. consultants, but themselves composed of a wide range of highly specialized as well as generalist skills), (3) Market contacts through the supply chain (i.e. customers and suppliers), (4) Social contacts (i.e. family and business friends), (5) Business associations (i.e. trade and professional bodies, local chambers of commerce), and (6) Government sponsored agents (i.e. Business Link/ Business Shop/business Connect, TECs, Rural Development Commission, enterprise agencies, etc.).

It is clear that the Cambridge's categories contain the ones classified by Bennet and Robson (1999) and by Breen and Bergin-Seers (2002). In particular the 'educational institutions' was not specifically mentioned by the Cambridge's categories. However, the 'educational institutions' can be fit into the 'professional generalists' category, in that 'educational institutions' usually hold professional knowledge and theories, with relatively lower level in practice. Also, the six categories defined by Cambridge (1997) are ordered in terms of the specialist level of services, from the highest to the lowest.

Overall, according to a wide range of literature, different researchers and business practitioners hold various terminologies with similar meanings. Especially, the six categories defined by Cambridge (1997) can basically contain various sets of terminologies given by other researchers.

2.5.7.2 External Supports

Basically, the external services providers can offer SMEs, with a vast range of activities, to help them carry out their businesses more efficiently and effectively. Specifically, many researchers examine the sources offered by external services providers, and give various summaries upon them.

For example, Gibb (2000) categorizes the different types of support offered to SMEs as assistance, intervention and training, in two types of contexts, first of which focuses on SMEs development policies and is usually within the context of subsidized programs of public intervention, and the other of which is centred on commercial services and part of the conduct

of normal business activity, e.g. the support from accountants, bankers, educational institutions, chambers of commerce and business networks, etc.

Moreover, Howard and Hine (1997) describe three different forms of government assistance to SMEs in Australia: (1) advisory services offered by quasi government agencies, (2) start-up support, e.g. trainings, financial assistance, and (3) business incubator development to foster successful business operations.

Breen and Bergin-Seers (2002) give further insights on this issue. They suggest two sides (i.e. demand side, and supply side) to analyse, as shown in below Table 2.15. Hence, they point out that "there is clearly a disparity between the learning opportunities offered by service providers and those taken up by the small business operators". Thereby, to make up such disparity, there is a great need to not only involve but also to collaborate with SMEs and all organizations offering external services to SMEs.

Table 2.15: The demand and supply sides (Breen & Bergin-Seers, 2002)

	Demand Side	**Supply Side**
Representative Body	SMEs	External services providers
Characteristics	A large number of SMEs, with varying needs but with little inclination to participate in small business learning, such as: • For accountancy, most of SMEs likely require for such assistance with statutory taxation matters [(1)]; less likely to use it as business advice; • Low participation in government programs; and so on.	Able to provide a broad range of activities to help SMEs carry out their businesses more effectively.

Source:

- Breen, J. and Bergin-Seers, S. (2002), 'The small business assistance dilemma: is the disparity between the offerings of support agencies and the needs of business irreconcilable?', Small Enterprise Research, Vol. 10(1).
- (1): from Peacock 1997, Holmes and Nicholl 1990, Yellow Pages 1995.

Overall, this section reviews the external support to SMEs on e-procurement, including the necessary organisations which are available to provide effective support, various types of external support to be obtained by SMEs.

2.6 Existing Frameworks relating to E-Procurement Implementation

This section investigates three major frameworks and methodologies which have been widely utilised by many organisations. They are SCOR framework and Prince2 project management methodology.

SCOR has been considered as the most widely accepted framework in the world of supply chain for evaluating and comparing supply chain activities and their performance.

PRINCE2 was initially developed in 1989 by the Central Computer and Telecommunications Agency (CCTA) as a UK government standard for information systems project management. However, it has become increasingly popular and regularly applied outside the purely information systems environment, and has spread beyond the UK to more than 50 other countries as a generic project management method (OGC, 2010).

2.6.1 SCOR Framework

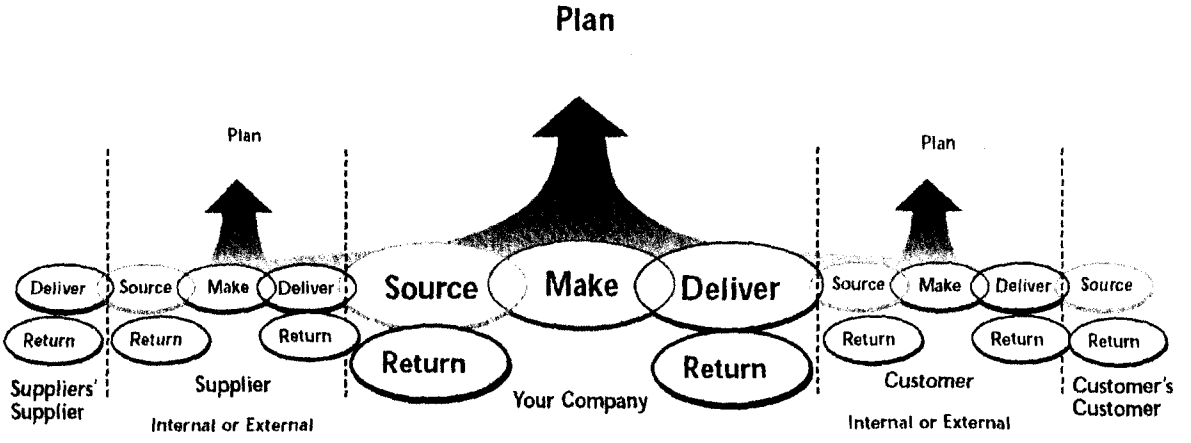
SCOR (supply chain operations reference model) framework is indeed a process reference model developed by PRTM (Pittiglio Rabin Todd & McGrath) and AMR Research in 1996, and endorsed by the Supply Chain Council (SCC) as the cross-industry standard diagnostic tool for supply chain management.

The scope of SCOR framework spans "all customer interactions, from order entry through paid invoice, all product (physical material and service) transactions, from an organisation's supplier's supplier to its customer's customer, including equipment, supplies, spare parts, bulk product, software, etc, and all market interactions, from the understanding of aggregate demand to the fulfilment of each order" (SCC, 2005).

This framework was established upon the concept that each basic supply chain is a 'chain' of source, make, and deliver execution processes. Accordingly, it contains five distinct management processes such as plan, source, make, deliver, and return (SCC, 2005), as presented in Figure 2.13 below. The details of each process are listed in Table 2.16. In addition, SCOR contains three levels of process details, as shown in Figure 2.14. In SCOR level 1, nine metrics are contained including perfect order fulfilment, order fulfilment cycle time, upside supply chain flexibility, upside supply chain adaptability, downside supply chain adaptability, supply chain management cost, cost of goods sold, cash-to-cash cycle time,

return n supply chain fixed assets. For each contained metric, the relevant performance attributes will be assessed. In SCOR level 2, three categories of more detailed process types are identified such as planning, execution, and enable. SCOR level 3 presents detailed process element information for each level 2 process category.

Figure 2.13: SCOR Framework Level 1



Source: SCC (supply chain council) (2005), Supply-Chain Operations Reference-model: SCOR Version 7.0 Overview, Supply Chain Council, USA.

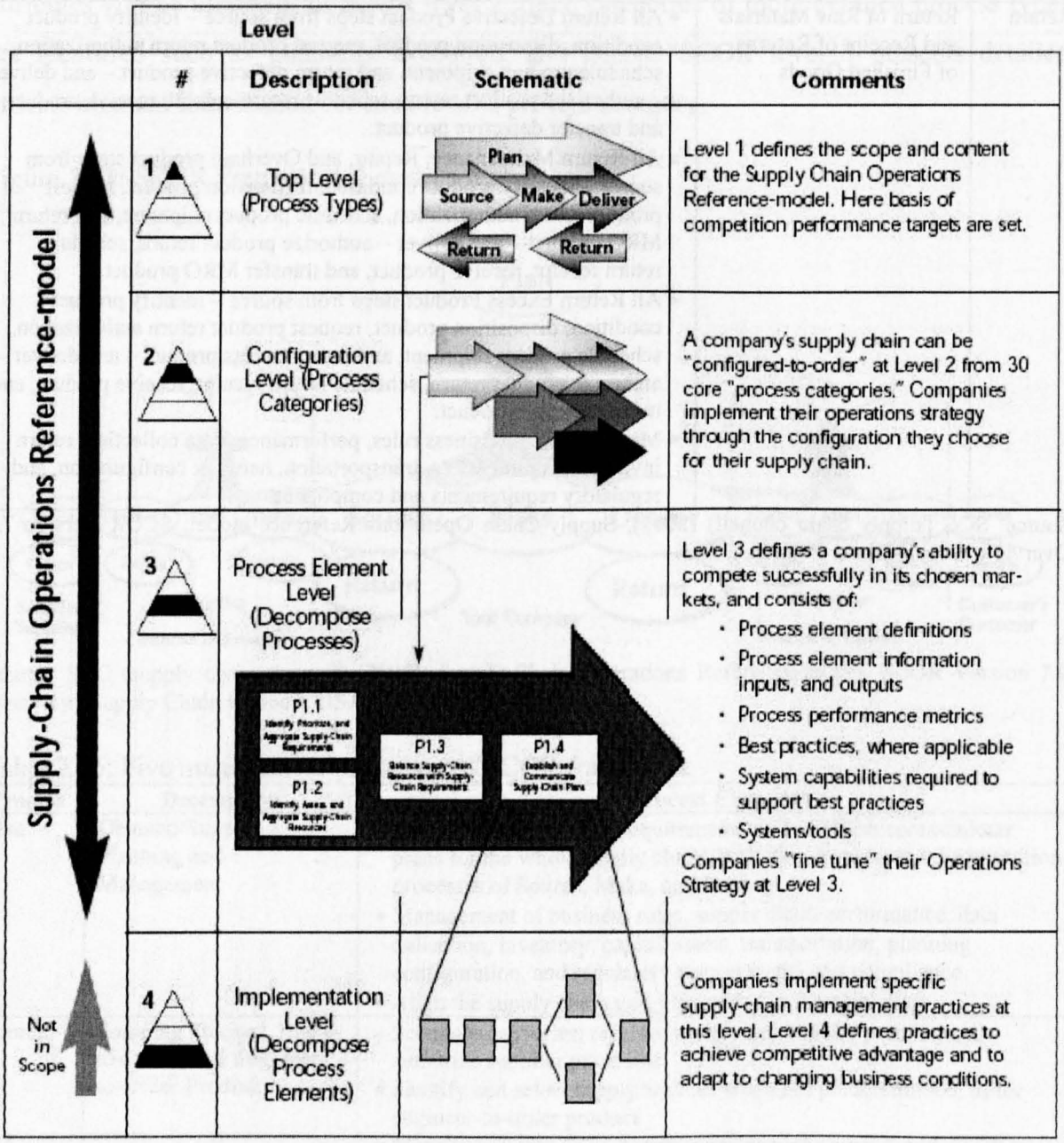
Table 2.16: Five management processes of SCOR framework

Process	Description	Process Elements
Plan	Demand/Supply Planning and Management	• Balance resources with requirements and establish/communicate plans for the whole supply chain, including Return, and the execution processes of Source, Make, and Deliver. • Management of business rules, supply chain performance, data collection, inventory, capital assets, transportation, planning configuration, and regulatory requirements and compliance. • Align the supply chain unit plan with the financial plan.
Source	Sourcing Stocked, Make-to-Order, and Engineer-to-Order Product	• Schedule deliveries; receive, verify, and transfer product; and authorize supplier payments. • Identify and select supply sources when not predetermined, as for engineer-to-order product. • Manage business rules, assess supplier performance, and maintain data. • Manage inventory, capital assets, incoming product, supplier network, import/export requirements, and supplier agreements.
Make	Make-to-Stock, Make-to-Order, and Engineer-to-Order Production Execution	• Schedule production activities, issue product, produce and test, package, stage product, and release product to deliver. • Finalize engineering for engineer-to-order product. • Manage rules, performance, data, in-process products (WIP), equipment and facilities, transportation, production network, and regulatory compliance for production.
Deliver	Order, Warehouse, Transportation, and Installation Management for Stocked, Make-to-Order, and Engineer-to-Order Product	• All order management steps from processing customer inquiries and quotes to routing shipments and selecting carriers. • Warehouse management from receiving and picking product to load and ship product. • Receive and verify product at customer site and install, if necessary. • Invoicing customer. • Manage Deliver business rules, performance, information, finished

		product inventories, capital assets, transportation, product life cycle, and import/export requirements.
Return	Return of Raw Materials and Receipt of Returns of Finished Goods	• All Return Defective Product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return defective product – and deliver – authorized product return, schedule return receipt, receive product, and transfer defective product. • All Return Maintenance, Repair, and Overhaul product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return MRO product – and deliver – authorize product return, schedule return receipt, receive product, and transfer MRO product. • All Return Excess Product steps from source – identify product condition, disposition product, request product return authorization, schedule product shipment, and return excess product – and deliver – authorize product return, schedule return receipt, receive product, and transfer excess product. • Manage Return business rules, performance, data collection, return inventory, capital assets, transportation, network configuration, and regulatory requirements and compliance.

Source: SCC (supply chain council) (2005), Supply-Chain Operations Reference-model: SCOR Version 7.0 Overview, Supply Chain Council, USA.

Figure 2.14: Three levels of process details of SCOR framework



Source: SCC (supply chain council) (2005), Supply-Chain Operations Reference-model: SCOR Version 7.0 Overview, Supply Chain Council, USA.

In order to easily adopt SCOR, four steps need to be followed (SCC, 2009):

- **Determine** what processes to improve and by how much to improve them;
- **Guide** the consolidation of internal supply chains (which results in significant cost reductions from eliminating duplicative assets);
- **Create** standard processes and common information systems across business units (which generates major cost savings, cycle time and quality improvements); and

- **Develop** a common scorecard by which customers can measure their performance and by which SCC members can measure suppliers' performance (which can lead to major cross organisational process improvements).

Subsequently, a series of implementation documents were generated to support the relevant implementation of SCOR, including business scope and overview, process mapping, performance attributes, as-is model, to-be model, and implementation plan (Hillborn, 2008).

Quiett (2006) addressed that "each company can identify, measure, and validate the processes used to produce their goods and services by adopting SCOR, once these processes have been identified and measured, they can be compared to the Best Practices contained in the Model and the changes that are most advantageous for that particular company can be incorporated". Moreover, Phelps (2006) summarised the benefits of applying SCOR that SCOR meets the challenge occurring when customers demand more and supply chains must be agile enough to adapt to constant changes in their markets. In particular, with experiencing SCOR, HP (Hewlett-Packard), as a member of SCC, reported their benefits obtained as follows (Phelps, 2006):

- Improve the agility of supply chains;
- Speed up introduction of new products and services to market;
- Design and provide anything anywhere;
- Manage change and global operations more easily;
- Enable profitable growth.

However, although SCOR can bring a lot of benefits, it still incurs challenges when companies attempt to adopt it. The challenges are focused on the following aspects (SCC, 2005; Quiett, 2006):

- It takes a great deal of time and effort to adopt SCOR because it is a standardised business model with continuous improvement process. Following the steps of SCOR, the adoption procedure normally involves business process reengineering, benchmarking, best practices analysis, and process reference model establishment based upon specific companies' businesses;
- Companies' cultures have to change from concentrating on merely own business to doing business from supply chain management perspective.

Overall, as a reference model, SCOR provides a standard language for communicating among supply chain partners. Since its creation in 1996, SCOR has been continuously improved based upon practices of nearly 1,000 members of SCC in worldwide scope (SCC, 2010). It has been considered as an industry neutral model because of its wide adoption across various sectors spanning from manufacturing to service industries. However, as a mature business model, SCOR does not provide detailed instruction on how multiple organisations effectively collaborate to implement e-procurement systems in terms of specific requirements relating to procurement improvement across relative supply chains (SCC, 2005).

However, the principles and details of SCOR still can be applied when multiple organisations attempt to implement e-procurement into their supply chains, because SCOR provides valuable points covering the following aspects:

- It aims for evaluating and comparing supply chain activities and their performance, and eventually improving the communication among supply chain partners. Therefore, SCOR can be deemed as a reference model when multi organisations, especially clusters of organisations, attempt to form and improve their collaboration upon supply chains;
- It includes five management processes (i.e. plan, source, make, deliver, and return), all of which are related with procurement. In addition, the implementation of any e-procurement system involves similar processes, which are normally called as preparation, design, development, implementation, and further improvement. Therefore, SCOR provides standard processes and tasks normally required when an e-procurement system is to implement;
- It contains project management, change management, and supporting documents generation, which are necessary when an e-procurement system is to implement.

2.6.2 PRINCE2 Project Management Methodology

PRINCE (projects in controlled environments) is a project management method, covering the management, control and organisation of a project. PRINCE2 refers to the second major version of this method and is a registered trademark of the Office of Government Commerce (OGC), an independent office of HM Treasury of the UK. Nowadays, PRINCE2 has been recognised as a standard which can be utilised not only in information systems environment

but also other environment such as manufacturing and service sectors. It has been widely accepted as a generic project management method by more than fifty countries inclusive of the UK.

PRINCE2 contains forty activities and organises them into seven processes, such as starting up a project, initiating a project, directing a project, controlling a stage, managing stage boundaries, managing product delivery, and closing a project, as demonstrated in Figure 2.15. Each process is specified with its key inputs and outputs and with specific goals and activities to be carried out stage by stage, which gives an automatic control of any deviations from the plan. In terms of each stage, various management roles and responsibilities involved in a project are fully described and are adaptable to suit the complexity of the project and skills of the organisation, as presented in Table 2.17.

Figure 2.15: Processes of PRINCE2 project management method

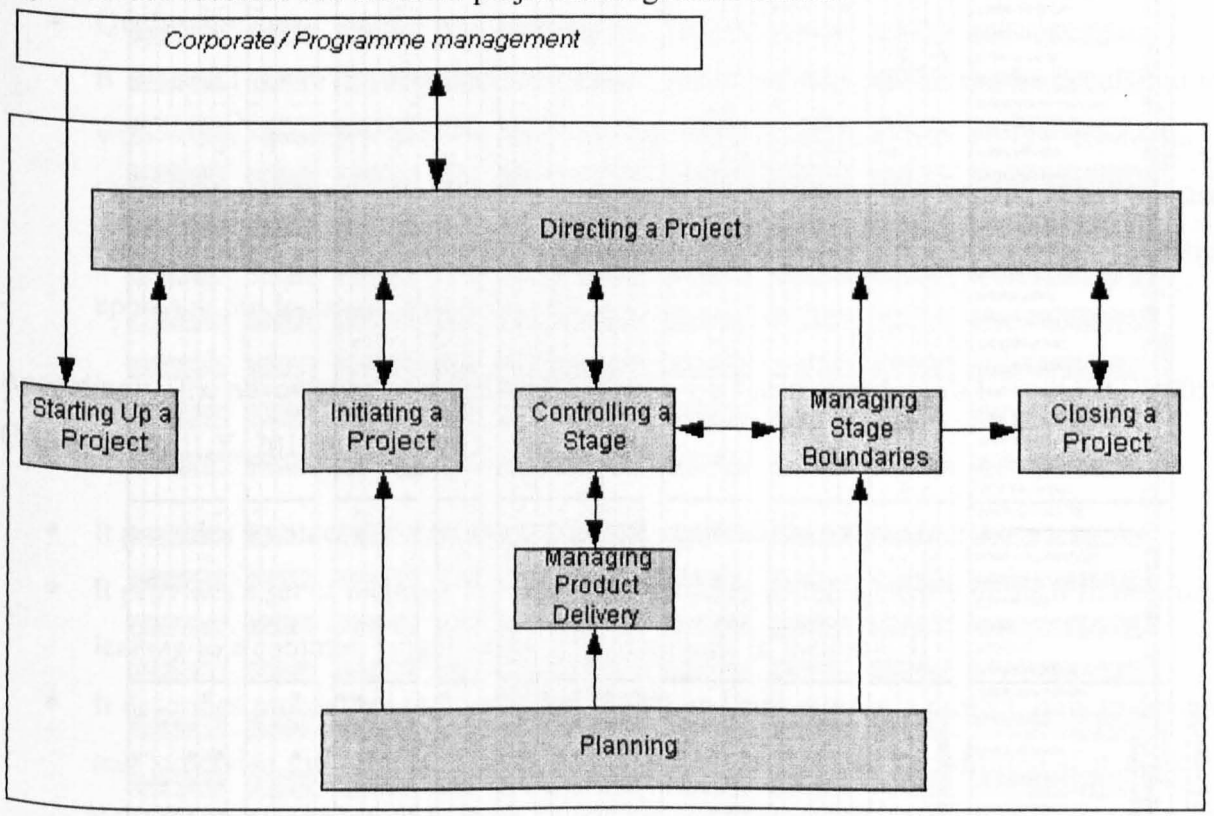


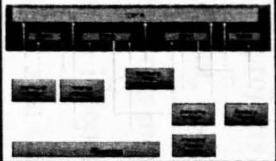
Table 2.17: PRINCE2 cross reference

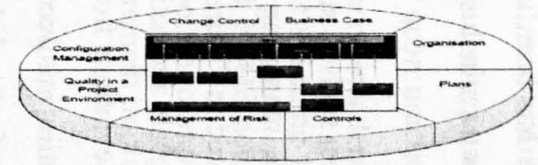
✓ = Responsible ☉ = Assists

I = Input O = Output U = Updated A = Approved

[O] = May be output at any time during project

PROCESSES and Sub-Processes





PRINCE Role Responsibility [Definitions in Appendix B] and COMPONENTS

Code	Process / Sub-process	Executive	Senior User	Senior Supplier	Project Manager	Team Manager	Project Assurance	Project Support	Configuration Librarian	Organisation [App B]	Plans [T-22]	Controls	Business Case	Management of Risk [App C]	Quality in a Project [T-24]	Configuration Management [App B]	Change Control [T-23]
SU	STARTING UP A PROJECT																
SU1	Appointing a Proj Board Exec & a Proj Mgr	Corporate or programme mngmnt								✓							
SU2	Designing a Project Management Team	✓			✓					✓					✓		
SU3	Appointing a Project Management Team	✓			☉					✓							
SU4	Preparing a Project Brief	✓			☉		☉	☉				✓	✓	✓	✓		
SU5	Defining Project Approach			☉	✓		☉	☉							✓		
SU6	Planning an Initiation Stage				✓		☉	☉			✓						
IP	INITIATING A PROJECT																
IP1	Planning Quality				✓		☉								✓	✓	✓
IP2	Planning a Project				✓		☉	☉			✓	✓	✓	✓			
IP3	Refining the Business Case and Risks				✓		☉	☉				✓	✓	✓			
IP4	Setting up Project Controls				✓		☉	☉				✓					
IP5	Setting up Project Files [App E]				✓		☉	☉		✓						✓	✓
IP6	Assembling a Project Initiation Document				✓		☉	☉					✓				
DP	DIRECTING A PROJECT																
DP1	Authorising Initiation	The Board			☉		☉					✓	✓				
DP2	Authorising a Project	The Board			☉		☉					✓	✓				
DP3	Authorising a Stage or Exception Plan	The Board			☉		☉					✓	✓	✓			
DP4	Giving ad hoc Direction	The Board					☉					✓		✓			
DP5	Confirming Project Closure	The Board					☉					✓					
CS	CONTROLLING A STAGE																
CS1	Authorising Work Package				✓	☉	☉	☉	☉			✓			✓	✓	
CS2	Assessing Progress				✓	☉	☉	☉	☉			✓			✓		
CS3	Capturing Project Issues				✓			☉	☉			✓					✓
CS4	Examining Project Issues				✓	☉	☉	☉	☉			✓	✓	✓			✓
CS5	Reviewing Stage Status				✓		☉	☉	☉			✓		✓			
CS6	Reporting Highlights				✓		☉	☉				✓					
CS7	Taking Corrective Action				✓	☉	☉	☉	☉			✓					
CS8	Escalating Project Issues				✓		☉		☉			✓	✓				✓
CS9	Receiving Completed Work Package				✓	☉		☉	☉			✓			✓	✓	
MP	MANAGING PRODUCT DELIVERY																
MP1	Accepting a Work Package				☉	✓	☉				✓	✓		✓		✓	
MP2	Executing a Work Package [T-24]					✓	☉					✓		✓	✓		
MP3	Delivering a Work Package					✓			☉			✓				✓	
SB	MANAGING STAGE BOUNDARIES																
SB1	Planning a Stage				✓	☉	☉	☉		✓	✓			✓	✓		
SB2	Updating a Project Plan				✓		☉	☉			✓						
SB3	Updating a Project Business Case				✓		☉	☉					✓	✓			
SB4	Updating the Risk Log				✓		☉	☉				✓		✓			
SB5	Reporting Stage End				✓		☉	☉	☉			✓				✓	✓
SB6	Producing an Exception Plan				✓		☉	☉	☉		✓	✓		✓			
CP	CLOSING A PROJECT																
CP1	Decommissioning a Project				✓		☉	☉	☉			✓					
CP2	Identifying Follow-on Actions				✓							✓	✓				
CP3	Project Evaluation Review				✓							✓				✓	✓
PL	PLANNING																
PL1	Designing a Plan	The Board			☉	☉	☉				✓						✓
PL2	Defining and Analysing Products [T-22]				✓	☉	☉		☉		✓	✓			✓	✓	
PL3	Identifying Activities and Dependencies				✓	☉	☉	☉			✓						
PL4	Estimating				✓	☉		☉			✓						
PL5	Scheduling				✓	☉		☉			✓						
PL6	Analysing Risks	☉	☉	☉	✓	☉	☉				✓			✓			
PL7	Completing a Plan				✓	☉	☉	☉			✓						

COMPLEX PRODUCTS [Outlines in Appendix A] (Lessons Learned Log, Project Initiation Document and Quality Log marked [O])

Code	Acceptance Criteria	Business Case	Checkpoint Report	Communications Plan	Configuration Item Record	End Project Report	End Stage Report	Exception Report	Highlight Report	Issue Log	Lessons Learned Log	Off-Specification	Post Project Review Plan	Product Checklist	Project Approach	Project Brief	Project Initiation Document	Project Issue	Project Mandate	Project Plan	Project Quality Plan	Quality Log	Request For Change	Risk Log	Stage Plan	Work Package
SU																										
SU1																			I/U							
SU2																			I							
SU3																										
SU4	O	O														O			I/O					O		
SU5															O	I								I		
SU6															I	I								U	O	
IP																										
IP1															I	I					O	O				
IP2															I	I				O	I			U	O	
IP3		U													I	I				U				U		
IP4				O																U	I			U		
IP5										O	O									I	U					
IP6		I		I											I	I	O			I	I			I	O	
DP																										
DP1															I	A								I	U/O	
DP2																	A								A/O	
DP3		I					I										I			I				I	A/O	
DP4				I				I	I									O								
DP5				I		A							A				I									
CS																										
CS1					U					U				U								U		U	U	O
CS2			I/O		U					U				U								I			U	
CS3										U								I								
CS4		I								U										I				U	I	
CS5		I			I					I				I						I		I		I	I	
CS6			I	I					I/O	I				I						I		I		I	I	
CS7					U					U				I						I				U	I	
CS8		I			U			I/O		I/U							I			I				I	I	
CS9					U																	I				A/O
MP																										
MP1																						U		U		I/O
MP2			O																			U				I/O
MP3																						I				I/O
SB																										
SB1										I							I			I	I	U		U	I/O	
SB2										U					U					U	U			U	I	
SB3		U								U										I				U		
SB4		I								U										U				U		
SB5		I		U	U		O			I	U											I		I	I/O	
SB6										I							I			I		U		I	I	
CP																										
CP1				I	I					I							I									
CP2		I								I			O											I		
CP3		I			I	O				I	I						I			U	I	I		I		
PL																										
PL1															I	I	I				I					
PL2					O									O							I					
PL3																								I		
PL4																										
PL5																										
PL6																								U		
PL7														U						I/O					I/O	

Summary of Approvals and Other Products

Code	Summary of Approvals and Other Products
SU	
SU1	Exec & PM JDs (O)
SU2	Exec & PM JDs (I), Team JDs (O)
SU3	Team Structure (I), Job Descriptions (I/O)
SU4	Daily Log (O)
SU5	
SU6	Draft Initiation Stage Plan (O)
IP	
IP1	Quality Standards (I), Job descriptions (I/U)
IP2	
IP3	
IP4	Project Controls (O), Job Descriptions (U)
IP5	
IP6	Controls (I), Project Team Structure and Job Descs (I), Project Tolerances (I)
DP	
DP1	Team Structure (I), Project Start-up Notification (O), Authorisation (O), JDs (I)
DP2	Authorisation to Proceed (O), Progress Information (O)
DP3	Authorisation (I/O), Project Management Team Changes (I), Progress Information (O)
DP4	Request for Advice (I), External Information (I), Corporate Mangement Reports (O), Project Board Guidance (O), Premature Close(O) Exception Plan Request (O)
DP5	Ops Acceptance (I), Proj closure recommendation (I), Customer acceptance (I), Follow-on Action (A), Project closure notification (O), Lessons Learned Report (A)
CS	
CS1	Product Description (I), Work Trigger (I), Authorisation to Proceed (I)
CS2	Work Package Status (I) Stage Status (O), Team Plan (I), Product Status Account (O)
CS3	
CS4	
CS5	Concession (I), Stage Status (I/O), Stage/Project End Notification (O), Work Triggers (O), Tolerance threat (O), Plan Deviation (O), Trigger for project end (O)
CS6	Stage status information (I/O), Communication to interested parties (O)
CS7	Plan Deviation (I), Work Trigger (O), Request for Advice (O), Project Board Guidance (I)
CS8	Tolerance threat (I), PB Decision (I), Trigger for premature close (O), Exception Plan Request (O), Concession (O)
CS9	
MP	
MP1	Team Plan (O/U)
MP2	Team Plan (U)
MP3	
SB	
SB1	Stage end notification (I), Team structure (U)
SB2	
SB3	
SB4	
SB5	Request to proceed (O)
SB6	Exception Plan Request (I), Exception Plan (O), Team Structure (U)
CP	
CP1	Product Status Account (I), Configuration Management Plan (I), Configuration audit (O), Trigger for premature close (I), Note of project end (I), Customer acceptance (O), Ops acceptance (O), Project close recommendation (O), Management information (archive)
CP2	Follow On Actions (O)
CP3	Daily Log (I), Lessons Learned Report (O)
PL	
PL1	Company planning standards (I), Plan Design (O)
PL2	Plan Design (I), PBS (O), Product Descriptions (O), PFD (O),
PL3	Product Flow Diagram (I), Product Descriptions (I), List of Activities (O), Activity Dependencies (O)
PL4	All Planning information so far !!! (I), Activity Estimates (O)
PL5	Activity estimates and dependencies (I), Resource availability (I), Schedule (O)
PL6	All Planning information so far !!! (I)
PL7	

Techniques
Chapter 22 [T-22] Product-based Planning
Chapter 23 [T-23] Change Control Approach
Chapter 24 [T-24] Quality Review Techniques

Appendices
[Appendix A] Product Outlines
[Appendix B] Project Management Team Roles
[Appendix C] Risk Categories
[Appendix D] Healthcheck
[Appendix E] Project Document Management

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In addition, "PRINCE2 is capable of working with most techniques that implement project management best practices" (OGC, 2005). Three techniques are specifically described by PRINCE2, including product-based planning, change control, and quality review (OGC, 2005):

- Product-based planning

  It is a key feature of PRINCE2, providing a focus on the products to be delivered and their quality. It forms an integral part of the Planning process and leads into the use of other generic planning techniques such as network planning and Gantt charts.
- Change control

  It is an essential part of any project management. PRINCE2 can integrate with any existing change control technique but a simple technique is offered for those projects that do not already have one.
- Quality reviews

  It is useful for reviewing document-based products, and can be used in conjunction with other quality checking and testing techniques. Its use is not mandatory. Organisations may already have a similar technique, but quality reviews are recommended as a well-proven technique where there is not a satisfactory standard approach for document inspection.

Accordingly, the advantages of utilising PRINCE2 are summarised as follows (OGC, 2005; Calder, 2008; ILX, 2010):

- It provides a process-driven and structured approach to project management;
- It provides a set of methods for managing projects within a clearly defined framework, leading to a common language for all participants in the project;
- It describes procedures to coordinate people and activities in a project, how to design and supervise the project, what to do if the project has to be adjusted if it doesn't develop as planned, and how to enable an efficient control of resources in terms of each stage.

Overall, in terms of this research, PRINCE2 provides a great deal of valuable points and support to organisations about managing and controlling their relevant projects, especially when multiple organisations are involved.

2.7 Chapter Summary

This chapter investigates four areas of literature, including procurement and supply chain management (SCM), SMEs with external support, e-procurement technologies and the adoption of e-procurement in SMEs.

Overall, procurement has become more and more important in supply chain management. A small percentage cost savings on procurement will bring many benefits to companies, especially for SMEs. In particular, SMEs have great contribution to both organisations and the entire economy. Therefore, it is essential to reach the full potential of them. However, since most of SMEs have limited resources and capability, it is necessary to provide effective external support for them. In order to offer SMEs with more efficient and effective external support on procurement improvements, a collective external organisations need to collaborate with SMEs when they implement e-procurement applications. The external organisations include governments, business associations, distributors, wholesalers, retailers, and other intermediate organisations and individuals alike. In addition to this, it has been identified that there is a need to apply a holistic framework in particular for SMEs when they implement e-procurement applications.

Chapter 3 Research Methodology

3.1 Introduction

This chapter describes the research methodology applied in supporting this research. It will provide an outline of how the research is conducted. To fulfil such purpose, this chapter will:

- Present the research design adopted and demonstrate the process flow undertaken;
- Present the research strategy deployed, including explanations of the specific research methodologies, methods, and techniques utilised in this research;
- Present the methods employed for data collection, data analysis and framework validation.

3.2 Research Design

Kerlinger (1986) defined research design as "a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The plan is the complete scheme or program of the research. It includes an outline of what the investigator will do from writing the hypotheses and their operational implications to the final analysis of data." Thyer (1993) gives another definition, stating that "a traditional research design is a blueprint or detailed plan for how a research study is to be completed – operationalizing variables so they can be measured, selecting a sample of interest to study, collecting data to be used as a basis for testing hypotheses, and analyzing the results"; and Kumar (1996) defines research design as "a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately, and economically." As such, although different researchers provide various definitions, the core concept of research design is that of a plan or strategy for organising a research study, with the aim of achieving the research goals.

According to the above definitions, two main functions of research design have been implied - "the first relates to the identification and/or development of procedures and logistical arrangements required to undertake a study, and the second emphasises the importance of quality in these procedures to ensure their validity, objectivity and accuracy". (Kumar, 1999)

In short, research design is used to structure the overall research, logically connecting from research strategy, to research methods, and also to research techniques focusing on a data

collecting aspect; the ultimate target being to achieve the research objectives (Denzin & Lincoln, 2000; Easterby-Smith et al, 2002).

As discussed in Chapter 1, the core aim of this research is the proposal of a framework to facilitate the adoption of e-procurement amongst SMEs. To achieve this goal, the overall research stages are demonstrated below in Figure 3.1 and exemplified as follows:

First of all, an extensive literature review, with a focus on four major areas, is undertaken, e.g. (1) SMEs with external supports, (2) procurement and supply chain management, (3) the adoption of e-procurement amongst SMEs, and (4) e-procurement technologies, and. As illustrated, the four major areas of literature review are detailed in Chapter 2.

Based on the literature review, three primary parts of this research are generated, including research gaps and questions, research objectives, and research strategy and design. The first two parts, i.e. research gaps and questions, and research objectives, constitute Stage One of 'formulating research questions' (see Chapter 1); whilst 'research strategy and research design' is covered in Stage Two: 'defining research methodology' (see Chapter 3).

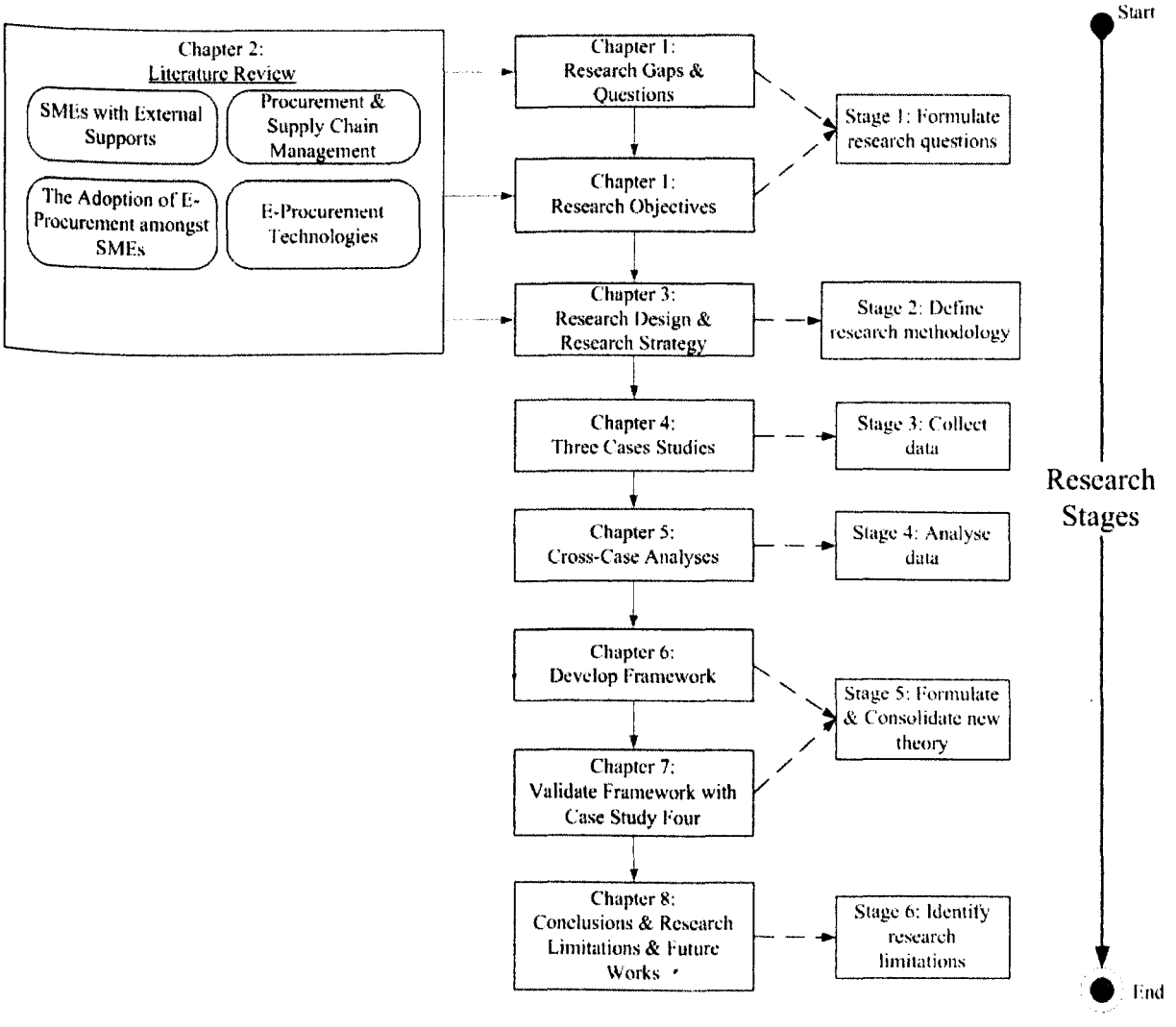
In Stage Three, three case studies relating to the aerospace sector are carried out. They are utilised to collect primary data, which constitutes the underlying foundation for this research. Each case study is depicted in Chapter 4.

Stage Four involves 'analysing data', a series of cross-case analyses are undertaken to explore insights based upon the similarities and differences among the three case studies (see Chapter 5).

'Formulating and consolidating new theory' is covered in Stage Five and serves to establish and validate the framework. The findings from Stage Four are regarded as essential inputs form a series of component parts of the framework (see Chapter 6). Case study four, concerning the food sector, is utilised in order to validate the framework (see Chapter 7) and enable more insights to be gained and incorporated.

Stage Six involves 'identifying research limitations'; corresponding conclusions are summarised, and research limitations are detailed in order to identify further work required for continuation of this research in the future (see Chapter 8).

Figure 3.1: Overall research design



3.3 Research Strategy

A research strategy is a plan of action providing focus and direction to systematic research. As a research strategy family, three sets of related terms, such as research methodologies, research methods, and research techniques, are briefly explained in the following (see Table 3.1).

Table 3.1: Research strategy family

Research Strategy	Contents	Descriptions
Research Methodologies	• Quantitative • Qualitative	Contain a more philosophical meaning, and usually refer to the approach or paradigm that underpins the research.
Research Methods	• Social surveys / Surveys • Case study • Action research	Relate principally to the tools of data collection or analysis.

	• Experiment	
Research Techniques	• Documentary • Official statistics • Questionnaires • Interviews • Participant observation/ Observation	Focus more on data collection.

Source:

- Galliers, R.D. (1991) Choosing Information Systems Research Approaches, in: Galliers, R.D. (Ed) (1992), *Information Systems Research: Issues, Methods and Practical Guidelines*, Alfred Waller: Henley-on-Thames: pp.149.
- Kumar, R. (1999), Research methodology: a step-by-step guide for beginners, London: Sage.
- May, T. (2001), Social Research: issues, methods and process, 3rd edition, Buckingham: Open University Press, UK.
- O'Leary, Z. (2004), The Essential Guide to Doing Research, SAGE Publications Ltd, London.
- Blaxter, L., Hughes, C., and Tight, M. (2006), How to research, 3rd Edition, Open University Press.
- Myers (1997)
- Blaxter et al, (2006)

Note: the 'research strategy family' is generated based on a combo of various classifications made by the above researchers on research methodologies, methods and techniques.

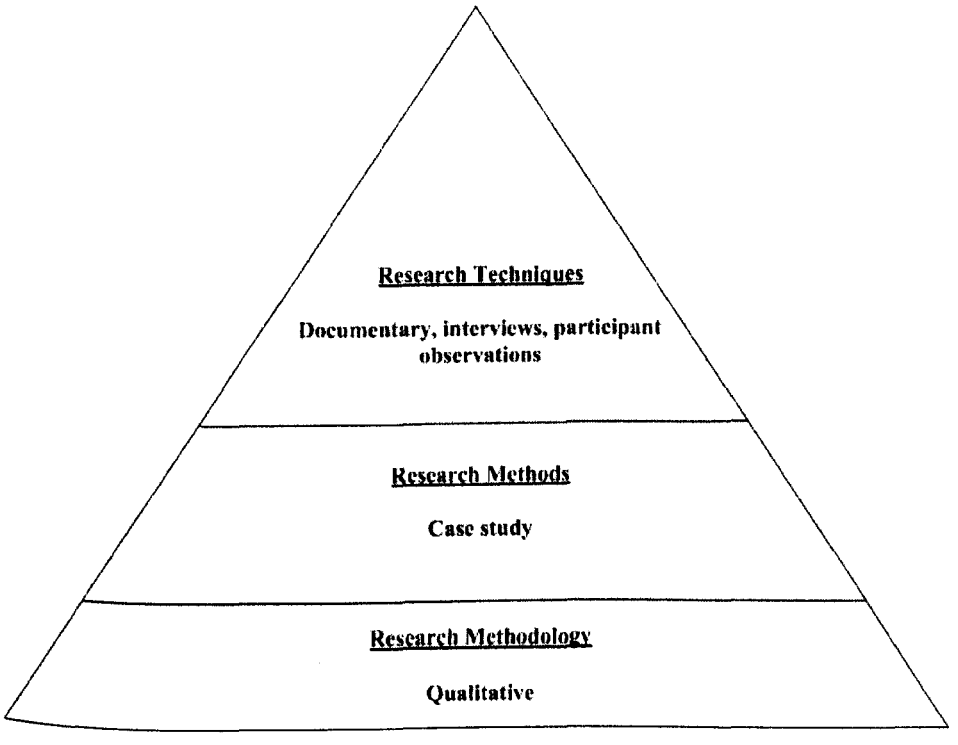
Specifically, this research was conducted following four steps, as shown in below Table 3.2. Accordingly, a 'three-hierarchy research strategy' has been applied comprising appropriate research techniques, research methods, and research methodology, in consideration of the nature and the needs of this research (see Figure 3.2). Firstly, three major research techniques were applied to collect data, including documentary, interviews, and participant observations. With regard to the research method, case study was mainly utilised because four case studies were involved in this research. In terms of the research methodology, qualitative methodology is suitable for this research, since most of data collected are qualitative.

Table 3.2: Four steps conducting the research

Steps	Tasks
Step 1: Data Collection	Literature review
	Selection of case studies for framework development
	Conduction of case studies
Step 2: Research Methodology Rationalisation	Determination of research methodologies
	Determination of research methods
	Determination of research techniques
Step 3: Data Analysis	Individual case study analysis
	Cross-case studies analysis
Step 4: Framework Development &	Framework development

Validation	Selection of the case study for framework validation
	Conduction of the case study for framework validation
	Analysis on framework validation

Figure 3.2: Three-hierarchy research strategy



3.4 Data Collection Methods

This research mainly utilises two types of data, i.e. primary and secondary data. The primary data was collected through three techniques (i.e. documentary, participant observation, and semi-structured interviews) based on four case studies. The secondary data was gathered through documentary technique from a vast of literature, including official statics, conference papers, journal papers, white papers, internet resources, and so forth.

3.4.1 Documentary Research Technique

Documentary research is a broad term, covering a variety of research sources, e.g. official statistics, historical documents, photographs, texts, visual data, etc., which exist in either written, printed, or digital form and are obtained by researchers other than through the interview or questionnaire process (Rodriguez et al, 2006). The vast amount of literature on

the classification of documents (Denzin, 1978a; Burgess, 1990; J. Scott, 1990; Calvert, 1991; Forster, 1994; R. Lee, 2000; E. Webb et al, 2000) tends to fall into three main groups: (1) primary, secondary and tertiary documents, (2) public and private documents, and (3) unsolicited and solicited sources. "The use of documentary research is usually supplementary or complementary to either field studies or the statistical analysis of secondary data" (Rodriguez et al, 2006).

In this research, various channels were employed to establish a more comprehensive picture as a solid research background. For example, a large scale of official statistics has been examined to illustrate the importance of SMEs (section 2.2) and the significance of procurement to organisations (section 2.4) in Chapter 2. A wide range of literature has been explored in Chapter 2 to provide an underlying knowledge background so that the research can be conducted based upon current best practices and existing frameworks in e-procurement implementation. In addition, as a primary foundation of this research, a series of e-procurement project documents were utilised to provide primary data which makes the research results be more convincing and have more practical implications.

3.4.2 Case Study Research Method

Case study is considered one of several ways of doing social science research, along with surveys, histories, and the analysis of archival information (Yin, 2003). O'Leary (2004) described it as "a method of studying elements of the social through comprehensive description and analysis of a single situation or case, for example, a detailed study of an individual, group, episode, event, or any other unit of social life organisation". It is also particularly appropriate for developing, testing and refining new theories (Michaelides, 2005).

In terms of the role of case study in social research, researchers hold differing views. For example, Goode and Hatt (1952) and O'Leary (2004) regarded case study as a research methodology. However, Yin (2003) treated it as a research strategy, while Blaxter et al (2006), considered it a research method/approach.

Regardless of the various roles of case study in social science research, "case study renders investigators to retain the holistic and meaningful characteristics of real-life events, such as individual life cycles, organisational and managerial processes, neighbourhood change,

international relations, and the maturation of industries" (Yin, 2003). Five primary advantages of case study are observed by many researchers:

- Case study can be based on either quantitative or qualitative research.
- The research object is studied in its natural environment, and relevant theory can be generated from the in-depth understanding following observation (Meredith, 1998; Bebansat, et al, 1987; Michaelides, 2005).
- The research questions are mostly centred on 'how' and 'why' (Yin, 2003).
- Case study is successfully used in the early stages of research investigation, when not all influencing factors are known and understood.
- Case study allows deep investigation and intensive analyses, through multifarious phenomena that constitute the life cycle of the unit, with a view to establishing generalisations about the wider population to which that unit belongs (Cohen et al, 2000).
- Case study provides a systematic way of looking at events, and covers the logic of design, techniques for collecting data, and specific approaches for analysing information (Stoecker, 1991; Yin, 2003).

In summary, in line with the research questions raised in Chapter 1, case study is treated as an all-encompassing research method that provides essential instructions for selecting suitable cases, and offers guidelines for data collection and data analysis.

3.4.2.1 Selection of Case Studies

According to the case study research method addressed in previous section, four case studies were selected to support this research: three of them are related to the aerospace sector, and the fourth is related to the food sector. The selection rationales are based on the three pre-questions of the case study research method. Since these pre-questions are important, it is necessary to repeat them again here:

- What principles are to be followed when selecting suitable case studies?
- Are single-case or multiple-cases necessary?
- What rationales are applied when conducting single and multiple case studies?

According to this research, the principles are (1) to verify the utilisation of multiple cases, rather than single case, (2) to establish criteria for judging the quality of case study research design, and (3) to determine case study design.

With respect to the utilisation of multiple-cases or single-case, Yin (2003) identified five rationales for single case, as presented in Table 3.3:

Table 3.3: Five rationales for single case

Critical case	A single case can be used to determine whether a theory's propositions are correct or whether some alternative set of explanations might be more relevant, because the case may meet all of the conditions for testing the theory.
Extreme case or a unique case	Either of the two situations commonly occurs in clinical psychology, in which a specific injury or disorder may be so rare that any single case is worth documenting and analysing.
Representative case	The objective is to capture the circumstances and conditions of an everyday or commonplace situation. The lessons learned from such single case are assumed to be informative about the experiences of the average person or institution.
Revelatory case	This situation exists when an investigator has an opportunity to observe and analyse a phenomenon previously inaccessible to scientific investigation.
Longitudinal case	This situation exists when a single case is studied at two or more points in time. The theory of interest would likely specify how certain conditions change over time, and the desired time intervals to be selected would reflect the presumed stages at which the changes should reveal themselves.

Source: Yin, R. K. (2003), *Case study research: design and methods*, Edition 3rd, Thousand Oaks, Calif.: Sage Publications: pp.40-42.

As a result, it is apparent that the four case studies in this research do not meet any of the five rationales of single case. Therefore, it is appropriate to use multiple cases in this research.

With regard to the criteria for judging the quality of case study research design, Yin (2003) states that certain logical tests can become the basis for judging the quality of any given research design, and four tests – construct validity, internal validity, external validity, and reliability – have been commonly utilised to establish the quality of any empirical social research. Since case study is regarded as one of several ways of doing social science research, these four tests are relevant to case study (Yin, 2003). The four tests have been summarised by many researchers (Kidder & Judd, 1986: pp.26-29):

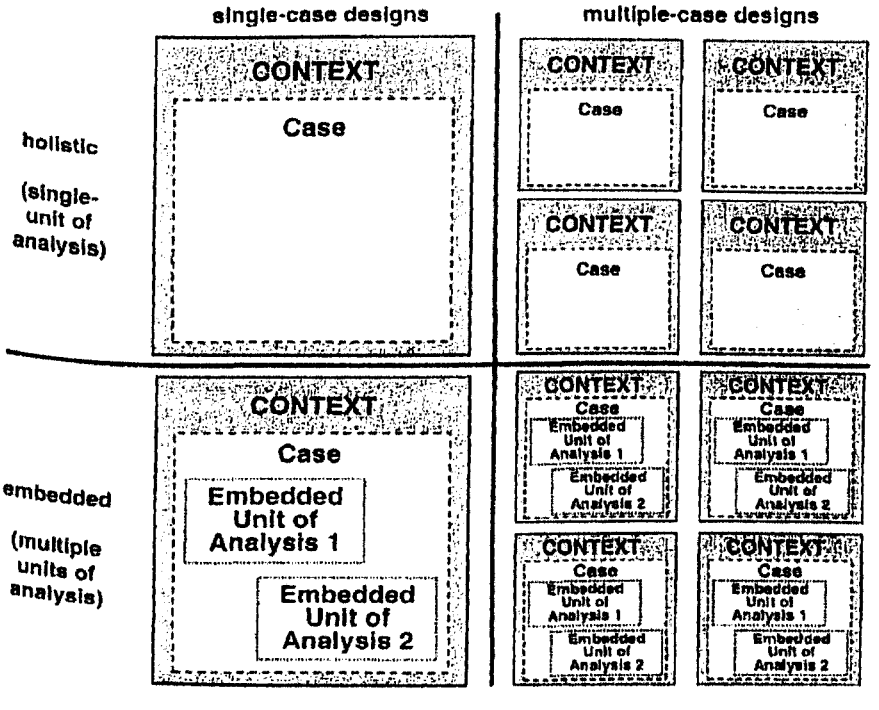
- Construct validity: establishing correct operational measures for the concepts being studied.
- Internal validity (for explanatory or causal studies only, and not for descriptive or exploratory studies): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.
- External validity: establishing the domain to which a study's findings can be generalised.

- Reliability: demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results.

According to the summaries of the four tests addressed above, external validity is the chief logical test utilised in this research. Yin (2003) stated that "external validity deals with the problem of knowing whether a study's findings are generalisable beyond the immediate case study". In this respect, multiple cases are selected for this research, instead of a single case. The main target of this research is to establish a holistic framework based upon the three case studies concerning the aerospace sector. To consolidate and expand the generalisations across industrial sectors, a fourth case study concerning the food sector is utilised to validate the framework.

In terms of the specific case study design for this research, Yin (2003) proposed four types of designs, as demonstrated in Figure 3.3 below. As mentioned earlier, multiple cases are utilised in this research; therefore, a decision needs to be made on whether a holistic or an embedded design should be adopted. Yin (2003) explained that this decision depends on whether more than one unit of analysis is involved in every case study contained in a research. In line with the research questions in Chapter 1, several areas are to be observed in each case study; therefore, embedded design is suitable for this research.

Figure 3.3: Basic types of designs for case studies



Source: Yin, R. K. (2003), *Case study research: design and methods*, Edition 3rd, Thousand Oaks, Calif.: Sage Publications: pp.40-42.

In summary, the case study design for this research contains the following principles:

- Four cases are selected for this research.
- External validity is utilised in this research. Therefore, three case studies are selected from the aerospace sector; whilst, the fourth case study is selected from the food sector.
- Embedded design is adopted because there are multiple units of analyses in each case study.

3.4.2.2 Participant Observation Research Technique

As Blaxter et al (2006) claimed, participant observation is another method at the disposal of social researchers for the collection of data. More specifically, it is about engaging in a social scene, experiencing it and seeking to understand and explain it (May, 2001). Additionally, Wilkinson and Birmingham (2003) claimed that "observation is an extremely handy tool for researchers in this regard, and can render researchers to understand much more about what goes on in complex real-world situations than they can ever discover simply by asking questions of those who experience them (no matter how probing the questions may be), and by looking only at what is said about them in questionnaires and interviews". In this respect, by using this research technique, researchers are generally required to watch, record, and analyse events of interest, either being members of team works or working alone (May, 2001; Blaxter et al, 2006).

In addition, the role of researchers in participant observation can vary, depending on the relevant research aims. Four major roles have been identified such as (1) fieldworker (Gold, 1969; Gergen & Gergen, 1991), (2) complete participant (Gold, 1969; Humphreys, 1970; May, 2001), (3) participant as observer (Campbell, 1984; T. Watson, 1994; May, 2001), and (4) observer as participant (Gold, 1969; May, 2001).

In this research, the role of the researcher was identified as a participant as observer. May (1991) addresses that such role requires researchers to adopt an overt role and make their presence and intentions known to the group who also takes part in the relevant research or

social activities. Accordingly, the researchers are chiefly mediums within participant observation. In particular, this research contains four case studies which are based on four e-procurement projects respectively. The researcher fully participated in each project and observed the issues happened when each project was conducted. At the beginning of each project, the role of the researcher as a 'participant as observer' was notified to the rest of project team members.

However, "participant observation is not an easy method to perform or to analyse, but despite the arguments of its critics, it is a systematic and disciplined study which, if performed well, greatly assists in understanding human actions and brings with it new ways of viewing the social world" (May, 2001). The major difficulties are: (1) it possibly contains untrue issues when researchers write reports because they may be subject to business intentions, (2) the research targets may be distorted since researchers probably take personal ideas in it.

3.4.2.3 Interviews Research Technique

"Any person-to-person interaction between two or more individuals with a specific purpose in mind is called an interview", which is a commonly-used method, at the disposal of social researchers, for collecting information from people (Kumar, 1999). O'Leary (2004) points out that the questions asked by researchers during interviews are basically open-ended. Moreover, Blaxter et al (2006) recognises that "interview is a useful technique for collecting data which would likely not be accessible using techniques such as observation or questionnaires". Interviews, therefore, are considered to be an important method for the collection of data in social research.

Interviews can take difference forms. For example, in terms of flexibility, Kumar (1999) explains two types of interviews: (1) unstructured/in-depth interviews, and (2) structured interviews. Further, May (2001) provides more detailed classifications with respect to the flexibility of interviews, including (1) structured, (2) semi-structured, (3) unstructured or focused, and (4) group and focused interviews. O'Leary (2004) basically agrees with both Kumar and May, categorising interviews into three types: (1) structured, (2) semi-structured, and (3) unstructured, but goes on to divide them into two broad types based on the formality of the interview: (1) formal, and (2) informal. Additionally, O'Leary (2004) identifies interviews as either one-to-one or group, depending on the nature of the interaction with

interviewees. However, it is apparent that different researchers utilise similar interview classifications, which include three major types, i.e. structured, semi-structured, and unstructured, in terms of the flexibility of interviews.

In respect of the contents of interviews, Kumar (1999) pointed out that "the interviewer develops a framework, called an interview guide, within which to conduct the interview"; whilst, "the interviewers formulate questions spontaneously or pre-determinedly during an interview". In particular, an interview schedule needs to be prepared in advance of structured interviews. Accordingly, "an interview schedule is a written list of questions, open or closed-ended, prepared for use by an interviewer, in a person-to-person interaction (this may be face-to-face, by telephone or by other electronic media)" (Kumar, 1999).

With regard to the process of interview, O'Leary (2004) argues that "a 'good' interview is a process that requires a lot more steps than you may realize", and includes six main steps: (1) plan for all contingencies, (2) prepare an interview schedule and data recording system, (3) run a trial or pilot, (4) modify the process as appropriate, (5) conduct the interviews, and (6) analyse the data.

The key advantage of an unstructured interview is its flexibility, which can elicit extremely rich information (Kumar, 1999). Holland and Ramazanoglu (1994) state that "the interviewer can become more adept at interviewing, in general, in terms of the strategies which are appropriate for eliciting responses, and in particular, in our case, in enabling people to talk about the sensitive topic, and thus to disclose more about themselves". In Table 3.4, a summarized set of advantages and disadvantages of interviews are listed.

Table 3.4: Advantages and disadvantages of interviews

Advantages	Disadvantages
• The interview is more appropriate for complex situations. • It is useful for collecting in-depth information. • Information can be supplemented. • Questions can be explained. • Interviewing has a wider application.	• Interviewing is time-consuming and expensive. • The quality of data depends upon the quality of the interaction. • The quality of data depends upon the quality of the interviewer. • The quality of data may vary when many interviewers are used. • The researcher may introduce his/her bias. • The interviewer may be biased.

Source: Kumar, R. (1999), Research methodology: a step-by-step guide for beginners, London: Sage: pp.115.

Overall, just like other research methods, interview techniques have advantages and disadvantages. Consequently, the choice of such methods depends on the focus of the research and researchers need to be aware, in advance, of the limitations.

In short, primary data and secondary data are utilised to support this research. Primary data are collected through semi-structured interviews of four case studies, three of which concern the aerospace sector, and one of which concerns the food sector. These interviews were undertaken by the researcher whilst fully participating in each case study. The interview questions were designed for several areas of each case study; however, more specific questions are to be asked depending on the specific interviewees and the specific organisations. These interview questions lead to multiple units of analyses for each case study, as follows:

- Commercial objectives;
- Previous procurement, including backgrounds of the supply chains, procurement processes and activities and the problems;
- New procurement, including key features of new processes and activities, e-procurement collaboration networks, e-procurement systems and implementation stages.

Corresponding notes were taken to record interview feedback and documents were generated to use as part of secondary data for this research. The other significant secondary data are obtained from extensive literature review.

3.5 Determination of Qualitative Research Methodology

In terms of 'research methodology', the consensus is centred on quantitative and qualitative research approaches (Blaxter et al, 2006). As defined by Punch, "quantitative research is empirical research where the data are in the form of numbers; whilst, qualitative research is empirical research where the data are not in the form of numbers" (Punch, 2005: 3).

Although the two research approaches provide a basic framework for dividing the knowledge camp, "the discussions about the relative merits of quantitative or qualitative approaches have at times become a veritable war zone" (Blaxter et al, 2006). Some researchers regard quantitative research as more scientific or 'objective', because it tends to involve relatively large-scale and representative sets of data, in a way that could be considered to represent a gathering of 'facts'. However, other researchers argue in favour of qualitative research, in that it is focused more on 'depth' than 'breadth', exploring, in smaller quantities but in as much detail as possible, issues considered interesting or illuminating.

There are many complex and interacting aspects of social science. In many cases, a specific phenomenon in social science cannot be interpreted easily, or even demonstrated with a mathematical formula. The differences and similarities between qualitative and quantitative research have been identified by Oakley (1999), as shown below in Tables 3.5 and 3.6. As such, it is apparent that qualitative methodology is more suitable for testing hypotheses and theories, and even for generating new theories. Further, from the wording aspect, qualitative methodology tends not to utilise very precise terms regarding quantification (e.g. more than, less than, most, etc), although specific numbers do also appear in such methodology. In addition, in qualitative methodology, the underlying philosophical positions are not necessarily as distinct as the stereotypes suggest.

Table 3.5: The differences between qualitative and quantitative research

Qualitative Paradigms	Quantitative Paradigms
• Concerned with understanding behaviour from actors' own frames of reference	• Seeks the facts/causes of social phenomena
• Naturalistic and uncontrolled observation	• Obtrusive and controlled measurement
• Subjective	• Objective
• Close to the data: the 'insider' perspective	• Removed from the data: the 'outsider' perspective
• Grounded, discovery oriented, exploratory, expansionist, descriptive, inductive	• Ungrounded, verification oriented, reductionist, hypothetico-deductive
• Process-oriented	• Outcome-oriented
• Valid: real, rich, deep data	• Reliable: hard and replicable data
• Ungeneralizable: single case study	• Generalizable: multiple case studies
• Holistic	• Particularistic
• Assumes a dynamic reality	• Assumes a stable reality

Adapted from Source: Oakley, (1999): pp.156

Table 3.6: The similarities between qualitative and quantitative research

Qualitative Paradigms	Quantitative Paradigms
• More suitable for testing hypotheses and theories, and even for generating theories.	• More suitable for testing theory; Less suitable for exploring an area and generating hypotheses and theory.
• Usually include quantification (e.g. statements such as more than, less than, most, as well as specific numbers).	• Usually involve large-scale surveys, with also gathering qualitative (non-numeric) data through open-ended questions.
• The underlying philosophical positions are not necessarily as distinct as the stereotypes suggest.	• The same.

Adapted from Source: Oakley, (1999): pp.156

This research adopts a mainly qualitative methodology. As discussed in Chapter 1, the major research objective is to identify how SMEs can obtain more effective external support for their e-procurement projects, which is obviously a subject related to social science research and quite difficult to demonstrate with a mathematical formula. As most of the data collected

relates to the adoption of e-procurement amongst SMEs, the focus of this research is on analysis of the qualitative data. For these reasons, qualitative research methodology is more appropriate to this research than quantitative methodology.

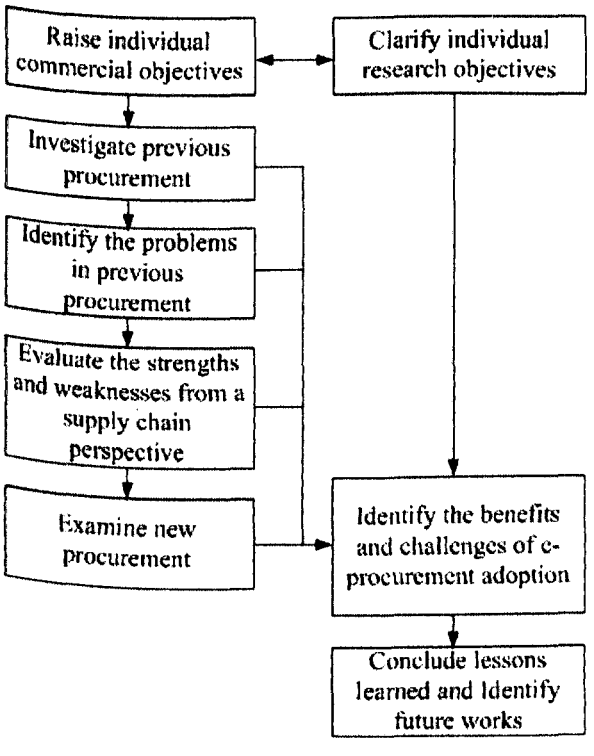
3.6 Data Analysis Methods

The methods for analysing data in this research involve three aspects:

- Individual case study analysis;
- Cross-case analyses;
- Framework validation.

With respect to individual case study analysis, this is undertaken because multiple units of analyses are contained in each case study. Figure 3.4 demonstrates the process for individual case study analysis.

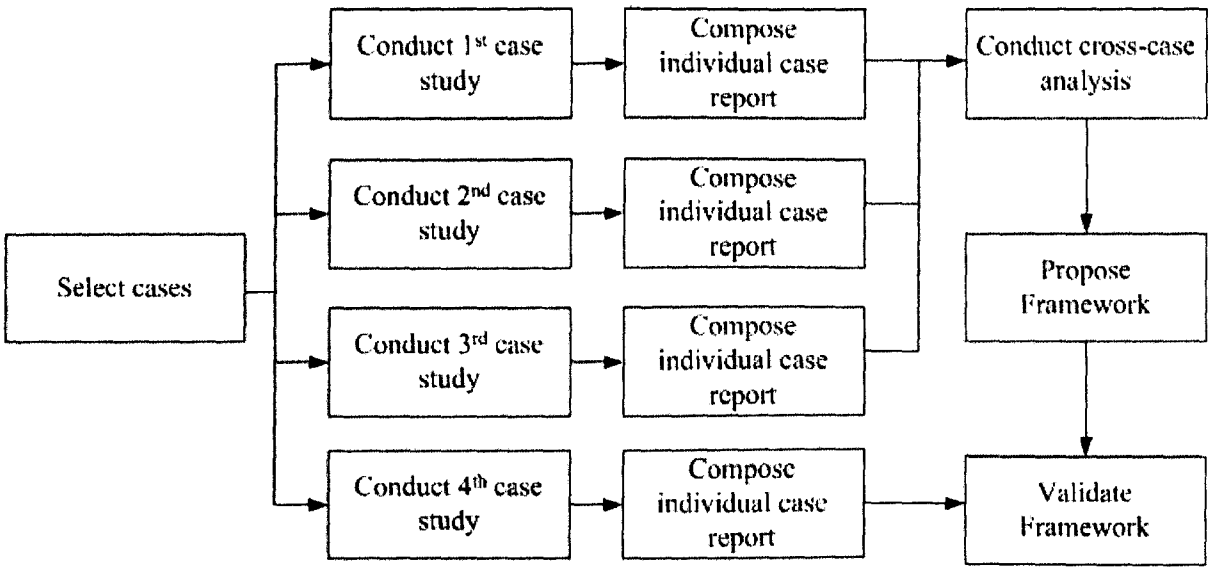
Figure 3.4: Individual case study research process



With regard to cross-cases analyses, as addressed earlier, three cases are selected from the aerospace sector and utilised to extract components which constitute the underlying

foundation for the framework; whilst, the fourth case is selected from the food sector and adopted to validate the framework, as demonstrated in Figure 3.5.

Figure 3.5: Overall case studies research method



In terms of the framework validation, the fourth case is taken apart for deep analysis according to the components involved in the framework. More insights are obtained from the findings of case study four, and utilised to make the framework more generalisable across industrial sectors.

3.7 Chapter Summary

This chapter outlines the holistic structure of this research. The research design illustrates the structure of the overall research. A certain research strategy is established, containing a set of research techniques and methods to facilitate the data collection, determination of appropriate research methodologies and data analysis in this research. Specifically, most of the data collected is qualitative based on semi-structured interviews, participant observation, and documentary research techniques applied in four case studies. Accordingly, qualitative research was considered as a suitable methodology employed in the research. Therefore, a series of data analysis was carried out for individual case studies, as well as, multiple case studies. In the fourth case study, the framework is validated to become more standardised for real-world situations.

Chapter 4 Case Studies

4.1 Introduction

Following the research methodology specified in Chapter 3, three case studies are presented in this chapter respectively. All these case studies are based on e-procurement projects, which were generally centred on how an individual SME or a cluster of SMEs obtain more benefits through utilising e-procurement technologies to facilitate procurement improvements. In particular, case study one is based on an e-procurement project about how a cluster of SMEs simplified and automated the procurement document exchanges between themselves and two original equipment manufacturers (OEMs). Case study two is based on an e-procurement project about how an SME utilised e-procurement technology to increase its procurement performances and formed an integrated network across the supply chain in order to achieve its business expansion target. Case study three is based on an e-procurement project about an individual SME simplified its suppliers' selection process, and automated suppliers' tendering process, to ultimately reduce the corresponding procurement costs.

All of the three case studies concentrate on same aspects and are presented in the following structure respectively, according to the 'individual case study research' (see section 3.6):

- Research objectives;
- Data collection;
- Commercial objectives;
- Previous procurement within the supply chain:
    - Backgrounds of the supply chain;
    - Procurement processes and activities;
    - Procurement problems;
- Strengths and weaknesses from a supply chain perspective;
- New procurement:
    - Key features;
    - E-procurement collaboration network;
    - E-procurement system;
    - Implementation stages.
- Benefits and challenges of e-procurement adoption;
- Conclusions and recommendations.

Consequently, the findings through each case study can be easily comparable in Chapter 5 Cross-Cases Analyses.

4.2 Case Study One

Case Study one is based upon a real project that aimed to adopt e-procurement technologies for an SME cluster, containing fourteen SMEs, in the aerospace sector. The scope of the project is to establish an e-procurement system which would facilitate the procurement document exchanges between the SME cluster and two OEMs in a supply chain.

From a commercial perspective, the project is one attempt to introduce e-procurement solutions into the supply chain, which is comprised of two OEMs as buyers and the SME cluster as the supplier base. With limited or even no experience on e-procurement systems, the operational performance on procurement in each participant company in the SME cluster was low, and severely behind the two OEMs. In order to secure their businesses and acquire more purchase orders from the two OEMs, the fourteen independent SMEs cooperated together to establish this project. The aim was to greatly simplify the difficulties in processing procurement documents, increase their operational efficiency, and thus obtain more opportunities to provide products and services to the two OEMs. In addition, the SME cluster obtained external support from two external organisations, Company C which provides supply chain integration services (e.g. procurement document exchange, etc.) in the aerospace sector and Company D which provides professional consultancy and technical support in e-procurement adoption.

From an academic perspective, this project provides a valuable opportunity for the researcher to explore the drivers of why the SME cluster is formulated, why procurement document exchanges are the focus area, why and how the SME cluster obtains external support, how the e-procurement collaboration network is formulated, and why the specific e-procurement system is adopted to meet the basic needs of the SME cluster. Meanwhile, the roles and relationships in the e-procurement collaboration network is another significant issue to examine.

Accordingly, lessons were learned based upon the successful and unsuccessful aspects that occurred when the project was carried out. The researcher, as the main contact, participated in the project to assist two companies in the SME cluster to resolve their usage problems with the e-procurement system. This was useful in obtaining primary data for the case study research, as well as gaining practical knowledge and experience.

4.2.1 Research Objectives

In this case study, a range of research objectives related to the project are to be achieved, and described as follows:

- Identify the participant organisations in the project;
- Identify the roles and functions played by each participant organisation;
- Investigate the resources provided by each participant organisation;
- Identify the reasons to bring fourteen independent SMEs together to formulate a cluster;
- Investigate the relationships in the e-procurement collaboration network;
- Examine the previous procurement contexts concerned in the project;
- Identify the specific procurement process, namely, the procurement document exchange process, to be improved in the project;
- Investigate the reasons why it is necessary to introduce e-procurement technologies into the SME cluster;
- Identify the procedure how a suitable e-procurement model is adopted;
- Identify the specific technical infrastructure adopted in the project;
- Investigate the specific e-procurement system functions implemented in the project;
- Recognise the effects on the relevant supply chain of adopting a specific e-procurement system;
- Investigate whether there is a future plan for further improvements;
- Identify the lessons learned via the case study;
- Propose recommendations for further improvements.

4.2.2 Data Collection

As stated beforehand, the researcher took part in the project as the role of participant as observer. The researcher mainly took responsibilities for two of the fourteen SMEs, namely Company A and Company B, to give them support with their usage problems of the e-procurement system.

The major communication methods between the researcher and the two SMEs were through email and telephone interviews. All interviews were problem-oriented and carried out in a semi-structured way. The researcher was in contact with the managing director of Company A and the IT manager of Company B. Based on interview records, these project documents were generated:

- Original procurement documents, including purchase orders, dispatch notes, delivery notes, and invoices;
- Original templates for generating these procurement documents;
- The usage problems of the existing e-procurement system encountered;
- The requirements for further improvements for the e-procurement system;
- The reasons of the SME cluster's having low interest to use web-based system.

Meanwhile, the researcher collaborated with the technician in charge of maintaining the e-procurement system to identify aspects such as the specific technology applied, the particular technical infrastructure employed, and the data format in the system. As a result, the following data were collected as follows:

- The facts about the associated data exchange process between the two groups;
- The risks and issues that challenged the design of the project.

Additionally, a series of project documents, generated during the implementation of the e-procurement system, served as primary references for the researcher:

- Project contracts and invoices;
- Overview specifications;
- Functional requirements;
- High level design documentation, i.e. activity diagrams, class diagrams, sequence diagrams, and use cases;
- Detailed design documentation, i.e. prototype, database scripts, and software source codes;
- Project risks and issues report;
- Project traceability matrix report;
- Software installation instruction;
- User manual;
- Knowledge transfer Questions and Answers documents.

As such, the project documents listed above provided primary data for the researcher to carry out the case study research. Other confidential data have been excluded.

4.2.3 Commercial Objectives

In brief, the project objective was to enable the SME cluster to easily cope with the difficulties in maintaining and processing the procurement documents, including purchase orders, despatch notes, delivery notes and invoices. The difficulties were due to the fact that each participant company in the SME cluster largely depends on manual procurement methods.

More specifically, as clarified in the project document 'Overview Specification', the purpose was to develop an e-procurement system enabling each participant SME with the following functions (Case Study One Overview Specification, 2005):

- View information from the two OEMs, irrespective of the original standards (CSV, length delimited or XML).
- Provide a mechanism to modify the 'view' of the information from the two OEMs, that is, one universal solution meeting distinctive demands of each participant company in the SME cluster.
- Provide the integration capability to extract information from two identified (supported) systems: Redthorn and Sage line 50/100.
- An additional integration capability may be required to write hub information flows into a supported local repository.

Considering the different operating configurations set up in each of the participant SMEs, the e-procurement system was to fulfil the various demands requested by each SME, wishing to use either Hosted or Distributed configuration. The hosted configuration provides the service through the Internet, incorporating the backend facilities of the Redthorn 10g platform. The distributed alternative empowers an SME to benefit from the service, but incorporates their backend systems (Redthorn and Sage line 50/100 initially supported).

4.2.4 Previous Procurement within the Supply Chain

The supply chain contained sixteen companies, including the two OEMs and the fourteen independent SMEs. This section investigates the previous procurement within the supply chain from three aspects:

- Backgrounds of the supply chain;
- Previous procurement processes and activities;
- Previous procurement problems.

4.2.4.1 Backgrounds of the Supply Chain

As addressed earlier, the operational performance on procurement in the two OEMs were excelled each small company involved in the SME cluster.

Each of the two OEMs had developed their own Internet hub/portal to disseminate purchase orders and receive invoice and dispatch notes from their supply base. Meanwhile, each hub adheres to their own specified but different standard for information exchange and data processing, which causes difficulties for their supply base to process procurement documents (i.e. purchase orders, dispatch notes, delivery notes, and invoices). The details of the previous procurement documents exchange process are specified in section 4.2.4.2.

As to the fourteen SMEs, although each provided different products to the OEMs, the SME cluster, as a whole, were encountered common difficulties in processing procurement documents with the appropriate data standards. These common difficulties are summarised as follows:

- Translating invoice/dispatch information into the standard(s).
- Viewing/converting information from the purchase order.
- Confusion with working with the standard.
- Uploading the information from the standard into their internal systems.

Meanwhile, it was observed that the help from the two OEMs to the SME cluster was limited, due to the number of companies they work with and various technical operating configurations used in each of them. Consequently, the needs to adopt an e-procurement system to resolve these difficulties have become more urgent, with the increasingly intensive pressures from the market.

The previous procurement configurations across the supply chain are presented in the Table 4.1.

Table 4.1: Case study one - previous procurement configurations across the supply chain

Procurement Configurations	Two OEMs	SME Cluster
Is there separate procurement department?	Y	N
How many employees executing procurement functions?	Many employees	1 to 2 employees
How many procurement experts?	Many	None or only 1 expert
Is there any e-procurement system	Y	N

already in use to facilitate procurement process?		
Are there mature standards for processing procurement data?	Y	N
What kinds of tools employed to process procurement documents?	In-house developed ERP systems, and e-procurement systems	Microsoft Excel
What is the major way used to communicate with each other?	Telephone, and email via their own ERP systems or e-procurement systems	Telephone, email service provided by third party

Source: Case Study One: Overview Specification, 2005 (See Appendix A Case Study One Commercial Project Document Summary).

4.2.4.2 Previous Procurement Processes and Activities

The previous procurement transactions between the two parties (i.e. two OEMs, and the SME cluster) have been explored as follows:

1. Fax purchase orders to each SME of the SME cluster

   The OEMs normally fax purchase orders to each SME, with a series of associated work package documents (e.g. drawings, specifications, etc). The purchase orders sent out are in different data formats, generated by each OEM's ERP system.

   Moreover, the OEMs sometimes issue different versions of the purchase orders related to one work package.

2. View and Convert Purchase Orders

   After receiving purchase orders from the OEMs, each SME converts them into a recognisable format and stores them in Microsoft Excel file format.

   If several versions of purchase orders are sent out by the OEMs, the SME needs to manually process them repetitively.

3. Generate Response Documents

   Each SME extracts useful information from the received purchase orders, and generates the relevant response documents (i.e. dispatch notes, delivery notes and invoices), which are then converted into the required standards, corresponding to the specific OEM.

   If an SME receives several versions of purchase orders from an OEM, the associated response documents need to be redone.

4. Fax / Email Response Documents

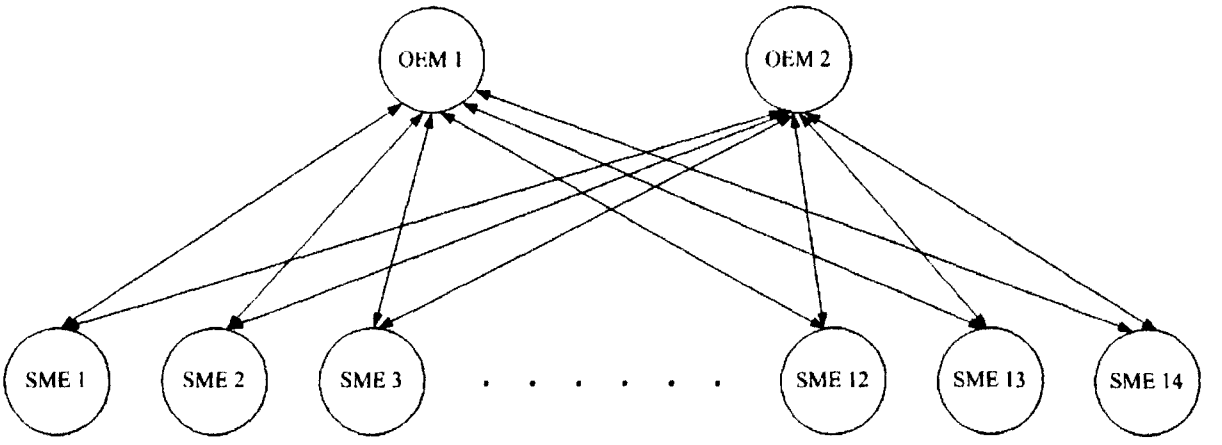
After processing the response documents, each SME replies to the specific OEM through fax or email. Several phone calls or emails are followed to confirm the appropriate OEM receives the correct documents, particularly in the case where the purchase orders are issued with several versions.

5. Convert and Store Response Documents

   After receiving the response documents, the OEM needs to manually convert them according to their own data formats, and then store them into their ERP or e-procurement systems.

Accordingly, a previous procurement model is demonstrated in Figure 4.1 below. There were twenty-eight links in total between the two parties.

Figure 4.1: Case study one - previous procurement transaction model



4.2.4.3 Problems with the Previous Procurement

Based on the project documents, a range of problems have been identified that made the previous procurement transactions difficult and inefficient. These problems can be divided into two categories, internal and external.

Four major internal problems have been identified as follows:

1) Complicated and time-consuming process for uploading the information from the OEM standard into individual SME internal systems

   Owing to possessing various formats for storing data, the organisations need to spend a considerable amount of time to process the received documents in accordance with their own standards. Thus, the process for uploading the information to their individual internal system is a complicated and time-consuming process to each SME.

2) Resource intensive processes for viewing/converting procurement documents

   Normally, one person was responsible for processing procurement documents in each SME, which can be very time-consuming. For example, the received purchase orders

first need to be converted into the appropriate format. Then, key information needs to be extracted from each purchase order. Next, a series of response documents needs to be generated based on the key information extracted. Finally, the response documents need to be sent back to the appropriate OEM via email. Usually, after these response documents are sent out, several phones calls follow to confirm whether the OEM receives them correctly.

3) Repetitive manual processes for interpreting purchase orders

   In each organisation within the SME cluster, the manual process for parsing purchase orders is always identical. In particular, if an OEM issues several versions of purchase orders related to one work package, the employee in each organisation within the SME cluster has to repeat the same procedure to parse the newly received purchase orders.

4) Confusion due to various data standards

   In the previous procurement processes, errors frequently occurred due to the manual processing. In addition, a lot of confusion exists, due to the various data standards sent out by the two OEMs.

Three external problems are presented below, mainly concerning the inefficiency and barriers between the two parties (i.e. OEMs and the SME Cluster):

1) Fragile and inefficient information communication between the OEMs and the SME cluster

   Since there were no formal information systems within the SME cluster, communications with the OEMs are more dependent on labour and fax based paper documents. In particular, in each organisation within the SME cluster, if the responsible persons are absent or busy on other tasks, the information communication with the OEMs becomes less efficient and prone to errors.

2) Long cycle time for exchanging procurement documents, especially when there were several versions of purchase orders issued by the OEMs

   Since the communications between the two parties largely depend on manual processes, the average time for processing a received purchase order is around one or two days, depending on how busy the responsible persons are. Therefore, the cycle time for exchanging procurement documents is always prolonged due to personnel issues.

   When several versions of purchase order were exchanged, even more time was wasted on interpretation.

3) Lack of updated information to support the communication between the OEMs and the SME cluster.Most of the communication between the two parties depends on outdated material such as the two year ago product catalogue, leading to a large amount of waste on time and mankind resource.

4.2.5 Strengths and Weaknesses from a Supply Chain Perspective

In spite of the identified internal and external problems, it is necessary to take a deeper analysis to explore what the strengths and weaknesses are with respect to the supply chain. Through a close observation of the supply chain, there are several weaknesses that can be summarised as follows:

- Lack of expertise on data exchange in the SME cluster

  As small enterprises, most companies in the SME cluster had no information support department. Although there was at least one person responsible in each of the second tier supplier cluster to process data, these responsible persons were not only taking charge of processing data, they had various other daily tasks to handle as well. Indeed, these responsible persons always needed assistance on processing data into the appropriate standards, owing to their lack of knowledge, and insufficient professional experience of information processing.

- Lack of skills and expertise in the SME cluster

  As mentioned earlier, there are no specific persons responsible for processing the received business information within most of the SME companies in the SEM cluster. Consequently, many jobs are postponed at least one or two days against the schedule, bringing about the difficulties and operational inefficiencies on data processing across the entire supply chain.

- Lack of financial support to establish formal information systems in the SME cluster

  None of the fourteen SMEs has sufficient financial capabilities to independently afford a customised e-procurement system. Consequently, they have to stick with manually processing the large quantity of procurement documents (i.e. purchase orders, dispatch notes, delivery notes, and invoices) every day.

Although there are many weaknesses within the supply chain, the business transactions across the supply chain are still increasingly developing and expanding. Therefore, the strengths possessed within the supply chain are summarised as follows:

- Increasingly developing and expanding business transactions are a strong backbone for improving operational efficiency

  In the supply chain, the business transactions have been steadily and increasingly expanding. This strong backbone helps to underpin the e-procurement collaboration network to commence the project.

- Mature standards for processing procurement information

  The two OEMs involved in the supply chain already possess mature standards for processing procurement information. Therefore, the mature standards saved a lot of effort and time for the supply chain to create new ones, to some extent, because the SME cluster could directly utilise them.

- Readiness to take part in the new e-procurement system

  In order secure the supply chain, the fourteen SMEs were ready to adopt e-procurement technologies to automate their internal operations and speed up the communication with the two OEMs.

- Available external supports on procurement documents exchange

  The SME cluster had business connections with Company C which also served in the aerospace sector and located in the same region with the SME cluster. In addition, Company C had expertise on procurement document exchange in the aerospace sector. It was Company C which initiated the project and facilitated the cooperation of the fourteen SMEs. Company D provided IT and software service and had professional knowledge and personnel to give the SME cluster support on developing and implementing the e-procurement system.

4.2.6 New Procurement

This section examines the new procurement after adopting the e-procurement system. Four aspects are presented in the following subsections.

4.2.6.1 Key Features of New Procurement

Overall, there are three key features on the process and activities across the new procurement process. They are:

- Automated activities

  Compared with previous activities, the new procurement process offers the SME cluster a series of automated activities including interpreting purchase orders,

extracting key information from purchase orders, generating response documents (i.e. dispatch notes, delivery notes, and invoices), and allowing to send response documents to the appropriate OEM via the e-procurement system.

- Simplified process

  The new procurement process enables the SME cluster to easily maintain the procurement documents (i.e. purchase orders, dispatch notes, delivery notes, and invoices), and convert these documents from various formats to the appropriate ones.

- Procurement customisations

  Considering various technical configurations across the SME cluster, the new procurement provides two types of customisations. One allows the fourteen SMEs to utilise either desktop or web-based application. The other allows them to create their specific templates for procurement documents (See Appendix A).

- Relatively simple technology adoption

  With respect to the limited knowledge on e-procurement technologies across the SME cluster, it is more suitable to apply relatively simple technologies to implement the e-procurement system. Otherwise, complex technologies might increase the SME cluster's concerns on security and facilitation issues, which possibly become obstacles to the success of the overall project.

- Improved operational performance on procurement

  The new procurement offers an efficient way for each company of the SME cluster to exchange their procurement documents with the two OEMs, which greatly increase their operational performances on procurement.

- Improved visibility across the supply chain

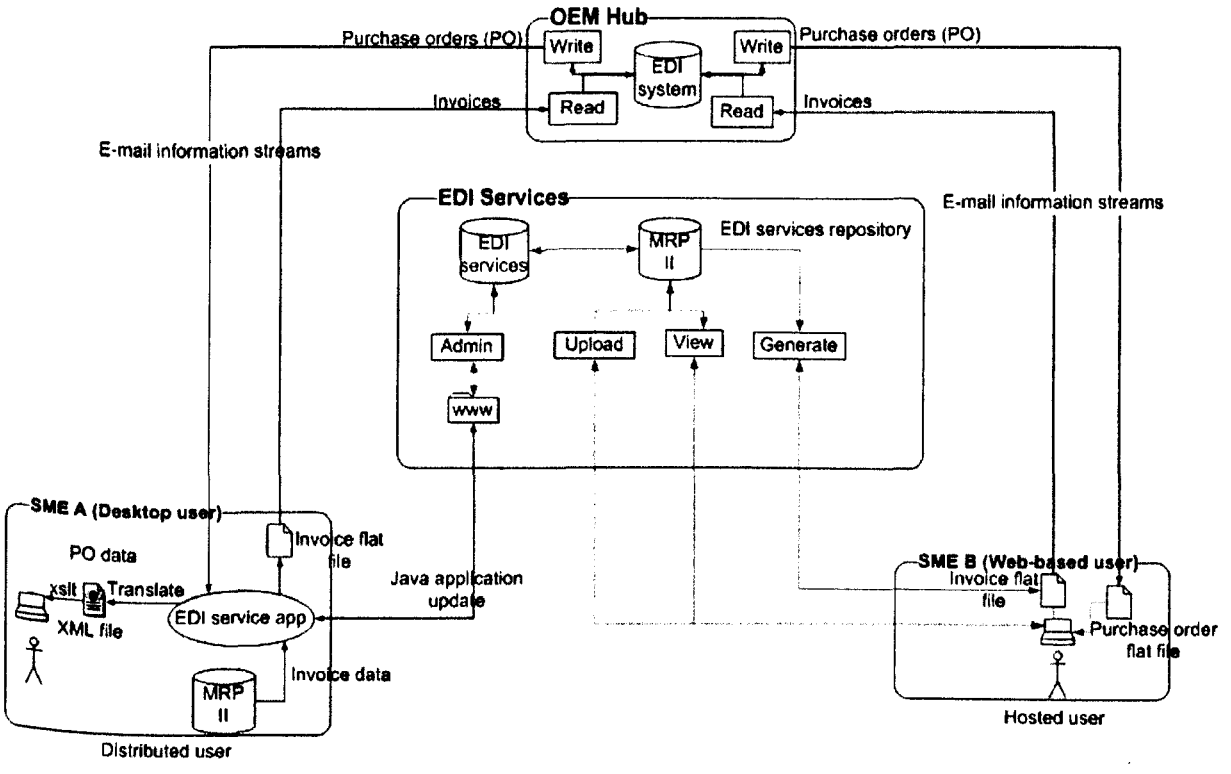
  The new procurement makes core procurement information presented online, leading to the visibility between the SME cluster and the OEMs.

- Improved collaboration across the supply chain

  Quick response and efficient procurement document exchange make the fourteen SMEs and the two OEMs link more closely, leading to more seamless collaboration across the supply chain.

The overview of the new process is outlined in Figure 4.2.

Figure 4.2: Case study one - overview of new procurement process



4.2.6.2 E-Procurement Collaboration Network

To implement the new procurement, new organisations were involved, including Company C and Company D, besides the two OEMs and fourteen SMEs.

- Company C, standing in the aerospace sector and located in the same region with the SME cluster, was involved in the project to facilitate the new procurement implementation. The major task for this company was to offer an e-procurement system particularly suitable for the SME cluster.
- Company D joined in the project to provide professional knowledge, technical skills and technical personnel while developing the e-procurement system. After the project was commissioned, the company provided technical supports to ensure the e-procurement system operated correctly. Moreover, Company D had close business partnership with Company C.

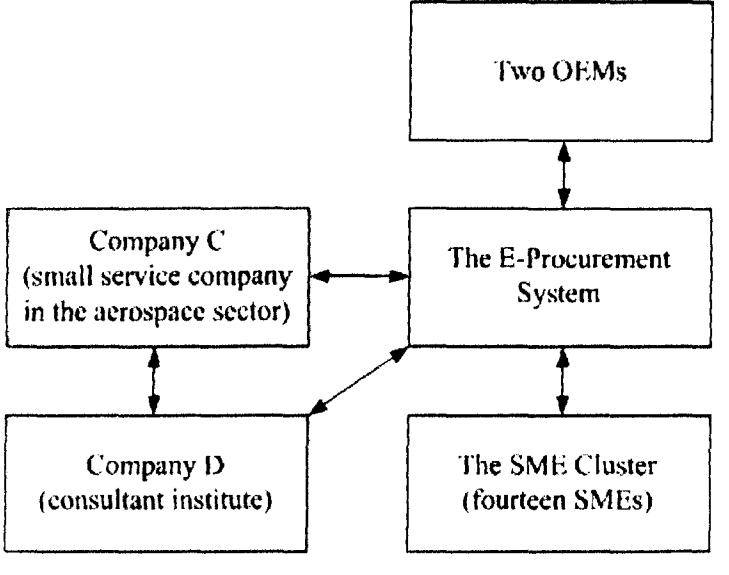
A close observation was carried out to examine the roles and resources of each group of participant organisations within the e-procurement collaboration network, and the details are summarised in Table 4.2.

Table 4.2: Case study one - the e-procurement collaboration network from resource point of view

Aspects	Two OEMs	The SME Cluster	Company C	Company D
Role	Buyers across the supply chain	• Suppliers across the supply chain • System users of the EDI system	Owner of the stand-alone e-procurement system	• Provider of the stand-alone e-procurement system • Consultant on supply chain management • Technical supporter of the stand-alone e-procurement system
Resources provided	Purchase orders	• Dispatch notes, delivery notes, and invoices; • Explanations about previous procurement process.	• Professional knowledge and experience on e-procurement system development and implementation within aerospace industry • Financial support • Business partnership with Company D	• Professional knowledge and experience on e-procurement system development and implementation; • Software developers and technicians.

In particular, the participant organisations and their relationships within the e-procurement collaboration network are demonstrated in Figure 4.3.

Figure 4.3: Case study one - relationship model in the e-procurement collaboration network



4.2.6.3 E-Procurement System

This section introduces the e-procurement system, including the model utilised and system functions.

As identified in different categories of e-procurement models (section 2.5.5), the specific set of e-procurement models are recognised as follows:

- From the aspect of procurement processes and activities, the model of e-reporting is adopted to facilitate the procurement documents exchange process between the two OEMs and the SME cluster;
- From the aspect of ownership of e-procurement system, the model of solo ownership is adopted because Company C (small service company) owns the e-procurement system. The fourteen SMEs utilise the system by paying annual subscription fees (See Appendix A).

The system functions contain the following:

- PO function

  This function enables each supplier company to view a purchase order within the e-procurement system without transferring to suppliers' individual data formats. Moreover, the function allows each supplier company to extract information for generating invoices and dispatch advice notes later.
- Schedule status function

  Via this function, each supplier company is able to extract the schedule information from purchase orders.
- Goods received notes function

  This function facilitates each supplier company to receive the feedback from the SME Company about confirmation of goods received.
- Invoice function

  This function assist each supplier company to generate invoices based on the received purchase orders.
- Delivery notes function

  This function enables each supplier company to create related dispatch advice notes.
- Customer Organisations Data Maintenance function

  This function enables each of the fourteen SMEs to maintain their customer organisations' profiles.
- Supplier Organisations Data Maintenance function

  This function enables each supplier company to maintain their own organisation's profiles.
- Supplier Template Maintenance function

This function facilitates each supplier company to maintain their own templates for invoices and dispatch advice notes, which are according to their individual data formats.

In consideration of the required system functions and system sustainability, the technology utilised meets the following requirements:

- Some small businesses have internet connections, but do not have the skills or personnel to manage data repository;
- Others do not have internet connections at all;
- The business across the relevant supply chain expands rapidly, so the technology utilized should be compatible and be able to keep up with rapidly changing e-procurement technologies;
- Easy to use.

As a consequence, the ultimate solution contains two implementation methods, i.e. hosted and distributed. The hosted solution can meet the requirements for some small businesses which have internet connections without skills and personnel to manage data repository. In this sense, they do not need to care about the difficulty of managing data. A distributed solution can fulfil the requirements for others which do not have internet connections. For these small businesses, they can install stand-alone application onto their individual desktops to implement the functionalities provided by the e-procurement system. Particularly, for stand-alone application users, they need to manually upload the purchase orders (txt format) received from the two OEMs. A series of details are extracted automatically by the system, allowing the generation of corresponding documents such as dispatch notes and invoices.

4.2.6.4 Implementation Stages

As stated in the project plan as well as in the project contract, the project was divided into several stages with different milestones respectively, as listed in Table 4.3 below.

Table 4.3: Case study one - stages with milestones of the project

Implementation Stage & Milestone	Criteria
Requirement analysis document delivery	1) Requirements and acceptance criteria for the project were fully detailed and defined based on the functional specification document. 2) A set of use-case diagrams were produced, both for prototype functionality and for the whole product.

System structure design document draft, Test plan and test cases delivery	1) A detailed system architecture was defined, with detailed explanation of components/modules and interactions between them. 2) Testing methods and evaluation criteria were defined at a high level.
Detailed design document draft delivery	Detailed design document including: 1) Class diagrams with attributes and main methods. 2) Associations, aggregation, composition and generalization of classes represented in terms of a class diagram. 3) Collaboration diagrams 4) Interaction sequence diagrams 5) Activity diagrams
Source code alpha version	1) Functional scope for alpha version is defined and implemented. 2) All main functions defined in the Functional specification can be performed with possible bugs.
Source code beta version	1) Functional scope for beta version was defined and implemented. 2) Most bugs in alpha version were fixed and no critical defects.
Test result report, system implementation document	1) Testing result was fully documented. 2) The system installation and deployment were fully documented.
Maintenance phase	1) System deployed on the customer's side. 2) All issues identified by the customers and accepted by the suppliers during support phase were fixed

4.2.7 Benefits and Challenges of the E-Procurement Adoption

According to the feedback from the SME cluster, the main system users of the e-procurement system, the benefits and challenges of the e-procurement adoption are discussed.

The benefits obtained are summarised as follows:

- Each participant company in the SME cluster has obtained benefits from the e-procurement system by greatly decreasing the difficulties in maintaining and processing procurement documents (i.e. purchase orders, dispatch notes, delivery notes, and invoices);

- The life cycle of processing the procurement documents has been greatly shortened, so that the overall operational performance has been largely enhanced;
- The traditional procurement process and activities, especially on processing procurement documents, have been automated and simplified;
- The procedure of processing procurement documents has been standardized across the supply chain, which leads to more convenient and effective business communications and interactions across the supply chain.
- Each participant company in the SME cluster has obtained professional knowledge and advanced procurement management expertise through this project.
- The e-procurement system offers an opportunity for further supply chain integration in the future.

Although the above mentioned benefits have been acknowledged by the SME cluster, there are also some problems relating to the e-procurement system. For example, after the new process had been adopted for about one year, Company A and B, two companies of the SME cluster, encountered the problems to utilise the e-procurement system, namely, they could not upload the purchase orders received from the two OEMs, or send out the generated documents (i.e. dispatch notes, delivery notes, and invoices) back to the OEMs via the e-procurement system. The major reason for this problem was due to the e-procurement system being based on an old version of Java. When the two SMEs reinstalled the e-procurement system onto their new desktops, the system was not fully compatible with latest version of Java.

Apart from the usage problems, most companies in the SME cluster still depend on the desktop application, which provides relatively low procurement improvements.

4.2.8 Conclusions and Recommendations

There are a number of lessons learned from the case study. These are presented below, along with the relevant recommendations for future work.

4.2.8.1 Lessons Learned

The three major drivers for adopting the e-procurement system were (1) the intensive pressure from the buyer side, (2) the operational inefficiency in processing procurement transactions in the supplier side across the supply chain, and (3) the need to improve the

overall competitive advantage across the supply chain by introducing and utilizing advanced technologies.

The major drivers to formulate the SME cluster were generated from four intentions: (1) to decrease potential risks undertaken by each participant company from conducting the project, (2) to decrease the cost burden of the project for each participant company, (3) to share knowledge and experience, and (4) to maximize the benefits through the cluster.

The needs for external supports to the SME cluster were due to five reasons: (1) on the whole, the SME cluster held relatively limited knowledge and experience on e-procurement technologies and project development and implementations, (2) the financial capability of each company in the SME cluster was relatively weaker than the small service company, so that it was difficult for the SME cluster to afford the project costs and technical maintenance fees, (3) the human resource in the SME cluster was limited, especially on procurement management, project management, and technical support, (4) the SME cluster had relatively limited experience on cooperating with consultancy organisations, namely, the intermediate institute in the project, and (5) none of the participant companies in the SME cluster had the capability to bring all the fourteen independent companies together.

The four drivers for letting the service company control the project and have proprietary ownership of the e-procurement system were: (1) being familiar with the interactions between the two OEMs and the SME cluster, because the service company was involved in the same supply chain with the SME cluster, but did not belong to the SME cluster, (2) having more knowledge and experience in adopting e-procurement technologies and implementing e-procurement projects, led to offer more industry-oriented suggestions to the SME cluster, especially when designing the e-procurement system, (3) having stronger financial capability to afford the project costs and technical maintenance fees, and (4) having close connections with the intermediate institute, led to the increased possibility of a successful project.

Three problems hindered the continuous improvement and upgrade of the e-procurement system (see Appendix A): (1) there was no direct collaboration between the SME cluster and the intermediate institute (Company D), resulting in the delay in resolving the problems encountered by the SME cluster. In fact, the small service company (Company C) took responsibility for collecting and confirming the system requirements with the SME cluster. Company D was in charge of developing and deploying the system. In terms of technical problems encountered by any company of the SME cluster, Company D will be involved in the case when Company C cannot deal with; (2) the solo ownership of the e-procurement system led to difficulties for continuous system improvement. Some companies of the SME

cluster have proposed to Company C with some requirements for further system improvement. However, some requirements have been postponed for future development because they were considered as private business requirements; (3) the adoption of relatively simple e-procurement technologies by the SME cluster still could not greatly increase the overall collaboration level across the entire supply chain. Although the e-procurement system enhances the visibility of the entire supply chain, it only improves the efficiency of data exchange between the two OEMs and the SME cluster. It is necessary to facilitate deeper collaboration across the entire supply chain.

4.2.8.2 Recommendations

Most companies of the SME cluster still use the stand-alone version of the e-procurement system, because they have concern on security and business confidential issues, although a web-based system has been developed and ready to use..

As a result, the following recommendations are given as follows:

- Build in latest demands required by some participant companies of the SME cluster into the stand-alone e-procurement system. Although some requirements for system improvement are raised due to private business demand, they need to be implemented to make the system more friendly to the relevant users;
- Expand the focus from procurement documents exchange to a broader extent. Since the e-procurement system is mainly utilised to facilitate procurement documents exchange across the supply chain, it needs to be expanded to involve more procurement transactions and eventually enhance the overall efficiency, visibility of the supply chain;
- Reengineer the internal operations in each participant company in the SME cluster to adapt them so that they are suitable to an electronic business process.

In addition to the above recommendations, there are more details to be recommended. For example, it is necessary to think about how to adjust the business according to the rapid changes to the external business environment perspective. The training and continuous improvements for employees are also critical.

4.3 Case Study Two

Case study two is based upon a project to establish an e-procurement system for Company E, an SME, standing in the aerospace sector. The scope of the project was centred on procurement processes and activities occurred routinely in Company E. At the end of the project, an e-procurement system was implemented by this company, so that a more efficient operational way was adopted, and more benefits were obtained through an integrated supply chain. These benefits included as follows:

- Online catalogue;
- Instant communications with supply chain partners;
- Data repository for historical procurement information;
- Shortened life cycle of procurement process;
- More savings on procurement costs.

From a commercial perspective, this project aimed to utilise e-procurement technologies in Company E, so that this company was able to obtain the benefits from both the improved procurement performances and the formed collaboration network.

From an academic perspective, this project provides a valuable opportunity for the researcher to observe closely why and how a medium-sized company conducts an e-procurement project, what the specific roles and responsibilities required to form an e-procurement collaboration network, and how the participant organisations interact with each other upon the network.

Accordingly, lessons are extracted based upon the successful and failure aspects occurred when the project was conducted. The researcher, as the role of participant as observer, fully participated in the project. This was useful in obtaining primary data for the case study research, as well as gaining practical knowledge and experience.

4.3.1 Research Objectives

In the case study, a set of research objectives relating to the project are described as follows:

- Identify the participant organisations in the project;
- Identify the roles and functions played by each participant organisation;
- To investigate the resources provided by each participant organisation;
- Investigate the relationships amongst the e-procurement collaboration network;
- Identify the reasons why improving procurement is deemed as a major aim to bring benefits to Company E;

- Identify why the procurement processes and activities relating to ordering are focused;
- Examine the contexts across the previous procurement process within Company E, as well as its relevant supply chain;
- Identify the particular e-procurement model to underpin the specific procurement area;
- Identify the specific technical infrastructure adopted in the project;
- Investigate the particular e-procurement system functions implemented in the project;
- Investigate whether there is a future plan for further improvements;
- Identify the lessons learned via the case study;
- Propose recommendations for further improvements.

4.3.2 Data Collection

In the case study, the main methods for collecting raw data were through semi-structured interviews and emails. The interviews were carried out by the researcher every week in three months. The interviewees were from five participant organisations, i.e. Company E (medium-sized manufacturing company), Company F (large supplier), Company G (small service company), Company H (consultant company), and Company I (software development company). Different set of questions were prepared for different companies.

For Company E, there were three interviewees including the managing director, the procurement manager and the procurement assistant. The questions were prepared from three aspects as follows:

- the background of their business and relevant supply chain;
- the relationship with their suppliers, especially Company F in this case;
- the relationship with one of their business partners, namely Company G;
- the readiness to adopt e-procurement technologies into their business;
- their budget and expected duration for developing and deploying the proposed e-procurement system;
- the main benefits to be obtained through the system;
- the organisations to be involved onto the system;
- their detailed specification of the system, such as the requirements on catalogue function of the proposed system;

the detailed technical issues such as how to integrate the proposed system with the electronic systems or tools they utilised.For Company F, three interviewees were involved including their procurement manager and two procurement assistants. They answered the questions covering the following details:

- their business relationship with Company E;
- their mid-term and long-term business development strategies with Company E;
- their short-term procurement cooperation with Company E;
- their readiness to be involved in the relevant e-procurement project;
- their daily procurement activities and the relevant materials used.

For Company G, it is a small software service provider. One of their main e-procurement systems has been utilised by 300 SMEs, including Company E. Therefore, based on Company G's e-procurement system, Company G and Company E have formed a long-term business partner relationship. Company E planned to involve most of customers of Company G through the proposed system. In this case, two interviewees in Company G were involved including the managing director and the IT manager. They answered the questions covering the following details:

- their business relationship with Company E;
- their mid-term and long-term business development strategies with Company E;
- their customer base of the e-procurement system utilised by Company E, because Company E is one of the largest and the most promising companies who utilise the system;
- their readiness to be involved in the relevant e-procurement project;
- the technical details of the e-procurement system utilised by Company E;
- the technical requirements on the proposed system, especially on how to integrate the proposed system and the e-procurement system provided by Company G through catalogue function;
- the detailed specifications on how to maintain product catalogue, in order to ensure the integrated catalogue providing updated data to all of the perspective system uses;
- the technical issues about how to enable users to easily generate request for quotations and purchase orders with integrated product catalogue information, especially from the side of Company G.

For Company H, it mainly took charge of organising the project to successfully deliver the proposed e-procurement system. Two interviewees were involved including the business director and technical engineer. They answered the questions in terms of the practice and methodologies applied to organise the overall project from business and technical aspects as follows:

- the practice obtained and methodologies employed to collaborate the project team across various relevant participant organisations;
- the practice obtained and methodologies for the system development and deployment;
- the suitable database and server to support the proposed e-procurement system;
- the configuration plan for developing and deploying the system;
- the other technical requirements to support the system.

Also, in Company H, the researcher, as project manager, as well as the role of participant as observer, took part in the project. In order to avoid bias, the academic role of researcher has been announced at the beginning of the project. Meanwhile, all project record generated by the researcher has been acknowledged by relevant participant organisations. Accordingly, the researcher took record on the following aspects:

- the overall procedure and detailed steps from the beginning of collecting customers' requirements of the proposed e-procurement system to the end of officially launch of the system;
- the questions prepared for effectively understanding relevant business background and collecting key requirements to the system;
- the necessary people involved to ensure the success of the project;
- the effective communication methods applied;
- the essential project documents involved to make sure the traceability of project details;
- the methods employed when problems were encountered.

For Company I, it is a software development company. It developed the proposed system and provided system maintenance after the system was officially launched. One staff of the system development team, the team manager, was interviewed through telephone and answered the following questions:

- the methodologies applied to develop and deploy the system;

- the documents utilised during the system development procedure;
- the problems and issues happened during the development and deployment procedure of the system.

As such, all the above documents served as primary data for the researcher to conduct relevant research of this case study. Other confidential data such as real data has been excluded.

4.3.3 Commercial Objectives

According to the "System Functional and Non-Functional Requirements Specifications", the overall project was divided into three phases, followed by a long-term strategy of Company E. In each phase, there were different focuses to be achieved:

- First phase

  It aimed to automate its internal procurement process and activities in Company E, and provide a web-based access for a cluster of SME buyers and suppliers, inclusive of its existing buyer and supplier base. A new procurement process was designed and deployed, in order to ensure the e-procurement system expandability and compatibility for the following two phases.

- Second phase

  It aimed to integrate Company F as a potential supplier to Company E into the e-procurement system, because this company was an international company providing a large scale of consumable goods for manufacturing companies.

- Third phase

  It aimed to integrate Company G into the e-procurement system. Company G was providing software solutions and implementations for SMEs in the aerospace sector, and had around 300 customers utilising its software products. Company E was a customer of the company.

The division of each phase was based on the agreement between the managing directors of Company E and Company H. As the initiator and the end client of the relevant project, Company E raised proposals and request in terms of business and technical aspects. As the organiser of the whole project and provider of the proposed e-procurement system, Company H offered solutions on the basis of the requirements of Company E and took action once obtaining officially acknowledgement from Company E. In this respect, the other organisations (i.e. Company F, Company G, the customers of Company G, and Company I)

were the main participants whose advice and requirements were valuable to Company E and Company H.

Overall, this project was a part of its business expansion progress of Company E. It aimed to not only promote the internal procurement performances, but also form an integrated network across the supply chain. Therefore, Company E was able to obtain more benefits and expand their businesses afterwards.

4.3.4 Previous Procurement within the Supply Chain

The supply chain was to contain Company E (SME), Company F (large supplier), Company G (small service company) and its customer base, because it was part of business expansion progress of Company E. The details relating to the previous procurement within the supply chain are presented in three sub-sections:

- Backgrounds of the supply chain;
- Previous procurement processes and activities;
- Previous procurement problems.

4.3.4.1 Backgrounds of the Supply Chain

Company E was a medium-sized enterprise, chiefly providing aircraft parts to a range of large companies in the aerospace sector. This company started in 2003 and rapidly expanded so that there were 75 employees with £3.5 million annual turnover by 2006. Until then, this company had business partnerships with around 20 SMEs as its supplier base. With its rapidly expanding business, the managing director supported the implementation of the e-procurement system, while accepting the necessary changes introduced into business. Inevitably, the implementation of an e-procurement system led to potential changes about how the business to run and whether its personnel accepted the changes. In order to make sure the success of the project, the senior procurement manager was appointed to be in charge of directing and monitoring the overall project.

Company F was an international corporation providing a large range of consumable goods. This company aimed to expand its business in the SME sector in the UK. In this respect, they incorporated with Company E because Company E was one of the most promising SMEs in the UK. Their corporation was mainly through the project.

Company G was a small service company providing software solutions to SMEs in the aerospace sector. Until 2006, they had around 300 customers, inclusive of Company E.

In addition, the procurement configurations across the supply chain were investigated and presented in Table 4.4.

Table 4.4: Case study two - previous procurement configurations across the supply chain

Procurement Configurations	Company E	Company F	Company G	Customers of Company G
Organisational Type	Medium-sized manufacturing enterprise in the aerospace sector	Large manufacturing corporation	Small software service company	Manufacturing SMEs in the aerospace sector
Readiness to e-procurement adoption?	Yes	Yes	-	Yes
Was there a separate procurement department?	Yes	Yes	-	Not all companies had separate procurement departments
How many employees executing procurement functions?	Four employees	Many employees	-	1 to 2 employees
How many procurement experts?	One	Many	-	None or only one
Was there a dedicated IT department?	No	Yes	-	Not all companies had a dedicated IT departments
How many IT employees?	One	Many	-	1 to 2 employees
How many e-procurement systems already in use to facilitate procurement process?	Two	Several	-	One in most of the companies
Are there mature standards for processing procurement data?	Yes	Yes	-	Yes, because most of the companies utilised the system provided by Company G
What kinds of tools employed to process procurement documents?	E-procurement systems provided by third parties	In-house developed ERP systems, and e-procurement systems	-	The e-procurement system provided by Company G
What is the major way used to communicate with each other?	Telephone, email service provided by third party.	Telephone, and email via their own ERP systems or e-procurement systems	-	Telephone, email service provided by third party

Source: Case Study Two: Project Scope Document, 2006.

Note: Company C was a service company across the supply chain. Therefore, its procurement configurations were not reported here.

4.3.4.2 Previous Procurement Processes and Activities

In terms of the primary data collected, the previous procurement processes and activities are presented in Figure 4.4 below. Seven procurement activities were involved and described from the perspective of Company E (SME), as follows:

1. Procuring list decision

   Before any procurement the procurement department always communicated with its manufacturing department for identifying what materials to be procured. The staff in manufacturing department provided a procuring list based on their inventory records.

2. Create purchase order (PO)

   Based on the procuring list, the procurement staff filled in a series of purchase orders (POs). For each item on a PO, the staff provided its relevant specifications, e.g. supplier's name, supplier's product code, product descriptions, the order quantity, unit price, lead-time, final delivery date, etc. This information was extracted from paper-version catalogues published by its suppliers.

3. Send PO to suppliers

   Once a PO was finalised, it was sent out to the relevant suppliers via email or post. Normally, multiple POs were sent out to several various suppliers based on a procuring list.

4. Receive PO confirmations from suppliers

   After the suppliers received POs, they contacted the procurement department to confirm whether they accepted the received POs. The communications were normally by telephones or emails.

5. Receive goods from suppliers

   On POs, the delivery dates for materials were specified. According to the delivery dates, relevant suppliers delivered materials to Company E.

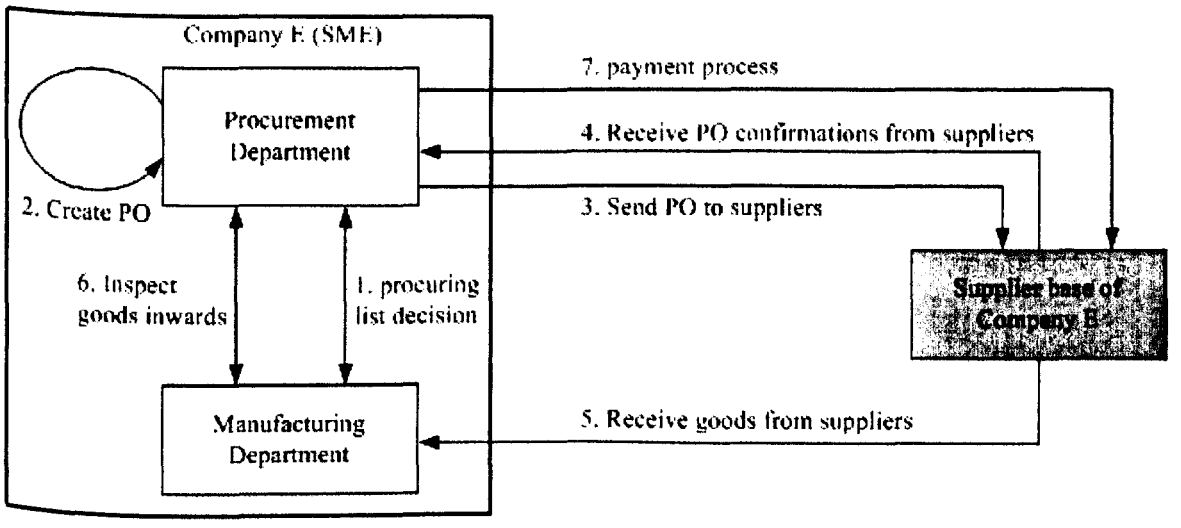
6. Inspect goods inwards

   After receiving the ordered goods from a supplier, quality inspection was carried out by the staff in manufacturing department. They copied the inspection results to the procurement department afterwards.

7. The payment process

   According to the inspection results, the procurement staff calculated the exact payment. Payment was made in accordance with the relevant invoices provided by the suppliers.

Figure 4.4: Case study two – previous procurement



4.3.4.3 Previous Procurement Problems

With the previous procurement processes and activities, several problems have been identified and classified as internal and external categories.

Five internal problems are presented below:

1) Lack of up-to-date product catalogues

   The product catalogues used were published two years ago.

2) Lack of efficient methods for documents management and control

   Seven types of procurement documents were involved: (1) product drawings, (2) product specifications, (3) changes and notes relating to products and engineering processes, (4) request for quotations, purchase orders, (5) despatch notes, (6) delivery notes, and (7) invoices.

   They were in paper-version and exchanged via faxes. To keep historical records, there was a great deal of procurement documents piled in the procurement department.

3) Lack of efficient methods for annual budget control

   The procurement employees submitted the copies of each issued purchase order to the accountant. However, the management across its accounting and procurement was split inside the company, which led to difficulties to monitor procurement activities against its annual budget.

4) Lack of professional employees

   There was only one expert and three primary employees in the procurement department. Almost every procurement document was reviewed by the expert, which consumed more time spent on procurement activities and limited the development and expansion of the company.

5) Long leadtime of a procurement transaction

It took a week or even several weeks to complete a life cycle relating to a procurement transaction. For example, a course of supportive actions were needed:

- Errors relating to the relevant procurement documents to be checked within the company;
- Available products storage to be checked from relevant suppliers;
- Newest product specifications (e.g. codes, names, prices, lead time, etc.) to be confirmed from relevant suppliers;
- The time consumed for negotiating and waiting for relevant suppliers' replies.

Four major external problems are presented below:

1) Relatively high price for procuring consumable goods;
2) Difficulties in acquiring raw material goods with relatively low price;
3) Limited channels to increase their market proportion;
4) Limited scope of supplier base;
5) Lack of formal information system to make procurement transactions proceed more efficiently

Although two e-procurement systems were in use in Company E, none of them supported procurement transactions between the company and its supplier base.

4.3.5 Strengths and Weaknesses from a Supply Chain Perspective

In spite of the identified internal and external problems, it is necessary to take a deeper analysis to explore what the strengths and weaknesses are with respect to the supply chain.

Four weaknesses are summarised as follows:

- Lack of dedicated technical personnel to develop and implement e-procurement systems in Company E;
- Lack of expertise on procurement improvements with e-procurement technologies in Company E;
- Lack of financial resource to support the e-procurement implementation in Company E;
- Company E had no business interactions with Company F before this project.

Four strengths possessed within the supply chain are summarised as follows:

- Experience on utilising e-procurement systems;

- Readiness to adopt e-procurement technologies;
- Trust established between Company E and Company G, because Company E was one of customers of Company G;
- Strong desires on business collaboration between Company E and Company F.

4.3.6 New Procurement

This section examines the new procurement after adopting the e-procurement system. Four aspects are presented in the following subsections.

4.3.6.1 Key Features of New Procurement

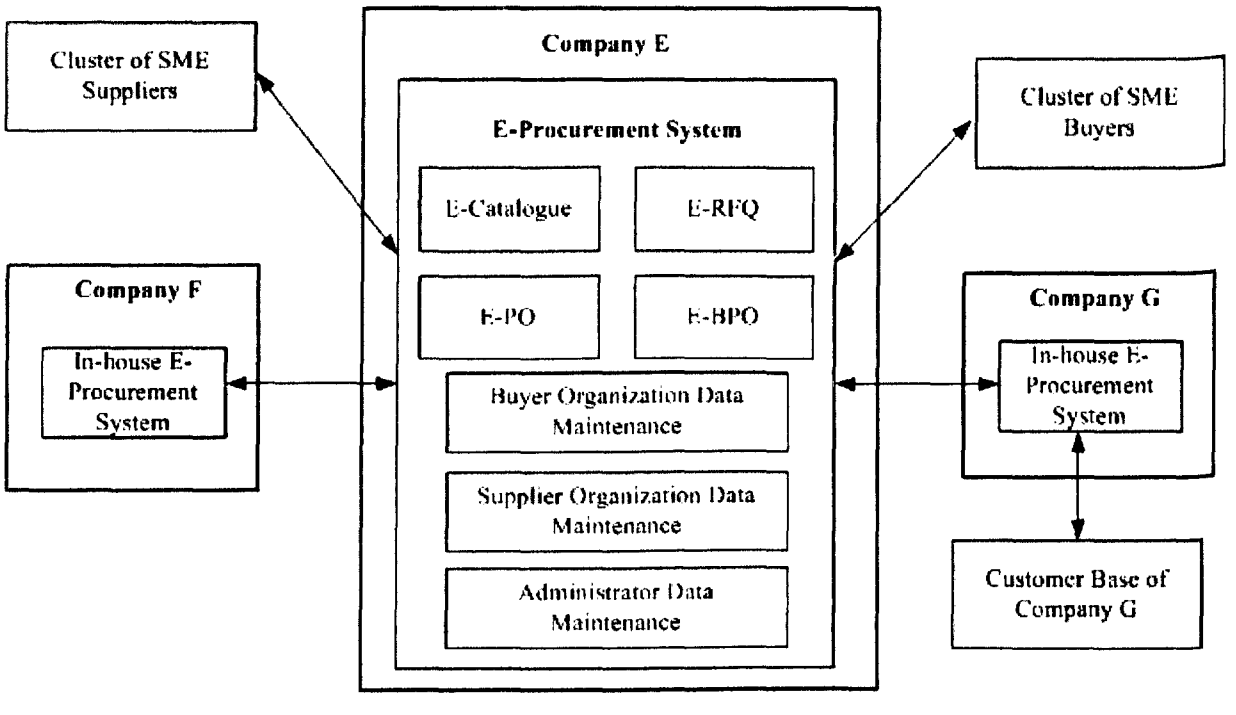
Overall, there are a number of key features of the new procurement, such as:

- Automated activities
- Simplified process
- Online products catalogue
- Electronic version of procurement documents (i.e. POs, RFQs, and BPOs), and archived in database
- Easily retrieve historical records from database
- Procurement-contexts-oriented design
- Relatively advanced technology adoption

The overview of the new procurement is outlined in Figure 4.5 below. The new procurement enables Company E the following:

- To easily communicate with clusters of SME buyers and suppliers, inclusive of its existing buyer and supplier base;
- To easily integrate with Company F through communicating between the e-procurement systems;
- To easily connect with the customer base of Company G through communicating between the e-procurement systems;
- To establish Web APIs for future integrating with other companies.

Figure 4.5: Case study two – overview of new procurement



4.3.6.2 E-Procurement Collaboration Network

As addressed earlier, the project was part of its business expansion progress of Company E (see section 4.3.3). Therefore, the supply chain was established based on the project. To implement the new procurement, several organisations were participated, including Company E (SME), Company F (large supplier), Company G (small service company), customer base of Company G, Company H (consultant company) and Company I (software development company).

Three people in Company E were joined in the project. They were the managing director, procurement department manager, and one procurement assistant. Four people in Company F were involved. They were the director and two employees in procurement department, and the main contact person in the UK branch. Two people in Company G were involved. They were the managing director, and the IT specialist. In the customer base of Company F, five companies expressed their interest of involvement in the third phase of the project.

Company H joined in the project to provide the professional knowledge on procurement improvements and supply chain management, and two dedicated personnel who obtained professional trainings of Prince2 project management. During the conduction of the project, the company served as the organiser, system designer and project inspector.

Company I joined in the project to offer technical skills to develop and implement the e-procurement system. Also, a dedicated project development team with seven staff were appointed. After the project was completed, the company offered technical supports to ensure

the e-procurement system operates properly. Moreover, Company I had close business partnership with Company H.

A close observation was carried out to examine the roles and resources of each group of participant organisations within the e-procurement collaboration network, and the details are summarised in Table 4.5.

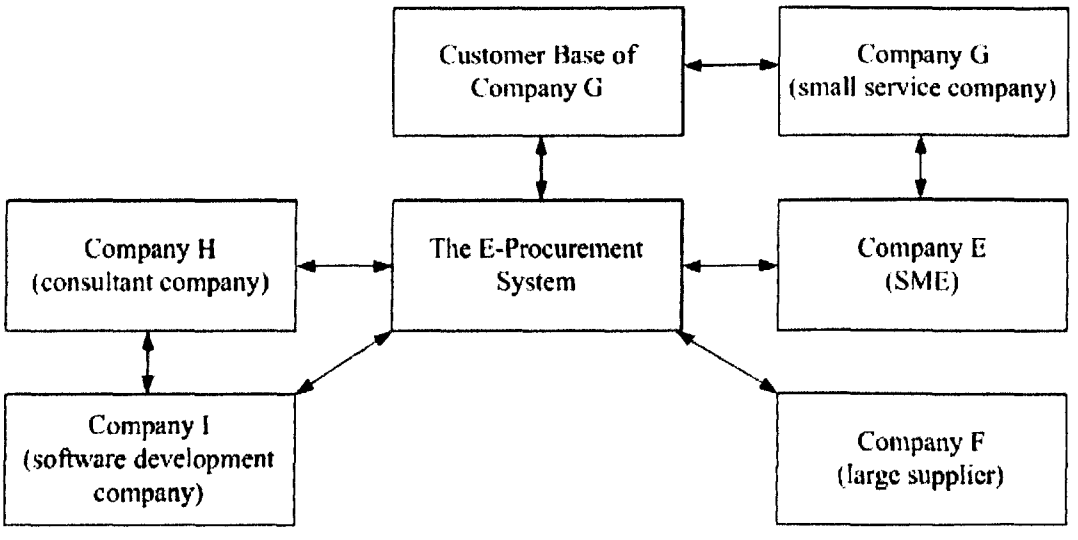
Table 4.5: Case study two - the role and functions of the participant organisations in the project team

Participant Organisation	Role	Functions	Resources provided
Company E	End client of the project, and owner of the e-procurement system	• Request for the e-procurement system • Propose the e-procurement system requirements	• Explanations on its previous procurement process; • Samples of procurement materials and documents; • Supply chain connections to bring Company F and G into the project; • Business connections to bring Company H into the project.
Company F	Participant supplier providing catalogue to the e-procurement system	Refine the requirements of the e-procurement system	Integrated and extensive products catalogue
Company G	Intermediate organisation across the supply chain	Refine the requirements of the e-procurement system	Business connections with its customer base, including around 300 SMEs in the aerospace sector.
Company H	• e-procurement system designer and administrator; • project organiser and progress inspector.	• Analyse system requirements from high-level point of view • Design system architecture • Monitor progress of the project • Validate the quality of the system • Give system training the end client, the SME in UK	• Professional knowledge on procurement improvements and supply chain management; • Professional personnel in charge of organising and inspecting the entire project; • Standardised templates of project documents; • Business partnership with Company I
Company I	e-procurement system developer and technical supporter	• Analyse system requirements from software development's viewpoint • Design detailed work flows of the e-procurement system • Development the system • Release the system • Give technical support for using the system	• Technical skills on software development and implementation; • Professional personnel in charge of developing and implementing the e-procurement system.

In particular, the relationship or interactions amongst the e-procurement collaboration network is another issue to consider and demonstrated in Figure 4.6.

- Company E is connected with the Company F and G respectively, owing to supply chain partnerships.
- Company E is linked with the customer base of Company G via the e-procurement system.
- Company H and I are connected because of their long-term partnerships.
- Apart from the above three connections, these organisations are linked together via the e-procurement system upon the project.

Figure 4.6: Case study two - relationship model in the e-procurement collaboration network



4.3.6.3 E-Procurement System

This section introduces the e-procurement system, including the model utilised and system functions.

As identified in different categories of e-procurement models (section 2.5.5), the specific set of e-procurement models are recognised as follows:

- From the aspect of procurement processes and activities, the model of e-ordering is adopted to facilitate the ordering process and activities across the supply chain involving Company E (SME), Company F (large supplier), Company G (small service company) and its customer base;
- From the aspect of ownership of e-procurement system, the model of buyer-side and the model of solo ownership were adopted. The e-procurement system was designed to hold more supplier users than buyer users, so that buyer users can obtain more benefits. And, Company E (SME) owns the e-procurement system.

The system functions contain the following:

- RFQ function
- PO function

  This function facilitates each supplier company to view the purchase order with the e-procurement system without transferring to suppliers' individual data formats. Moreover, the function allows each supplier company to extract information for generating invoices and dispatch advice notes later.
- BPO function
- Catalogue function
- Customer Organisations Data Maintenance function

  This function facilitates each second tier supplier company to maintain the customer organisations' profiles.
- Supplier Organisations Data Maintenance function

  This function facilitates each supplier company to maintain their own organisation's profiles.

4.3.6.4 Implementation Stages

As stated in the project plan, the project was divided into three phases, each including several sub-stages. In the first phase, a detailed plan contained a series of milestone, as presented in Table 4.6.

Table 4.6: Case study two - details plans in first phase

Stage & Milestone	Description
User interface prototype	A system with most major screenshots available to provide a look and feel but without the functionality in place.
Design documents	A design document including the whole system architecture, main UML diagrams and database schema. UML diagrams include: • Use cases • Class diagrams • Collaboration diagrams • Interaction sequence diagrams • Activity diagrams Note: only key business flows/activities are required to be depicted using collaboration diagrams, interaction sequence diagrams or activity diagrams.
Testing documents	Test plan and test cases
Functional release 1	The system includes the functionalities below:

	• Customer – Manage Accounts Requirements • Customer – Requests For Quotes • Administration – Configure Users Requirements • Administration – Configure RFQ Requirements
Functional release 2	The system includes the functionalities below: • Administration – Catalogue Management Requirements • Customer Catalogue Requirements • Customer Favourites Requirements
Functional release 3	The system includes the functionalities below: • Customer – Generate PO • Customer – Generate Blanket Purchase Order Requirements • Customer – Manage Accounts Requirements (Completed i.e. PO Archive completed) • Administration – Configure Users Requirements (complete) • Administration – Reporting Tool • Admin – All POs Searchable Archive
Supporting documents	Deployment document and user manual
End of Main Support phase	System deployed and went live on the customer's side. All issues identified by CUSTOMER and accepted by SUPPLIER during support phase are resolved. However, the end of this point is only defined for the final payment to be issued to the supplier. Any bug occurs on the system developed by the supplier is discovered after this phase, the supplier has the responsibility to fix it free of charge.

4.3.7 Benefits and Challenges of the E-Procurement Adoption

According to the feedback from Company E (SME), the owner and main user of the e-procurement system, the benefits and challenges of the e-procurement adoption are discussed.

The benefits obtained are summarised as follows:

- Improved and simplified ordering process and activities;
- Shortened life cycle ordering process;
- Efficient communication established across the supply chain;
- An integrated procurement network formed across the supply chain;
- The e-procurement system offers an opportunity for further supply chain integration in the future.

The challenges of the e-procurement adoption are summarised as follows:

- Business interdependency has been increased, which indicates the stability of the supply chain, to some extent, depends on the participant organisations in the e-procurement collaboration network.
- Business confidentiality relies on all the participant organisations in the e-procurement collaboration network, which becomes more complicated and difficult than before.
- The amount of trade conflicts might be increased in the e-procurement collaboration network, because more organisations are involved.

4.3.8 Conclusions and Recommendations

There are a number of lessons learned from this case study. As well, the relevant recommendations for future work are presented accordingly.

4.3.8.1 Lessons Learned

The lessons learned from the case study are categorised into five aspects:

- Business relationships

  In this case study, the business relationships upon the e-procurement system need to be greatly transformed, so that the procurement integration among buyers and suppliers is essential to the success of the project. Although the e-procurement system was fully developed with high quality, there were no buyers or suppliers companies to join the online procurement club. Most of Company E's business partners are SMEs, who usually lack financial investment, technical support, and are reluctant to adopt new technologies in their traditional businesses. Company A, as an SME, faced more resistance pressure to convince its buyers and suppliers to join the online procurement club, in that the company has difficulty in attracting a large quantity of SMEs onto the e-procurement platform with its own market influence.
- Business strategy and procurement tactics

  Regarding to Company E, it does have the vision to provide e-business solutions in supply chain management in aerospace sector. The company's strategy is not clear enough to formulate into applicable tactics to direct its short-term business operations. Moreover, the company did not have a clear procurement tactic which can be

integrated into its long-term business strategy, which quite possibly lead this project to fail in the end.

- Business operation

  Concerning Company E's daily operation, it needed more shifting from manual mode to electronic mode in many activities, which resulted in difficulties to its daily operation. For example, the employees were not familiar with how to use the e-procurement system to generate a RFQ or a PO. Subsequently, staff training needed to be much broader, so that every employee in the company can get the opportunity to learn how to use the system, rather than only the company's managing director and procurement manager understand the work flow in the system.

4.3.8.2 Recommendations

The following recommendations might be helpful:

- Compose the corresponding procurement tactics of Company E based on the e-procurement system;
- Integrate its procurement tactics into the company's long-term strategy;
- Reengineer Company E's internal operation first to adapt it to more suit the business processes involved in the e-procurement system;
- Tackle the difficulties in catalogue integration and updating real time; and
- Enhance the work flow for process RFQ, PO, and BPO, so that these processes can be systematically connected in chain to relevant procurement activities.

In addition to the above recommendations, there are more details to be considered. For example, it is necessary to think about how to adjust the business according to rapid changes and turbulence from external business environment perspective. The training and continuous improvements for employees are also quite important, after all most of business successes depends on the people's capability, especially inside Company E.

4.4 Case Study Three

Case study three is based upon a real project to establish an e-procurement system which facilitates the supplier sourcing processes in the aerospace sector for Company J. The scope of the project is to establish an e-procurement system to facilitate its supplier selection process.

From a commercial perspective, Company J aimed to utilise e-procurement technologies to not only automate its supplier sourcing processes, but also form a more integrated supply chain with its supplier base, which provided an easy channel for involving potential suppliers. From an academic perspective, this project provides a valuable opportunity for the researcher to explore the drivers concerning the following aspects:

- Why and how an SME facilitates the new supplier sourcing process;
- How an SME obtains effective external support to conduct the project;
- How the e-procurement collaboration network upon this project is formed;
- What the roles and relationships required to form the network;
- How the participant organisations interact with each other upon the network;
- What functions the e-procurement system provides.

Accordingly, the lessons are extracted based upon the successful and failure aspects occurred when the project is conducted. In order to obtain more primary data for case study research, as well acquaint with more practical knowledge and experience, the researcher fully participated in the project.

4.4.1 Research Objectives

In the case study, several research objectives are to be explored, and described as follows:

- Identify the participant organisations in the project;
- Identify the roles and functions played by each participant organisation;
- Investigate the contributions provided by each participant organisation;
- Investigate the relationships in the e-procurement collaboration network;
-
- To identify the reasons for selecting supplier sourcing process as the focus of the project by the end client Company J;
- Examine the previous procurement contexts concerned in the project;
- Identify the particular e-procurement model, specifically, the e-tendering model, to underpin the specific procurement process;

- Identify the specific technical infrastructure adopted in the project;
- Investigate the particular e-procurement system functions implemented in the project;
- Investigate whether there is a future plan for further improvements;
- Identify the lessons learned via the case study;
- Propose recommendations for further improvements.

4.4.2 Data Collection

In the case study, the main methods for collecting raw data were semi-structured interviews, emails and telephones. These interviews were carried out weekly by the researcher as the project manager. The interviewees were three employees, including the managing director, the procurement manager and the procurement assistant, within Company J. Based on the interview records, the following documents were generated:

- Project scope document;
- Functional and non-functional requirements;
- Functional and non-functional change requirements;
- New supplier selecting process flow chart;
- Project plan;
- Project technical documents (i.e. technical implementation architecture) to specify the server and database applied;
- Project progress logs;
- Project risks and issues;
- E-procurement system testing cases and plan;
- Questions and answers about the e-procurement system testing.

Company K and L were involved as intermediate organisations in the project. Company K was a consultancy company, mainly responsible for organising and inspecting the project, as well as, designing the e-procurement system. Two key persons in Company M were directly involved:

- The researcher, as project manager assistance, collected the requirements for the e-procurement system from Company J, controlled the project progress, and took collective actions if any problem occurs during the project duration;
- The technical engineer took charge of configuring and maintaining its database and servers for the project.

Company L was a software development company, chiefly in charge of developing and implementing the e-procurement system, and the following project documents were provided:

- Detailed design documentation, i.e. prototype, database scripts, and software source codes;
- Software installation instructions;
- E-procurement system user manual.

To verify the success of implementing the e-procurement system, the technical engineer in Company K produced the following project documents:

- Project technical documents (i.e. technical implementation architecture) to specify the server and database applied in this project.

Additionally, a series of documents were also involved in the project, such as:

- Project contracts and invoices;
- Knowledge transfer Questions and Answers documents communicated between Company K and L.

Although there is large quantity of data stored in database of the e-procurement system, it cannot be disclosed because of confidentiality issues.

4.4.3 Commercial Objectives

The fundamental commercial objectives of the project enable Company J to simplify its supplier selection process and automate the subsequent supplier tendering process, and to ultimately reduce the relevant procurement costs though an integrated supply chain.

As addressed in the project document 'functional and non-functional requirements', the purpose was to provide a 'fully functional live' e-procurement system, with the following benefits:

- Removal of multiple spreadsheets;
- All data centrally held enabling vital information to be disseminated throughout Company J;
- Efficient information exchange with no reliance on key individuals for information;
- No duplicated information and data entry (in paper copies and spreadsheets);
- Decreased administration costs and paperwork;
- Centralised online system – leading to improved control of RFQ's and quotations;
- Clear visibility of all quotations received and real time status of information;

- Removal of phone calls.

4.4.4 Previous Procurement within the Supply Chain

The supply chain contained Company J (SME) and its supplier base involving twenty small businesses. The details relating to the previous procurement within the supply chain are presented in three sub-sections:

- Backgrounds of the supply chain;
- Previous procurement processes and activities;
- Previous procurement problems.

4.4.4.1 Backgrounds of the Supply Chain

Company J was a medium-sized enterprise, chiefly providing aircraft parts to a range of large companies in the aerospace sector. Until 2006, there were 88 employees in the company and business partnerships with twenty small suppliers as its supplier base. With its rapid business development and expansion, the managing director supported the implementation of the e-procurement system, while accepting the necessary changes introduced into business. Inevitably, the adoption of an e-procurement system led to potential changes about how the business to run and whether its personnel accepted the changes. In order to make sure the success of the project, the procurement manager was appointed to be in charge of directing and monitoring the overall project.

The supplier base of Company J involved twenty SMEs. Each company of the supplier base had simple procurement configurations.

The procurement configurations across the supply chain were investigated and presented in Table 4.7.

Table 4.7: Case study three - previous procurement configurations across the supply chain

Procurement Configurations	Company J	The Supplier Base of Company J
Organisational Type	Medium-sized manufacturing enterprise in the aerospace sector	Manufacturing SMEs in the aerospace sector
Readiness to e-procurement adoption?	Yes	Yes for some; No for the others.
Was there a separate procurement department?	Yes	Not all companies had separate procurement departments
How many employees executing procurement functions?	Four employees	1 to 2 employees
How many procurement experts?	One	None or only one

Was there a dedicated IT department?	No	No
How many IT employees?	One	Zero or One
How many e-procurement systems already in use to facilitate procurement process?	Three	None
Are there mature standards for processing procurement data?	Yes	No
What kinds of tools employed to process procurement documents?	Microsoft Excel, E-procurement systems provided by third parties	Microsoft Excel
What is the major way used to communicate with each other?	Telephone, e-procurement systems and email service provided by third party	Telephone, email service provided by third party

Source: Case Study Three: Project Scope Document, 2006.

4.4.4.2 Previous Procurement Processes and Activities

The previous procurement processes and activities were examined and described as follows:

- Company J received a work package from a customer via fax / e-mail / post.
- One manufacturing engineer in Company J performed a technical review on each drawing within the work package to determine what manufacturing processes were required.
- One employee in the procurement department entered the initial work package details into a "Work Package" spreadsheet.
- Work package drawings and / or related documents were posted onto the suppliers of Company J.
- Based on the technical review findings, another employee in the procurement department selected a list of suppliers who were capable of manufacturing the parts required in a specific work package.
- RFQ(s) (with attached drawings) were composed and faxed / e-mailed / posted to each selected supplier.
- Suppliers reviewed RFQ (and drawings) and sent their quotations back to Company J though e-mail / post / fax if they considered the work worthwhile.
- The employees in the procurement department called each selected supplier on a daily basis to remind them of the RFQ.
- Once quotations were received, the employees in the procurement department manually extracted the prices into a new spreadsheet to make price comparisons.
- Suppliers were usually selected based on the cheapest quotation prices.

- A percentage mark-up were decided and calculated manually by the employees in procurement department.
- A quotation upon a particular work package was manually compiled for the customer in another new spreadsheet.
- The quotation was then sent to the customer through fax / e-mail.
- The customer reviewed the quotation and decided whether to commission the work to be performed.

4.4.4.3 Previous Procurement Problems

According to the project documentation, several problems were recognised and exemplified as follows:

- Manually intensive and lengthy spreadsheet driven process with no automation – led to a proliferation of non-value adding activities.
- All information retrieval was manual and paper based.
- Duplication of information.
- Complex and lengthy chain of communication between the company and suppliers.
- Numerous unnecessary steps (e.g. phone calls and e-mails) that led to inefficiencies and delays were to remove.
- No visibility of information – a small number of key employees in Company J processed vital information which was not always shared in a timely fashion.
- No dynamic reporting capability to provide management reports or up-to-date KPI's.
- Compulsory information was often left incomplete and time was wasted locating information stored in numerous spreadsheets.

4.4.5 Strengths and Weaknesses from a Supply Chain Perspective

In spite of the identified problems relating to previous procurement, it is necessary to take a deeper analysis to explore what the strengths and weaknesses are with respect to the supply chain.

Five weaknesses are summarised as follows:

- Lack of dedicated technical personnel to develop and implement e-procurement systems in Company J;

- Lack of expertise on advanced supplier sourcing processes with e-procurement facilitation in Company J;
- Lack of financial resource to support the e-procurement implementation in Company J;
- Lack of knowledge and experience on e-procurement adoptions across the supplier base of Company J;
- The supplier base of Company J had low interest to be involved in the project because they were not ready to compete online only upon price quotations.

Five strengths possessed within the supply chain are summarised as follows:

- Dedicated procurement personnel in Company J;
- Experience on utilising e-procurement systems in Company J;
- Readiness on e-procurement adoptions in Company J;
- Trust and long-term cooperation established between Company J and its supplier base;
- Strong influence on the supplier base of Company J because Company J hold business connections with many large corporations in the aerospace sector.

4.4.6 New Procurement

This section examines the new procurement after adopting the e-procurement system. Four aspects are presented in the following subsections.

4.4.6.1 Key Features of New Procurement

Five key features of the new procurement have been identified, summarised as follows:

- Automated and simplified supplier sourcing processes and activities;
- A more efficient mechanism applied to facilitate the selection of suitable suppliers;
- A new process flow deployed to facilitate suppliers' tendering activities;
- A more efficient and responsive communication channel established across the supply chain;
- Web-based technology utilised to embrace the requirements of the new procurement.

The overview of the new procurement is demonstrated in Figure 4.7a and Figure4.7b.

Figure -4.7a: Case study three - overview of new procurement process (part 1)

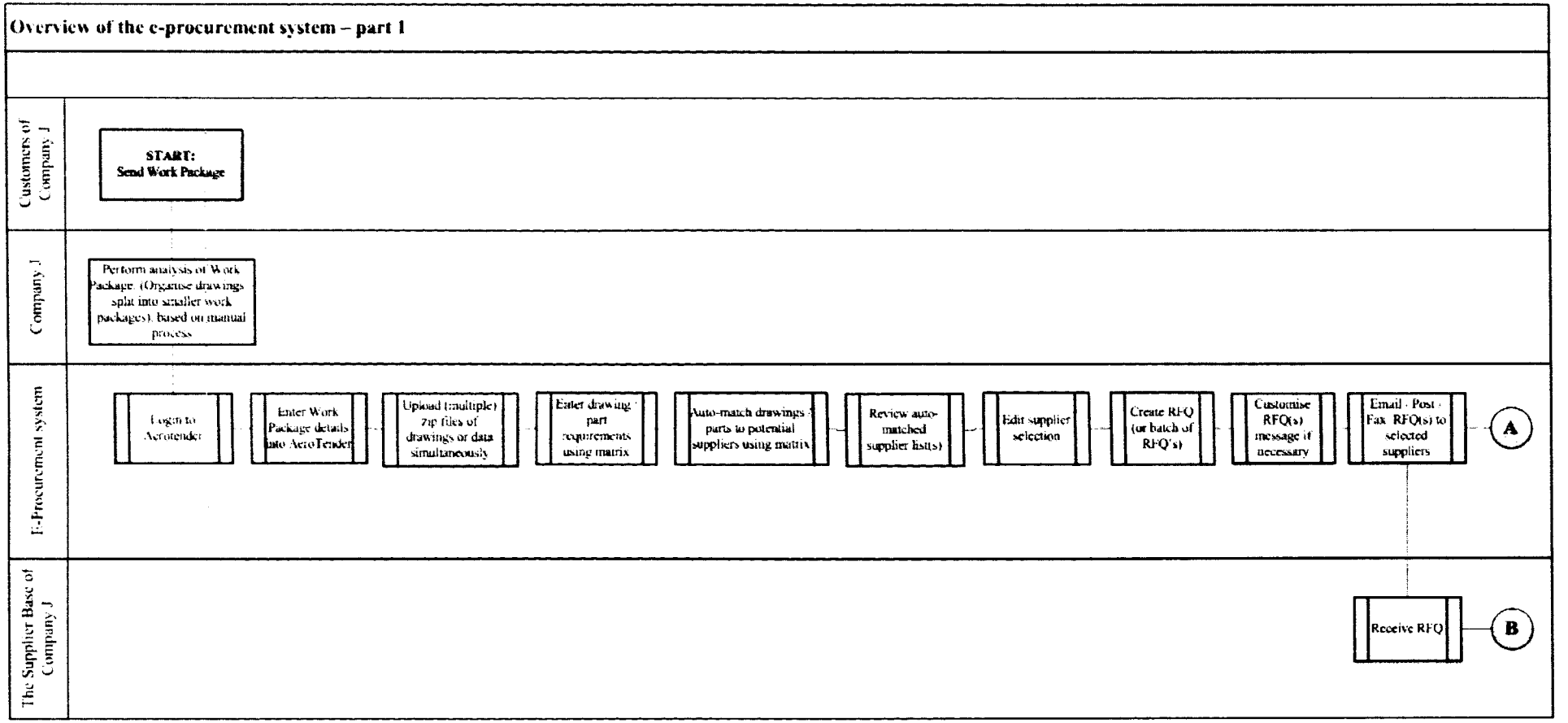
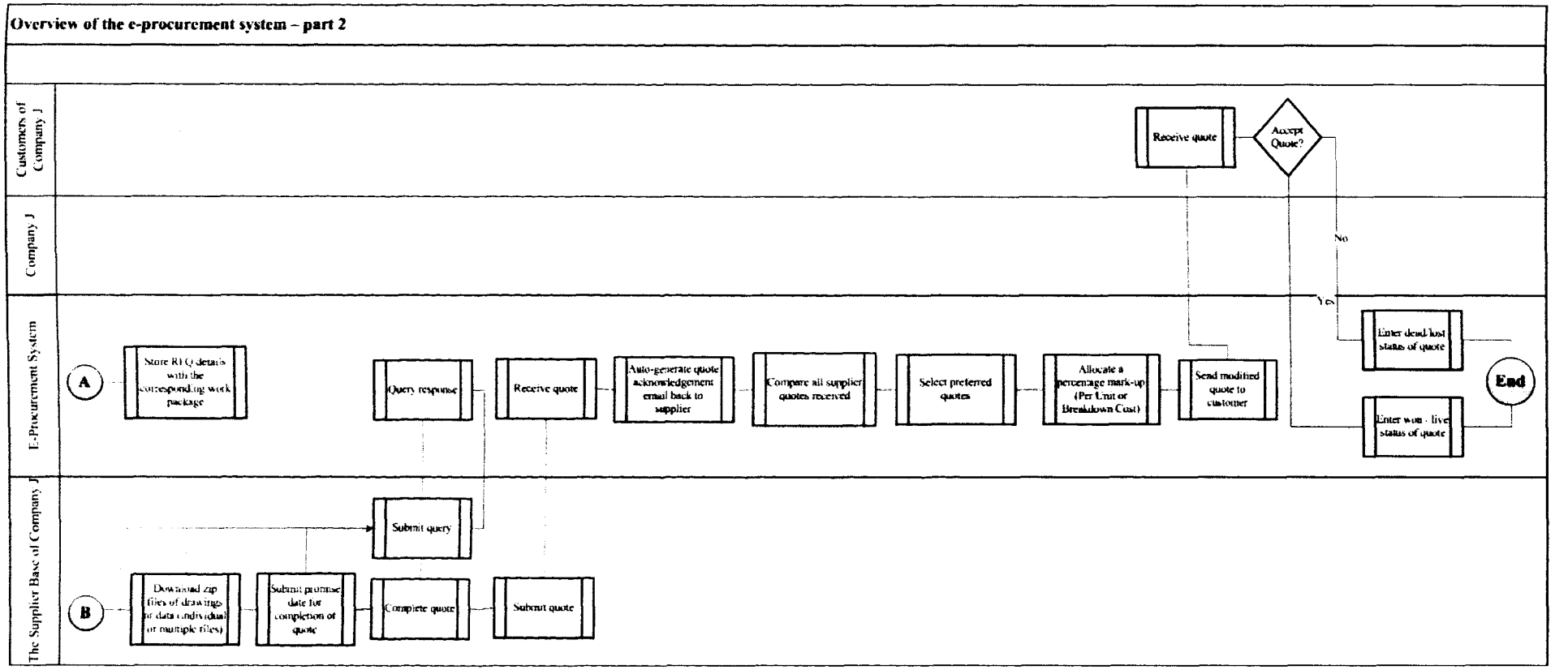


Figure 4.7b: Case study three - overview of new procurement process (part 2)



4.4.6.2 E-Procurement Collaboration Network

To implement the new procurement, several organisations participated in the project, including Company J (SME), the supplier base of Company J (SMEs), Company K (consultant company) and Company L (software development company).

The contacts of the supplier base were arranged by Company J. They did not join the project directly.

Company K joined in the project to provide the professional knowledge on procurement improvements and supply chain management, and two dedicated personnel who obtained professional trainings of Prince2 project management. During the conduction of the project, the company served as the organiser, system designer and project inspector.

Company L joined in the project to offer technical skills to develop and implement the e-procurement system. Also, a dedicated project development team with seven staff were appointed. After the project was completed, the company offered technical supports to ensure the e-procurement system operates properly. Moreover, Company L had close business partnership with Company K.

A close observation was carried out to examine the roles, functions and resources of each group of participant organisations within the e-procurement collaboration network, and the details are summarised in Table 4.8.

Table 4.8: Case study three - details of the e-procurement collaboration network

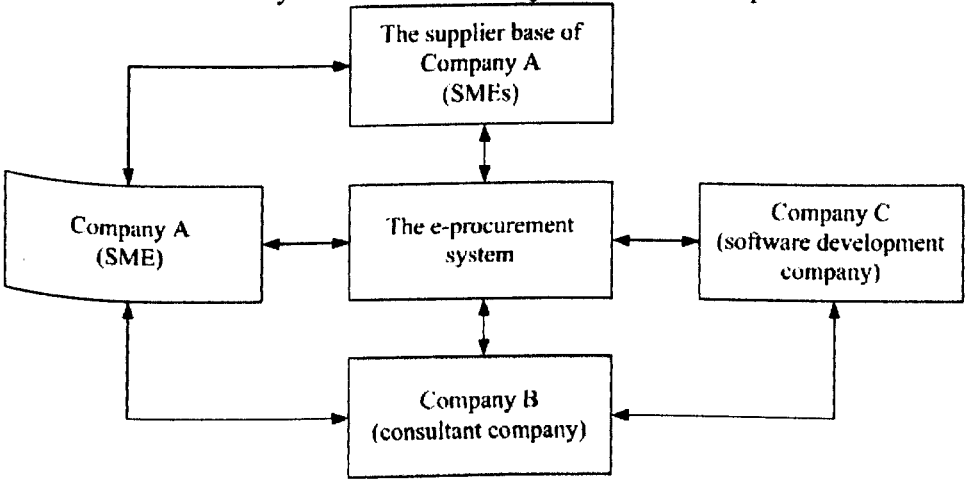
Participant Organisation	Role	Functions	Resources provided
Company J	End client of the project, and owner of the e-procurement system	• Request for the e-procurement system • Propose the e-procurement system requirements	• Explanations on its previous procurement process; • Samples of procurement materials and documents; • Supply chain connections to bring its supplier base into the project; • Business connections to bring Company K into the project.
The Supplier Base of Company J	Suppliers of Company A across the supply chain	Refine the requirements of the e-procurement system.	-
Company K	• e-procurement system designer and administrator; • project organiser and progress inspector.	• Analyse system requirements from high-level point of view • Design system architecture • Monitor progress of the project • Validate the quality of the system • Give system training the end client, the SME in UK	• Professional knowledge on procurement improvements and supply chain management; • Professional personnel in charge of organising and inspecting the entire project; • Standardised templates of project documents; • Business partnership with Company L
Company L	e-procurement system developer and technical	• Analyse system requirements from	• Technical skills on software development and

	supporter	software development's viewpoint • Design detailed work flows of the e-procurement system • Development the system • Release the system • Give technical support for using the system	implementation; • Professional personnel in charge of developing and implementing the e-procurement system.

In particular, the participant organisations and their relationships in the e-procurement collaboration network are considered and demonstrated in Figure 4.8.

- Company J is connected with its supplier base, owing to supply chain partnerships.
- Company J is linked with Company K, due to their close business relationships.
- Company K and L are connected because of their long-term partnerships.
- Apart from the above three connections, these organisations are linked together via the e-procurement system upon the project.

Figure 4.8: Case study three - relationship model in the e-procurement collaboration network



4.4.6.3 E-Procurement System

This section introduces the e-procurement system, including the model utilised and system functions.

As identified in different categories of e-procurement models (section 2.5.5), the specific set of e-procurement models are recognised as follows:

- From the aspect of procurement processes and activities, e-tendering model is adopted to facilitate the supplier sourcing and tendering processes and activities across the supply chain involving Company J (SME) and its supplier base;
- From the aspect of ownership of e-procurement system, buyer-side model and solo ownership model is adopted. The e-procurement system was designed to hold more

supplier users than buyer users, so that buyer users can obtain more benefits. And, Company J (SME) owns the e-procurement system.

The system enables systems users (i.e. buyer, and suppliers) to improve operational efficiency across the supplier sourcing process. The system 'buyer' is Company J; whilst, the system 'suppliers' contain its supplier base involving twenty SMEs.

In this sense, the system functions can be categorised into two groups: one is for the buyer side, and the other is for the supplier side, as follows:

System User Type: Buyer

- A database of suppliers and their capabilities (View / Add / Amend details)
- Entering a new work package
- Uploading zip files of drawings or supporting documents
- Entering drawing / part requirements – (A database of drawings and parts)
- Auto-matching the requirements of drawings / parts to suppliers with the appropriate capabilities
- Reviewing the auto-matched supplier list and editing the supplier selection
- Creating RFQ(s) for work packages to be sent to the suppliers selected
- Submitting a quotation (on behalf of a supplier)
- Comparing all quotations received from suppliers
- Preparing a quotation for a customer – with automated calculations
- Viewing details of existing work packages
- Creating management reports
- Handling enquiries - viewing / responding to supplier enquiries
- Amending / Deleting / Archiving work packages (Administrator only)
- Creating / Amending / Deleting Supplier and General Aerogistics users accounts with usernames and passwords (Administrator only)

System User Type: Suppliers

- Receiving an RFQ
- Acknowledging receipt of an RFQ and committing a date for response
- Downloading individual / multiple files of drawings or supporting documents as zip files
- Submitting a query
- Receiving a query response

- Submitting a quotation

4.4.6.4 Implementation Stages

As stated in the project plan, the project was divided into several stages with milestones respectively. The detailed plan is presented in Table 4.9.

Table 4.9: Case study three - detailed plan of the project

Stage & Milestone	Description
User interface prototype	A system with most major screenshots available to provide a looking feel but without the functionality in place.
Design documents	A design document including the whole system architecture, main UML diagrams and database schema. UML diagrams include • Use cases • Class diagrams • Collaboration diagrams • Interaction sequence diagrams • Activity diagrams Note: only key business flows/activities are required to be depicted using collaboration diagrams, interaction sequence diagrams or activity diagrams.
Testing documents	Test plan and test cases
Functional release 1	The system includes the functions below: • General Buyer – Manage Accounts Requirements • General Buyer – Requests For Quotes • Administration – Configure Users Requirements • Administration – Configure RFQ Requirements
Functional release 2	The system includes the functions below: • Administration – Quotation Management Requirements • Work package Requirements • Supplier Quotation Requirements
Functional release 3	The system includes the functions below: • General Buyer – Issue Work package • General Buyer – Generate RFQ Requirements • General Buyer – Generate Customer report Requirements
Supporting documents	Deployment document and user manual
End of Main Support phase	System deployed and went live on the customer's side. All issues identified by CUSTOMER and accepted by SUPPLIER during support phase are resolved. However, the end of this point is only defined for the final payment to be issued to the supplier. Any bug occurs on the system developed by the supplier is

	discovered after this phase, the supplier has the responsibility to fix it free of charge.

4.4.7 Benefits and Challenges of the E-Procurement Adoption

According to the feedback from Company J (SME), the owner and main user of the e-procurement system, the benefits and challenges of the e-procurement adoption are discussed.

The benefits obtained are summarised as follows:

- Improved and simplified supplier sourcing process and activities;
- Shortened life cycle of supplier sourcing process;
- Efficient communication channel established between Company J and its supplier base;
- An integrated network formed across the supply chain;
- More opportunities for involving potential suppliers for Company J.

The challenges of the e-procurement adoption are summarised as follows:

- Business competition among the supplier base of Company A has become more intensive; many suppliers of Company J were reluctant to join onto the reverse auction platform (i.e. the proposed e-procurement system) because they were concerned about losing profit.
- Business confidentiality relies on all the participant organisations in the e-procurement collaboration network, which becomes more complicated and difficult than before.
- The amount of trade conflicts might be increased in the e-procurement collaboration network, because more organisations are involved and more transparency of the supply chain are offered.

4.4.8 Conclusions and Recommendations

There are a number of lessons learned from the case study. The relevant recommendations for future work are also presented accordingly.

4.4.8.1 Lessons Learned

The lessons learned from the case study are categorized into four aspects as follows:

- The e-procurement collaboration network is grown out the supply chain network involving Company J and its supplier base;
- The e-procurement collaboration network can be formed because of the relationships linking the participant organisations, as well as the roles and responsibilities required upon the project.
- The success of the project partly depends on the resources aggregated by the entire e-procurement collaboration network, partly depends on the trust and alliances existing between the participant organisations, and also partly depends on the success of the e-procurement system.

4.4.8.2 Recommendations

The following recommendations might be helpful to improve the e-procurement system in the future:

- Offer more benefits for the supplier base of Company J, so that they could have more interest to utilise the e-procurement system, rather than being forced onto the system;
- Convince some large buyers of Company J to integrate with the e-procurement system, so that more pressures could be passed onto its supplier base;
- The ownership of the e-procurement system might be transferred to Company K (consultant company), to reduce the security concerns among the supplier base of Company J;
- More targeted trainings could be provided in particular for the supplier base of Company J, so that they could have more confidence with the e-procurement system.

4.5 Chapter Summary

In summary, this chapter presents three case studies, focusing on various aspects in procurement improvements across supply chains in the aerospace sector. Totally, the three case studies were carried out over a period of two years involving three sets of e-procurement collaboration networks.

Case study one is centred on the investigation of a one-size e-procurement solution to facilitate key procurement information exchanges between buyer and supplier across a supply chain; whilst, Case study two is emphasised on the examination of a strategic e-procurement adoption which eventually enhances the bargaining strengths of suppliers against large buyers across a supply chain; in the meantime, Case study three concentrates on the exploration of a strategic e-procurement application which promotes more benefits for this buyer side through an automated supplier sourcing process.

Through each individual case study, the findings are focused on the following aspects:

- The commercial objectives relating to each relevant project;
- The details of previous procurement across the relevant supply chains;
- The problems in terms of previous procurement;
- The key features of new procurement and the e-procurement models applied in new procurement;
- The details of e-procurement collaboration network formed based on relevant project, including participant organisations, the relationship formed, the responsibilities taken by each participant organisation;
- The stages for development and implementation of relevant e-procurement systems.

Overall, these findings through each individual case study lead to an easier cross cases analysis carried out in Chapter 5. Correspondingly, these findings establish the underlying foundation for the framework developed in Chapter 6.

Chapter 5 Cross-Case Analyses

5.1 Introduction

This chapter investigates the similarities and differences among the three case studies introduced in Chapter 4. And, the findings are observed through a series of cross-case analyses concerning five aspects, including:

- Commercial objectives;
- Previous procurement, including the backgrounds of supply chains, processes and problems.
- New procurement, including the key features of the new procurement, the e-procurement collaboration network, the e-procurement models, system functions and implementation stages;
- The interview procedures, including the type of interviews, the interviewees, and interview questions;
- The project documents, including the list of project documents, the explanations of project documents and the dedicated organisations in charge of project documents.

Correspondingly, the findings discovered in each aspect addressed here present a range of sufficient evidences, which are assembled into the components comprising the framework established in Chapter 6.

5.2 Cross-Case Analysis on Commercial Objectives

In case study one, the project was to enable the SME cluster to easily cope with the difficulties in maintaining and processing procurement documents with two OEMs (see section 4.2.3). In case study two, the project was to utilise e-procurement technology to increase its procurement performances and form an integrated network across the supply chain in order to achieve the business expansion target of Company E (SME) (see section 4.3.3). In case study three, the project was to enable Company J (SME) to ultimately reduce its procurement prices, by simplifying its process of selecting eligible suppliers and automating the subsequent suppliers' tendering process (see section 4.4.3).

In Table 5.1 below, it presents more detailed commercial objectives, foci of procurement improvements, and key drivers in each commercial project among the three case studies.

Table 5.1: Cross-case analysis on commercial objectives, procurement foci and key drivers

Case Study	Commercial Objectives	Procurement Foci	Key Drivers
Case study one	• To enable the SME cluster to easily cope with the difficulties that occur when maintaining and processing procurement documents; • To replace the manual process by adopting e-procurement system; • To secure business for the SME cluster; • To increase operational efficiencies across the supply chain.	• Automating and simplifying procurement documents exchange process; • Improving internal operational efficiency of each participant company in the SME cluster; • Enhancing external operational efficiencies for the overall supply chain.	• The pressure to secure business in a competing market; • The internal pressures to improve operational efficiencies of the supply chain.
Case study two	• To automate the internal procurement process and activities in Company E (SME) • To integrate Company F (large supplier) in the e-procurement system • To integrate Company G (small service company) in the e-procurement system; • To obtain more competitive prices, by connecting the customer base of Company G as SME buyers via an e-procurement system.	• Automating and simplifying the internal ordering process; • Adopting a real-time integrated products catalogue; • Integrating Company F as a large supplier; • Accessing the customer base of Company G by integrating with Company G; • Establishing a buyer side e-marketplace in the aerospace sector.	• Price pressures coming from large buyers, and other competitors.
Case study three	• To enable Company J (SME) to simplify its supplier selection process; • To automate the subsequent suppliers' tendering process;	• Automating and simplifying the process of selecting eligible suppliers; • Automating and simplifying suppliers' tendering process;	• The pressures coming from OEMs which act as large buyers of Company J.

	• To ultimately reduce the procurement costs.	• Automating and simplifying sourcing process to improve overall operational efficiency in the supply chain.	

Note: Please refer to the contents in sections 4.2.3, 4.3.3, and 4.4.3 in Chapter 4.

Based on the cross analysis presented above, the similarities among the three case studies are described as follows:

- They aim to enhance procurement process improvements for SMEs;
- They use e-procurement systems to facilitate procurement improvements;
- The procurement improvements usually start from improving internal operational efficiencies through automating and simplifying traditional processes and activities;
- A useful and effective way to enable procurement improvements is enhancing the overall operational efficiencies by improving collaboration in the supply chain;
- The process is typically subject to intensive competition across supply chains and reduction in procurement prices requested by supply chain partners;
- The key benefits via procurement improvements are decreased procurement prices and seamless integration across the supply chains, instead of cost reduction by refining paper-based documents with electronic-based documents;

The differences are that the drivers for procurement improvements were different across the three case studies, and therefore the foci of procurement improvement were different, resulting in distinct commercial objectives relating to specific e-procurement projects:

- In case study one, the major drivers were to enable the SME cluster to easily cope with the difficulties in maintaining and processing procurement document exchange with two OEMs.
- In case study two, the major drivers were to enhance internal procurement performance, form an integrated network across the relevant supply chain, and eventually achieve the business expansion of Company E.
- In case study three, the major drivers were to enable Company J to reduce its procuring cost by simplifying and automating its internal supplier selection process.

5.3 Cross-Case Analyses of Previous Procurement Contexts

This section presents the findings of cross-case analyses of the previous procurement relating to supply chains, including procurement backgrounds, processes, and problems.

Accordingly, this section is organised as follows: previous procurement backgrounds, previous procurement processes and activities, and the problems with the previous procurement.

5.3.1 Analysis on the Backgrounds of Supply Chains

In case study one, two groups of companies were involved, including two OEMs and the SME cluster involving fourteen independent small companies (see section 4.2.4.1). There were fewer procurement specialists in each company of the SME cluster in comparison to each OEM. There was no dedicated procurement department in each company of the SME cluster; whilst, there was a dedicated procurement department in each OEM.

In case study two, four groups of companies were involved, including Company E (SME), Company F (large supplier), Company G (small service company) and some SME buyers, most of whom are the customer base of Company G (see section 4.3.4.1).

In case study three, two groups of companies were involved, including Company J (SME) and its supplier base (see section 4.4.4.1).

Table 5.2 presents more details on previous procurement backgrounds.

Table 5.2: Cross-case analysis of the backgrounds of the supply chains

Case Study	Supply Chain Group	Role of Each Group across the Supply Chain	Is there a dedicated procurement department?	How many personnel serving procurement activities?	How many e-procurement systems in use?
Case study one	• Two OEMs; • The SME cluster.	• Two OEMs as buyers; • The SME cluster as a cluster of SME suppliers.	• One procurement department in each OEM; • No procurement department in each company of the SME cluster.	• Many in each OEM; • At most one in each participant SME.	• Several ERP and e-procurement systems in each OEM; • None in each participant SME.
Case study two	• Company E (SME); • Company F (large supplier); • Company G (small service company); • the customers base of Company G.	• Company B as a supplier of Company E and the customer base of Company G.	• One procurement department in Company E; • One procurement department in Company F; • No procurement department in most companies of the customer base of Company G.	• Four in Company E; • Many in Company F; • At most one in each company of the customer base of Company G.	• Two in Company E; • Several ERP and e-procurement systems in Company F; • One in each company of the customer base of Company G.
Case study three	• Company J; • The supplier base.	Company J as buyer of the supplier base	• One procurement department in Company J; • No procurement department in each company of the supplier base.	• Four in Company J; • At most one in each company of the supplier base.	• Three in Company J; • None in each company of the supplier base.

Note: the details are extracted based on the three case studies (see sections of 4.2.4.1, 4.3.4.1, and 4.4.4.1 in Chapter 4).

Based on the above cross-case analysis of the previous procurement backgrounds, the similarities among the three case studies are as follows:

- There are at least two groups of companies involved;
- There are dedicated personnel in charge of procurement activities in each company;
- There are gaps in usage and perception on e-procurement technologies across the supply chain.

The differences among the three case studies are as follows:

- In the participant SMEs, the involved personnel who executed procurement activities had various levels of skills and knowledge;
- Different participant SMEs had various experience and perception of e-procurement technologies and its adoption in business.

5.3.2 Analysis the Previous Procurement Processes

In case study one, the focus of procurement improvements was centred on procurement documents exchanges between the two OEMs and fourteen suppliers (the SME cluster) across the supply chain (see section 4.2.4.2).

In case study two, the focus of procurement improvements was concentrated on the ordering processes across the supply chain (see section 4.3.4.2).

In case study three, the focus of procurement improvements was centred on supplier sourcing and tendering processes between Company J as its suppliers base (twenty SMEs) (see section 4.4.4.2).

In Table 5.3 below, the cross-case analysis on previous procurement processes is presented.

Table 5.3: Cross-case analysis on previous procurement processes and activities

Case	Focused Procurement Processes	Methods of Procurement Processing	Methods of Communications
Case study one	Process of procurement documents exchanges	Manual processing.	Telephones, Emails.
Case study two	Ordering process	Manual processing.	Telephones, Faxes, Emails.
Case study	Tendering process	Manual processing.	Telephones, Faxes, Emails.

three			

Note: the details are extracted based on the three case studies (see sections of 4.2.4.2, 4.3.4.2, and 4.4.4.2).

Accordingly, the similar features of previous procurement processes and activities among the three case studies are as follows:

- Processes of activities are manual.
- The majority of communications across the supply chain depend on telephones, fax machines, and emails.

The major differences among the three case studies are that there were different foci of procurement improvements because of the distinctive business needs fulfilled.

5.3.3 Analysis of the Problems with the Previous Procurement

In the three case studies, the problems with the previous procurement processes were identified as internal or external. In Table 5.4, these problems are prepared in more details.

Table5.4: Cross-case analysis of the problems with the previous procurement

Case	Internal Problems	External Problems	Key Features of the Problems
Case study one	• Complicated and time-consuming process for uploading the received purchase orders; • Labour intensive for viewing/converting procurement documents; • Repetitive manual process for interpreting purchase orders; • Confusion with various data formats.	• Fragile and inefficient information communication between the two parties; • Long cycle life for exchanging procurement documents, especially in case that there are several versions of purchase orders issued by the OEMs; • Lack of dynamic communication between the two parties.	• Inefficiencies in both internal and external operations; • Ineffective collaboration across the supply chain.
Case study two	• Lack of efficient methods for documents management and control • Lack of efficient methods for annual budget control • Lack of professional employees • Long life cycle of a procurement transaction.	• Relatively high prices for procuring consumable goods; • Difficulties in acquiring new products with relatively low prices; • Limited channels for accessing new customers; • Limited scope of supplier base; • Lack of formal information system to make procurement transactions proceed more efficiently	• Inefficiencies in both internal and external operations; • Insufficiencies in terms of internal resources (i.e. dated and paper-based catalogues, procurement personnel, and business connections) in Company E (SME); • Ineffective collaboration across the supply chain.
Case study three	• Manually intensive and lengthy spreadsheet driven process with no automation – has led to a proliferation of	• Complex and lengthy chain of communication between Company J and its supplier base;	• Inefficiencies in both internal and external operations; • Insufficiencies in terms

	non-value adding activities; • All information retrieval is manual and paper based; • Duplication of information; • In Company J (SME), there is no visibility of information – a small number of key employees possess vital information which is not always shared in a timely fashion; • No dynamic reporting capability to provide management reports or up-to-date KPI's.	• Numerous unnecessary steps (e.g. phone calls and e-mails) that lead to inefficiencies and delays can be removed; • Compulsory information is often left incomplete and time is wasted locating information that is stored in numerous spreadsheets.	of internal resources (i.e. procurement personnel) in Company J; • Ineffective collaboration across the supply chain.

Note: the details are extracted based on the three case studies (see sections of 4.2.4.3, 4.3.4.3, and 4.4.4.3).

According to the cross-case analysis of the problems with the previous procurement, the similarities among the three case studies are as follows:

- Inefficiency in internal procurement operations;
- Insufficiency of internal resources (i.e. outdated tools and resources, procurement personnel, and business connections);
- Ineffectiveness in communications across supply chains;
- Inefficiency in collaboration across supply chains.

The major differences among the three case studies are therefore related to the specific requirements of the various businesses.

5.4 Cross-Case Analyses of New Procurement Processes

This section presents the results of five cross-case analyses concerning the new procurement process, including key features, the e-procurement collaboration network, the e-procurement models, the e-procurement system functions, and the stages.

5.4.1 Analysis of Key Features of New Procurement

In Table 5.5 below, a cross-case analysis of the key features of new procurement is presented:

Table 5.5: Cross-case analysis on the key features of new procurement processes

Key Features of New Procurement Processes	Case study one	Case study two	Case study three
Procurement customisation	√	√	√
Simplified processes	√	√	√
Automated activities	√	√	√
Electronic procurement documents	√	√	√
Retrievable historical records stored in database	-	√	√
New communication channels applied	√	√	√
New mechanism adopted to facilitate procurement processes	-	√	√
Stand-alone technology adoption	√	-	-
Web-based technology adoption	-	√	√

Note: the details are extracted upon the three case studies (see sections of 4.2.6.1, 4.3.6.1, and 4.4.6.1in Chapter 4).

Based on the above cross-case analysis, the similarities of new procurement process indicate five features, all of which are benefits resulting from the adoption of e-procurement technologies.

The major differences among the three case studies are dependent on the extent of e-procurement technologies adoption, and the various implementation modes applied.

5.4.2 Analysis of E-Procurement Collaboration Network

In the three case studies, multiple organisations took part and constituted the e-procurement collaboration networks. In Table 5.6, details of each e-procurement collaboration network are presented.

Table 5.6: Cross-case analysis on the e-procurement collaboration network

Participant Organisations		Case study one	Case study two	Case study three
Supply Chain Partners	OEMs	√	-	-
	First tier suppliers	√	√	√
	Second tier suppliers	-	-	√
	First tier buyers	-	-	-
	Second tier buyers	-	√ (3)	-
Intermediate Organisations	Consultant companies	√ (1)	√	√
	Software development companies	√ (2)	√	√

Note: the details are extracted upon the three case studies (see sections of 4.2.6.2, 4.3.6.2, and 4.4.6.2 in Chapter 4).

(1) In case study one, the consultant companies included the service company and the intermediate organisation.
(2) In case study one, the software development company was the intermediate organisation, because the personnel in charge of developing and implementing the e-procurement system were working for the intermediate organisation.
(3) In case study two, the second tier buyer is the cluster of SME buyers who were customers of the buyer agent.

Based on the cross-case analysis of the previous procurement backgrounds (see section 5.3.1), the role played and the resources provided by each participant organisation in the e-procurement collaboration network are presented in the Table 5.7. Table 5.8 presents the various types of relationship involved across the three e-procurement collaboration networks.

Table 5.7: Cross-case analysis on the roles and resources of participant organisations in the e-procurement collaboration network

Case Study	Participant Organisation	Role Played by Each Participant Organisation in the E-Procurement Collaboration Network	Resources Provided by Each Participant Organisation in the E-Procurement Collaboration Network
Case study one	• Two OEMs;	• Buyers across the supply chain;	• Data formats for purchase orders;
	• The SME cluster;	• First tier suppliers across the supply chain; • System users of the e-procurement system;	• Data formats for response documents (i.e. dispatch notes, delivery notes, and invoices); • Explanation about the business case of procurement documents exchanges across the supply chain; • Detailed requirements of the e-procurement system;
	• Company C (small service company);	• External supporter and intermediate organisation; • Solo owner of the e-procurement system;	• Business connections with the SME cluster; • A summary of detailed requirements of companies in the SME cluster; • Additional suggestions and feedback to the questions raised by the project manager; • Dedicated personnel in charge of monitoring the project;
	• Company D (consultant company).	• External supporter and intermediate organisation;	• Dedicated personnel in charge of organising and controlling the project; • Dedicated personnel in charge of developing and maintaining the e-procurement system; • Professional knowledge on procurement improvements and advanced supply chain management.
Case study two	• Company E (SME);	• First tier supplier across the supply chain; • Solo owner of the e-procurement system; • System users of the e-procurement system;	• Explanations about the business case of the ordering process and activities across the supply chain; • Detailed requirements of the e-procurement system; • Business connections with the other companies across the supply chain; • Business connections with Company H; • Dedicated personnel in charge of monitoring and inspecting the quality of the e-procurement system;
	• Company F (large supplier);	• Supplier of Company E, and internal supporter; • System users of the e-procurement system;	• Dedicated personnel in charge of integrating the e-procurement system owned by Company E; • Detailed requirements of catalogue updating upon system integration; • Integrated and comprehensive catalogue covering a large quantity of consumables;
	• Company G (small service company);	• Internal supporter as intermediate organisation across the supply chain; • System users of the e-procurement system;	• Dedicated personnel in charge of introducing SME buyers to the project; • Dedicated personnel in charge of integrating the e-procurement system owned by Company E; • Detailed requirements on system integration.

	• The cluster of SME buyers who were the customers of the buyer agent;	• Potential buyers of the small company; • System users of the e-procurement system;	• Potential purchase orders placed through the e-procurement system owned by Company E.
	• Company H (consultant company)	• External supporter and intermediate organisation; • System administrator of the e-procurement system;	• Dedicated personnel in charge of organising and controlling the project; • Dedicated personnel in charge of developing and maintaining the e-procurement system; • Professional knowledge of procurement improvements and advanced supply chain management; • Business connections with Company I; • Dedicated personnel in charge of knowledge transfer with Company I.
	• Company I (software development company)	• External supporter and intermediate organisation;	• Dedicated personnel in charge of detailed designs of the e-procurement system; • More practical suggestions to more easily and better implement the e-procurement system; • Dedicated personnel in charge of developing and maintaining the e-procurement system; • Dedicated personnel in charge of maintaining the e-procurement system after the project was completed.
Case study three	• Company J (SME);	• First tier supplier across the supply chain; • Solo owner of the e-procurement system; • System user of the e-procurement system;	• Explanations of the business case of sourcing process and activities across the supply chain; • Detailed requirements of the e-procurement system; • Business connections with the cluster of SME suppliers across the supply chain; • Business connections with Company K; • Dedicated personnel in charge of monitoring and inspecting the quality of the e-procurement system;
	• The cluster of SME suppliers;	• Suppliers of Company J, and Second tier suppliers across the supply chain; • System users of the e-procurement system;	• Dedicated personnel in charge of testing the e-procurement system;
	• Company K (consultant company)	• External supporter and intermediate organisation; • System administrator of the e-procurement system;	• Dedicated personnel in charge of organising and controlling the project; • Dedicated personnel in charge of developing and maintaining the e-procurement system; • Professional knowledge of procurement improvements and advanced supply chain management; • Business connections with Company L; • Dedicated personnel in charge of knowledge transfer.

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	• *Company L (software development company)*	• *External supporter and intermediate organisation;*	• *Dedicated personnel in charge of detailed designs of the e-procurement system;* • More practical suggestions to more easily and better implement the e-procurement system; • Dedicated personnel in charge of developing and maintaining the e-procurement system; • Dedicated personnel in charge of maintaining the e-procurement system after the project was completed.

Note: the details are extracted based on the three case studies (see sections of 4.2.4.1, 4.3.4.1, 4.4.4.1, 4.2.6.2, 4.3.6.2, and 4.4.6.2 in Chapter 4).

Table 5.8: Cross-case analysis on the relationship involved in e-procurement collaboration networks

Case	Relationship Types in the E-Procurement Collaboration Network
Case study one	• Preferred buyers (between the two OEMs and the SME cluster); • Long-term partnership (between Company C and Company D); • Network partnership (among the SME cluster).
Case study two	• Preferred supplier (between Company E and Company F); • Long-term partnership (between Company E and Company H; between Company E and Company G; between Company H and Company I); • Network partnership (between Company E and the customer base of Company G).
Case study three	• Adversarial leverage (among the supplier base of Company J); • Long-term partnership (between Company J and Company K; between Company K and Company L); • Network partnership (between Company J and its supplier base).

Based on the above cross-case analysis, the similarities are as follows:

- More than one company were involved across the supply chain;
- The companies across the supply chains normally acted as the service requesters in the projects as well as the inspectors to verify the quality of the e-procurement systems;
- The companies across the supply chains took responsibility for explaining previous procurement contexts, raising detailed requirements for the e-procurement systems, providing business cases, testing the e-procurement systems, and appointing relevant personnel to take part in the project;
- Multiple intermediate organisations were involved in facilitating the projects;
- In intermediate organisations, there were normally consultant companies and software development companies involved;
- Intermediate organisations acted as the external supporters to give professional advice, facilitate knowledge transfer, control progress and cope with problems occurring in the projects, and the technical supporter to develop, implement and maintain the e-procurement systems;
- Two same types of relationship were involved in the three e-procurement collaboration networks, that is, network partnership and long-term partnership (or, strategic partnership).

The major differences among the three case studies are presented as follows:

- Different tier supply chain partners were involved, because the focus of procurement improvements differed in each case;
- In case study one, Company C was served as one of intermediate organisations, although it was a manufacturing company.
- Different system users were involved in the e-procurement systems, due to various configurations across supply chains.

5.4.3 Analysis on E-Procurement Models

In the three case studies, specific e-procurement models were utilised to transfer the requirements of the procurement improvements to the e-procurement systems. In Table 5.9, more details are presented regarding to the three case studies.

Table 5.9: Cross-case analysis of the e-procurement models utilised

Case	Procurement Process Aspect	Ownership Aspect
Case study one	E-reporting model	Solo ownership model
Case study two	E-Ordering model	Buyer-side model; Solo ownership model
Case study three	E-Tendering model	Buyer-side model; Solo ownership model

Note: the details are extracted based on the three case studies (see sections of 4.2.6.3, 4.3.6.3, and 4.4.6.3 in Chapter 4).

Subsequently, the similarity of adopting appropriate e-procurement models is that the essential criteria to select the appropriate e-procurement model is based upon the new procurement processes deployed, as well as supply chain partnerships. The differences are that the appropriate e-procurement model is selected based on the specific procurement areas concentrated upon and distinctive procurement demands in the supply chains.

5.4.4 Analysis of the E-Procurement System Functions

In the three case studies, the system functions implemented in the e-procurement systems have been examined in chapter 4. In Table 5.10, a cross-case analysis is undertaken to present more details of system functions in each case.

Table 5.10: Cross-case analysis on the e-procurement system functions

System Function	Case study one	Case study two	Case study three
RFQ function	-	√	-
Suppliers' quotation function			√
PO function	√	√	-
BPO function	-	√	-
Schedule status function	√	-	-
Goods received notes function	√	-	-
Invoice function	√	-	-
Delivery notes function	√	-	-
Customer report function	-	-	√
Catalogue function	-	√	-

Work package function	-	-	√
Supplier matching function	-	-	√
Suppliers' tendering function	-	-	√
Suppliers' quotation comparing function	-	-	√
Organisation type function	-	√	-
Customer organisations data maintenance function	√	√	√
Supplier organisations data maintenance function	√	√	√
Supplier templates maintenance function	√	-	-
Search function	-	√	√

Note: the details are extracted based on the three case studies (see sections of 4.2.6.3, 4.3.6.3, and 4.4.6.3 in Chapter 4).

Correspondingly, there are several similar e-procurement system functions implemented across the three case studies, such as system user maintenance, and procurement documents maintenance. Meanwhile, the differences of the e-procurement system functions are related to the various procurement processes and activities implemented in each case.

5.4.5 Analysis of the Implementation Stages

In the three case studies, a series of stages were followed to implement the e-procurement systems. In Table 5.11, a cross-case analysis is carried out to present more details:

Table 5.11: Cross-case analysis on the implementation stages

Implementation Stages	Case study one	Case study two	Case study three
High level requirements analysis	√	√	√
Low level requirements analysis	√	√	√
High level system design	√	√	√
Low level system design	√	√	√
Prototype demonstration	-	√	√
Development	√	√	√
Implementation	√	√	√
Integrated system testing	√	√	√
User acceptance testing	√	√	√
System maintenance	√	√	√

Note: the details are extracted based on the three case studies (see sections of 4.2.6.4, 4.3.6.4, and 4.4.6.4 in Chapter 4).

Correspondingly, there are several similar e-procurement system functions implemented across the three case studies, such as system user maintenance, and procurement documents maintenance. Meanwhile, the differences of e-procurement system functions are related to the various procurement processes and activities implemented in each case.

5.5 Cross-Case Analyses of Interview Procedures

This section presents the results of cross-case analyses of the interview procedures from three aspects, the type of interviews, the interviewees, and the interview questions.

5.5.1 Analysis of the Type of Interviews

In all the three case studies, all of the interviews were conducted in semi-structured ways (see sections 4.2.2, 4.3.2, and 4.4.2). The key features of the interviews were (1) six general areas relating to previous procurement were predetermined (Appendix A), (2) a range of specific questions were asked in consideration with the specific interviewees and companies involved, in line with the several general areas, and (3) the expected answers were open-ended.

5.5.2 Analysis on Interviewees

In case study one, the interviewees were the managing director of Company A and the IT manager of Company B in the SME cluster, and the technician in charge of maintaining the e-procurement system in Company D (consultant company) (see section 4.2.2).

In case study two, the interviewees were the employees from Company E (SME). Company F (large supplier) and Company G (small service company) were indirectly interviewed through five meetings. Specifically, the three employees in Company E were interviewed, including the managing director, procurement manager and procurement assistant in its procurement department. In addition, Company H (consultant company) and Company I (software development company) were indirectly interviewed because they were involved in the project (see section 4.3.2).

In case study three, the interviewees were the employees from Company J (SME). Company K (consultant company) and Company L (software development company) were indirectly interviewed because they were involved in the project (see section 4.4.2).

In Table 5.12, a cross-case analysis of the interviewees is presented.

Table 5.12: Cross-case analysis of the interviewees

Case	Internal Companies across the Supply Chain	External Companies

Case study one	• The managing director of Company A in the SME cluster; • The IT manager of Company B in the SME cluster.	• The managing director and the senior manager in Company C; • The project manager and the technician in charge of the e-procurement system in Company D.
Case study two	• The managing director, procurement manager, and senior procurement assistant of Company E; • The manager and two employees in the procurement department of Company B. • The managing director and IT manager of Company G.	• The project manager, technician in charge of the e-procurement system in Company H; • The project development team of Company I.
Case study three	The managing director, procurement manager, and senior procurement assistant of Company J	• The project manager, technician in charge of the e-procurement system in Company K; • The project development team of Company L.

Note: the resources are extracted based on the three case studies (see sections of 4.2.2, 4.3.2, and 4.4.2).

The similarities in the three case studies are as follows:

- The interviewees were from various participant organisations to bring more comprehensive perspectives to build up the knowledge base in each case;
- The interviewees occupied different positions in each participant organisation, and brought more insight in each case study.

The differences of interviewees' involvement in the commercial project affected the extent of comprehensiveness of primary data collected among the three case studies. The more interviewees are involved, the more comprehensive primary data was collected.

5.5.3 Analysis of Interview Questions

Among the three case studies, the interview questions were focused on general aspects, rather than specific questions. The general aspects are centred on six major areas, including: supply chain situations, external procurement procedure, internal procurement contexts, requirements for procurement improvements, requirements of e-procurement system functions, and effects after adopting specific e-procurement system.

In each aspect listed above, there are relevant aims targeted and subsequent answers expected from various interviewees.

- In the aspect of supply chain situations, the specific questions examine the overall configurations, in particular the roles and functions of each participant organisation across the supply chain.

- In the aspect of external procurement procedure, the questions investigated the external organisational configurations to support procurement transactions across the participant organisations in the supply chain.
- In the aspect of internal procurement contexts, the questions examined the internal organisational configurations to underpin procurement processes and activities within major participant organisations.
- In the aspect of requirements for procurement improvements, the questions concentrated on the specific procurement areas focused in the related supply chains.
- In the aspect of requirements of e-procurement system functions, the questions focused on collecting the specific requirements to design appropriate e-procurement system.
- In the aspect of effects after adopting specific e-procurement system, the questions centred on collecting the feedback on the specific e-procurement systems from the participant organisations across supply chains, in order to make plans for further improvements.

In the Table 5.13 below, a cross-case analysis on the interview questions is undertaken. It is apparent that most interview questions were asked in each case and the only difference is that specific questions were asked due to varying situations in each case.

Table 5.13: Cross-case analysis on the interview questions

General Aspect	Specific Question on Individual Case	Case study one	Case study two	Case study three
Supply Chain Backgrounds	Which industry segment does the supply chain serve?	√	√	√
	What are the major products or services concerning the supply chain?	√	√	√
	How many companies are involved across the supply chain?	√	√	√
	Which role does each involved company play across the supply chain?	√	√	√
	What are the relationships among the companies across the supply chain?	√	√	√
	What kinds of business connections relate to each involved company across the supply chain?	√	√	√
	What are the main drivers to conduct a commercial project?	√	√	√
	What are the foci on procurement improvements across the supply chain?	√	√	√
	What are the commercial objectives to be achieved across the supply chain?	√	√	√
External Procurement Backgrounds	What are the routine procurement processes in the companies across the supply chain?	√	√	√
	What are the detailed activities associated with the routine procurement processes?	√	√	√
	How is product flow processed across the supply chain?	√	√	√
	How is the information flow managed across the supply chain?	√	√	√
	How is the financial flow transmitted across the supply chain?	√	√	√
	How does each involved company communicate with its supply chain partners?	√	√	√
	What are the factors facilitating cross-organisation collaboration across the supply chain?	√	√	√
	What are the major problems prohibiting operational efficiencies across the supply chain?	√	√	√
	What kind of specific e-procurement models need to be applied across the supply chain?	√	√	√
Internal Procurement Backgrounds	What products are provided by each company across the supply chain?	√	√	√
	Is there a dedicated procurement department in each company?	√	√	√

	How many employees are involved in procurement activities within each company?	√	√	√
	How many procurement specialists are employed in each company?			
	What level of qualification and experience do the personnel have in each company?			
	Which types of ICT, in particular e-procurement technology, are utilised in each company before the start of the project?	√	√	√
	Is there any e-procurement system already in use in each company?	√	√	√
	How is a request for quotation (RFQ) processed within the case company?	√	√	√
	How does the company select appropriate suppliers, in relation to the specific requirements requested by customers?	√	√	√
	How is a purchase order (PO) processed within the case company?	√	√	√
	How does the company control procurement budget?	√	√	√
External Supports	Is it required to seek for external support?	√	√	√
	Which external organisations are involved?	√	√	√
	What resources can be provided by each external organisation?	√	√	√
	What benefits were obtained by each external organisation?	√	√	√
	What are the risks brought by each external organisation?	√	√	√
	Are the costs of external supports affordable by the main company or a collective of companies across the supply chain?	√	√	√
	What kinds of fees will be paid by each company across the supply chain?	√	√	√
Requirements on Procurement Improvements	Based on the focus of procurement improvements, what are the specific targets to be achieved for individual company as well as for a collective of companies across the supply chain?	√	√	√
	Which companies across the supply chain are involved in identifying specific requirements concerning the proposed e-procurement system?	√	√	√
	Is it required to automate traditional procurement processes and activities?	√	√	√
	Is it required to simplify traditional procurement processes and activities?	√	√	√
	Is it required to introduce new mechanisms to promote traditional procurement processes and activities?	√	√	√
	Which general approach is preferable for the proposed e-procurement system, either developing in-house, or procuring an	√	√	√

	existing e-procurement system provided by a third party, or adding customisations based on an existing e-procurement system provided by a third party?			
Requirements on System Functions	Based on the specific e-procurement model applied, what kinds of system functions need to be implemented in the proposed e-procurement system?	√	√	√
	What kinds of customisations need to be implemented in the e-procurement system?			
	What are the system performance requirements?	√	√	√
	What are the specific requirements to implement organisation and users profile function?	√	√	√
	What are the specific requirements to implement the search function?	√	√	√
	What are the specific requirements to implement the business information exchange process?	√	√	√
	What are the specific requirements to implement the supplier matching process?	√	√	√
	What are the specific requirements to implement the request for quotation process?	√	√	√
	What are the specific requirements to implement the customer report function?	√	√	√
	What are the specific requirements to implement the catalogue function?	√	√	√
	What are the specific requirements to implement the procurement process?	√	√	√
	What are the specific requirements to implement the procurement budget control function?	√	√	√
	What are the specific requirements to implement the instant communication function?	√	√	√
Feedbacks after Adopting E-Procurement System	Is the e-procurement system useful to each involved company across the supply chain?	√	√	√
	What are the benefits obtained via the e-procurement system?	√	√	√
	What are the problems concerning the e-procurement system?	√	√	√
	Are there any additional plans for further improvements?	√	√	√
	If there is additional plan for further improvements, which specific procurement area will be involved?	√	√	√

Note: the details are extracted based on the interview records of each case study (refer to Appendix A about 'General Interview Questions').

5.6 Cross-Case Analyses of Project Documents

This section presents the results of a cross-case analysis of the three case studies concerning the project documents involved to facilitate the projects. Four detailed issues are presented in this section, (1) what supporting documents are involved, (2) what the specific aim to be fulfilled by each specific document is, (3) which stage a specific document is dedicated to, and (4) who is in charge of composing a specific document.

5.6.1 Analysis of the List of Project Documents Commonly Involved

In the three case studies, a cross-case analysis of the project documents is undertaken to observe the utilisation frequency of each document involved. This information is presented in Table 5.14.

Table 5.14: Cross-case analysis on supporting documents

Documentation Category	Documentation Sub-Category	Document Name	Case study one	Case study two	Case study three
Preparation	Project Plan	Project plans	√	√	√
		Project change requirement plans	-	√	-
	Project Progress	Project progress log	√	√	-
		Periodical work progress reports	-	√	-
	Project Issues and Risks	Issues log	-	√	√
		Risks log	√	√	√
Implementation	Scope Document	Project scope document	√	√	√
	E-Procurement System Design Documentation	Functional and Non-Functional Requirements Document	√	√	√
		Change requirements documentation	-	√	-
		Previous procurement process flow charts	√	√	√
		New procurement process design documents	√	√	-
		Class diagrams	√	√	-
		Database design document	√	√	√
		Use cases	√	√	-
		Software architecture document	√	√	√
		User interface design documents	-	-	√
	Test Documentation	Test scripts	√	√	√
		Test cases checklists	-	√	√
	Technical Documentation	Technical configuration documents	√	√	√
		Source code package	√	√	√
		Database scripts	√	√	√
		Software setup package	-	√	√
	Supporting Documentation	Software installation document	-	√	√
		User manual document	√	√	-
Control	Project Contracts	Project contract	√	√	√
		Project change requirements contract documentation	-	√	-
		Project quotation documentation	√	√	√
		Project change requirements quotation documentation	-	√	-
	Approval Documentation	Questions and Answers Logs	√	√	√
		Email Approvals	-	√	√

Note: the details are extracted upon the three case studies (see sections of 4.2.2, 4.3.2, and 4.4.2 in chapter 4).

Based on the above cross-case analysis, the similarities in project documents are as follows:

- Three categories (i.e. preparation, implementation, and control) were evident in the project documents involved;
- The list of project documents which were commonly utilised were the following:
  - Project scope document;
  - functional and non-functional requirements;
  - functional and non-functional change requirements;
  - new process flow chart;
  - Project plan with milestone;
  - additional project plan for change requirements;
  - project progress log;
  - risks and issues of the project;
  - testing cases and plan of the project;
  - Questions and answers about the e-procurement system testing;
  - Project technical documents (i.e. technical implementation architecture) to specify the server and database applied in this project;
  - Detailed design documentation, i.e. prototype, database scripts, and software source codes;
  - Software installation instruction;
  - E-procurement system user manual;
  - Project contracts and invoices;
  - Knowledge transfer Questions and Answers documents communicated between the two intermediate organisations.

The major differences on project documents are as follows:

- In the preparation category, the differences relate to the different level of preparation among the three case studies. The more supporting documents were involved, the better perception across participant organisations were achieved (see Appendix A, B, and C).
- In the implementation category, the differences are mainly centred on two aspects: one focuses on whether the change requirements documents were involved, and the other concentrates whether more detailed system design and analysis were involved..

- In the control category, the differences are chiefly concentrated on whether there are supporting documents on change requirements involved, largely depending on whether there are changes in the stages of analysis and design.

5.6.2 Explanations of the Project Documents

Detailed explanations about the three categories addressed above are as follows:

1. Preparation Category

   The documents in this category served for monitoring the progress of the project. It contains three sub-categories, project plan, project progress, and project risks and issues.

   1) Project Plan

      The documents in this sub-category define the duration of the project, and specify a series of milestones to accomplish. In terms of project requirements' changes, the associated change plan needs to be approved by the end client organisation. Subsequently, it might be possible to extend the planned project duration and amend the milestones related to each stage in the project.

      This sub-category documentation serves as the uppermost control over the timeline of the project.

   2) Project Progress

      The documents in this sub-category assist in monitoring the progress of the project. In particular, the Project Progress Log needs to be controlled by the project manager, either in the end client organisation or in a third party. If the project manager works for a third party, instead of directly for the end client organisation, the person should report to the end client regularly according to the relevant terms specified in project contract. Moreover, the periodic project progress reports are normally reported by the software development team manager, so that the project manager can easily be aware of potential risks and issues occurring during conducting the project.

   3) Project Issues and Risks

      The documents in this sub-category are mainly to alert the project team about risks and problems, either already happening or possibly to happen within the planned project duration.

      Issue logs contain the important issues happened when conducting a project, e.g. the functional and non-functional system requirement document is signed off, end client

requests for requirements changes, the additional costs for requirements changes are declined, a problem has been solved, etc.

Meanwhile, risk logs include the challenges, either already happening or possibly to happen in future, which might have effects on the success of the project.

2. Implementation Category

The documents within this category define the scope of the project, the details of the new procurement solution, the steps and methods to implement the new procurement solution, the validation methods to be adopted, and so on. In terms of the function, all documents belonging to this category are classified into five sub-categories:

1) Scope Document

It contains project scope document to briefly define what should be accomplished by the deadline of the project, who are the participant organisations, what role of each participant organisation takes, and what targets should be achieved ultimately.

2) E-Procurement System Design Documentation

A range of documents, e.g. high level system design documents and detailed system design documents, provide details of what the system involves.

3) Test Documentation

In order to ensure the quality of the e-procurement system meets end client's requirements, a series of tests are taken in accordance with the specific targets specified in the test documentation. It involves the testing scripts for users to verify whether an e-procurement system is exactly what the end client expects to be. In addition, test cases checklists are generated based on real business case, which represent the business process flow really happening in the organisation.

4) Technical Documentation

In this sub-category, the documents involved are technical configuration documents (i.e. servers' architecture, and database configuration document), software source code package, software setup package, and the related database scripts.

5) Supporting Documentation

Supporting documentation contains software installation documents and user manual, which are the final deliverables to end client organisation.

3. Control Category

1) Project Contracts

It mainly includes the project contracts, additional requirements or contract changes if necessary, and the relevant cost and quotation of the project.

2) Approval Documentation

During a project, there are lots of communications among participant organisations, in order that each participant can achieve as consistent understanding as possible. Many approval documents belong to this sub-category documentation in that participant organisations associated with a same project can clearly define targets to measure the quality of a project.

5.6.3 Analysis on the Dedicated Organisations in Charge of the Project Documents

In the three case studies, there were dedicated organisations and personnel in charge of each project document. In Table 5.15 below, a cross-case analysis is undertaken to investigate which organisation in the e-procurement collaboration network were specifically responsible for the project documents.

Table 5.15: Cross-case analysis on dedicated organisations in charge of project documents

Document Name	Case study one	Case study two	Case study three
Project plans	• Company C (small service company) • Company D (consultant company)	• Company E (SME) • Company H (consultant company) • Company I (software development company)	• Company J (SME) • Company K (consultant company) • Company L (software development company)
Project change requirement plans	• Company D	• Company E • Company H • Company I	-
Project progress log	-	• Company H	-
Periodical work progress reports	-	• Company I	-
Issues log	-	• Company H	• Company K
Risks log	• Company D	• Company H	• Company K
Project scope document	• Company D	• Company H	• Company K
Functional and Non-Functional Requirements Document	• Company D	• Company H	• Company K
Change requirements documentation	-	• Company H; • Company I	-
Previous procurement process flow charts	• Company C • Company D	• Company E • Company H	• Company J • Company K
New procurement process design documents	• Company C • Company D	• Company E • Company H • Company I	• Company J • Company K • Company L
Class diagrams	• Company D	• Company I	-
Database design document	• Company D	• Company I	• Company L
Use cases	• Company D	• Company I	-
Software architecture document	• Company D	• Company I	• Company L
User interface design documents	-	-	• Company L
Test scripts	• Company C took responsibility for user acceptance testing • Company D took responsibility for components and integrated	• Company E took responsibility for user acceptance testing • Company H took	• Company J took responsibility for user acceptance testing; • Company K took

	system testing	responsibility for integrated system testing • Company I took responsibility for components system testing	responsibility for integrated system testing • Company L took responsibility for components system testing
Test cases checklists	-	• Company I	• Company L
Technical configuration documents	• Company D	• Company H	• Company K
Source code package	• Company D	• Company I	• Company L
Database scripts	• Company D	• Company I	• Company L
Software setup package	-	• Company I	• Company L
Software installation document	-	• Company I	• Company L
User manual document	• Company D	• Company I	-
Project contract	• Company C • Company D	• Company E • Company H • Company I	• Company J • Company K • Company L
Project change requirements contract documentation	-	• Company E • Company H • Company I	-
Project quotation documentation	• Company D	• Company I	• Company L
Project change requirements quotation documentation	-	• Company I	-
Questions and Answers Logs	• Company C • Company D	• Company E • Company H • Company I	• Company J • Company K • Company L
Email Approvals	-	• Company E • Company H • Company I	• Company J • Company K • Company L

Note: the details are extracted upon the three case studies (see sections of 4.2.2, 4.3.2, and 4.4.2 in chapter 4).

Based on the above cross-case analysis, the similarities are as follows:

- The SMEs involved in supply chains were mainly responsible for the project documents in the preparation category and the implementation category, because they were familiar with the details about previous procurement;
- The consultant companies were in charge of most of the project documents in the three categories (i.e. preparation, implementation, and control), because they were the organisers and managers of the e-procurement projects;
- The software companies took responsibility for detailed analysis, detailed system design, components system testing, installation and configurations documents, and supporting documents (i.e. user manuals, and other relevant supporting documents), which largely covered the two categories of implementation and control.

One of the most important differences among the three case studies are described as follows:

- In case study one, Company D played two roles (i.e. procurement consultant and technical supporter) during the overall project, because the company provided not only business advice on procurement but also technical support to the e-procurement system;
- In case study two and case study three, Company H and Company K served only one role as 'procurement consultant', not 'technical supporter'.

5.7 Chapter Summary

In this chapter, cross-case analyses have been carried out to investigate the similarities and differences among the three case studies from five aspects, in accordance with the details observed in terms of each case in Chapter 4. The findings in each aspect are briefly summarised as follows:

- The major commercial objectives were to enhance the overall operational efficiencies across the supply chains, starting from improving the efficiencies of internal operations in specific procurement areas, by means of the e-procurement systems established.
- The activities of the previous procurement processes among the three case studies were largely dependent on manual resources, ineffective communications and inefficient ways of collaborating across the supply chain.
- The adoption of new procurement processes among the three case studies was mainly supported by the e-procurement collaboration networks involving external supporters, greatly facilitated by the e-procurement systems, and implemented step by step.
- The interview procedures among the three case studies were conducted in a semi-structured way, involving interviewees who held various positions in different companies in the e-procurement collaboration network.
- The project documents included a wide range of documents which were divided into three categories, generated by various organisations and personnel and used in different stages.

These findings form the basis of the components comprising the framework presented in Chapter 6.

Chapter 6 The Framework

6.1 Introduction

This chapter presents a framework, which is to be used to support and enhance practical adoption of e-procurement within SMEs. The framework is established upon the knowledge presented in Chapter 2 Literature Review, the three case studies in Chapter 4, and the cross-case analyses in Chapter 5.

This chapter initially describes the methodology used to develop the framework. The development of the framework is complicated owing to the existence of many diverse and complex issues affecting the adoption of e-procurement in SMEs. As a result, it was necessary to have a systematic methodology for developing the framework. The applicability of the framework is also discussed in this chapter.

Moreover, the core of this chapter is the description of the framework, including a brief description of the overall framework, and the details of each of the components contained in the framework.

Since the proposed framework aims to be practical, guidelines on how to implement this framework in an e-procurement project are given. Accordingly, the stages and steps facilitating the implementation of the framework in practice are discussed.

6.2 Methodology of Developing the Framework

Six stages are involved in the methodology to develop the framework, including knowledge foundation, practice, analysis, development, implementation and further improvements. Figure 6.1 below illustrates the overall development stages.

Stage One: Knowledge Foundation

This stage is to establish the knowledge bases by reviewing a large quantity of literature concentrating on four areas, i.e. small and medium-sized enterprises (SMEs), procurement and supply chain management, e-procurement technologies, and the adoption of e-procurement in SMEs (see Chapter 2). The major contribution of this stage is to build up knowledge for this research.

Stage Two: Practice

This stage is to obtain practical experience and perceptions from three case studies. A range of findings are obtained through investigating a set of units of analysis for each case study in Chapter 4, leading to the cross-case analyses in Chapter 5.

Stage Three: Analysis

Stage three is to conduct a series of cross-case analyses. The cross-case analyses are carried out by examining the similarities and differences among the three case studies in Chapter 4. These similarities and differences across the three case studies constitute the analysis results in Chapter 5.

Stage Four: Framework Development

This stage is to develop the framework based on the preparations made in the three previous stages. For the framework, three major aspects are explained: (1) the applicability exemplifies the cases where the framework can be utilised; (2) several components are systematically assembled with the analysis results observed in Chapter 5. Each component contains several elements, each of which is comprised of multiple units; and (3) a series of stages demonstrates the course of actions on how to implement the framework.

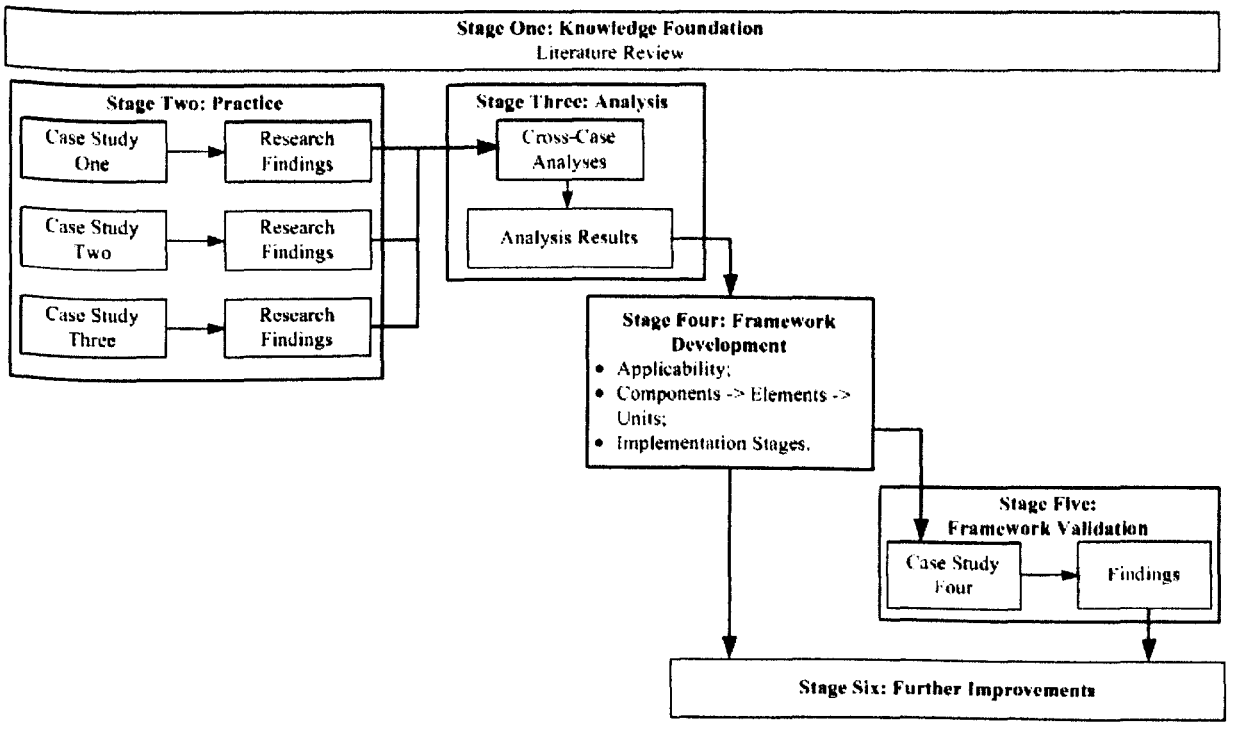
Stage Five: Framework Validation

This stage is to validate the framework with case study four which aimed to develop an e-procurement system for a cluster of SMEs in the food sector. Additional research findings are identified to provide more insights for the framework.

Stage Six: Further Improvements

This stage is to discuss the insights observed in stage five in accordance with the framework developed in stage four. These insights are regarded as additional findings to be added to the framework. Consequently, further improvements are proposed to make the nature of the framework more generalised.

Figure 6.1: The methodology of establishing the framework



In summary, the framework in this chapter is developed with the foundations of not only the findings and analysis results observed in Chapter 4 case studies and in Chapter 5 cross-case analyses, but also the findings of other researchers through extensive literature. As a result, the framework possesses more generalised characteristics, making it easier to assist SMEs to implement e-procurement applications within the applicability of the framework (refer to section 6.3 Applicability of the Framework).

6.3 Applicability of the Framework

This framework is applied to facilitate the adoption of e-procurement in SMEs, especially in the cases where a collective of companies cooperate together to implement an e-procurement system.

- The 'collective of companies' here include several SMEs involved in the same supply chain, and external organisations mainly acting as service providers to the participant SMEs. Accordingly, the SMEs act as service requesters to the participant external organisations, in order to enhance the operational efficiencies across the supply chain through adopting e-procurement technologies.
- The cooperation between the participant SMEs and external organisations are established upon a specific e-procurement project. Each company involved in the

cooperation has its own particular role to play and responsibilities to take, guided by a certain methodology.

- The methodology deployed here refers to the principles, procedures, tasks and rules specified in project management, the theories of software development and engineering, and the theories of cycle life of software.
- The prospective users of this framework are to be SMEs that attempt to develop their own e-procurement systems.

Overall, the framework is not appropriate universally, instead, it is only applicable to a certain scope. If beyond this scope, this framework might need modifications or rectifications before its adoption.

6.4 Descriptions of the Overall Framework

This section presents three key features of the framework, briefly describes the five components involved, and presents the overall framework in figure.

6.4.1 Key Features of the Framework

Three key features of the framework are presented below:

- Combination of knowledge and practice
  This framework is developed with the foundation of extensive literature and real e-procurement projects, as indicated in section 6.2 in this chapter.
- SME-focused
  This framework is targeted to facilitate SMEs when they carry out e-procurement projects to apply specific e-procurement systems with assistance from intermediate organisations.
- Application of Prince2 project management
  The implementation stages of the framework are based on the principles specified in the Prince2 Project Management.

6.4.2 Components of the Framework

Figure 6.2 below presents the overall framework. In this framework, five components are identifiable, each of which consists multiple elements respectively.

Component One: Participant Organisations

In this component, three categories of organisations are involved to constitute the participant organisations, e.g. (1) individual/cluster of SMEs, (2) supply chain partners, and (3) intermediate organisations. There are possibly more than one company belonging to each category. The definitions and details of each category are given in section 6.5 in this chapter.

Component Two: Supply Chain Collaboration Network

The 'supply chain collaboration network' involves two categories of participant organisations, i.e. 'individual/cluster of SMEs' and 'supply chain partners'. The establishment of such collaboration is partly due to a 'cause-effect pattern' between the two categories of participant organisations across relevant supply chains. The details of this component are presented in section 6.6 in this chapter.

Component Three: E-Procurement Collaboration Network

The 'e-procurement collaboration network' contains all three categories of participant organisations identified above, indicating that the 'supply chain collaboration network' is part of the 'e-procurement collaboration network'. The relationship between the two components is explained later in section 6.7 in this chapter. Also, in this component, there are four elements: (1) strategic facilitation, (2) dedicated personnel, (3) physical facilitation, and (4) intangible facilitation. Each of elements is discussed in section 6.7 in this chapter.

Component Four: E-Procurement System Modules

This component mainly contains the modules of the e-procurement system. For a specific project, the proposed e-procurement system might contain a distinctive combination of the modules presented in Figure 6.2, largely depending on the relevant system requirements. The details of each module are presented in section 6.8 in this chapter.

Component Five: Macro-Infrastructure

As presented in Figure 6.2 below, this component includes three elements, i.e. (1) government policies and laws, (2) information and communication technologies, and (3) software innovation theory. The major role of this component is as a basic foundation when a specific e-procurement project is carried out. More details are provided in section 6.9 in this chapter.

Arrow A:

It is a one-way arrow, and indicates that the 'e-procurement collaboration network' contains the elements involved in the 'supply chain collaboration network' and collective of intermediate organisations based on specific e-procurement projects.

Arrow B:

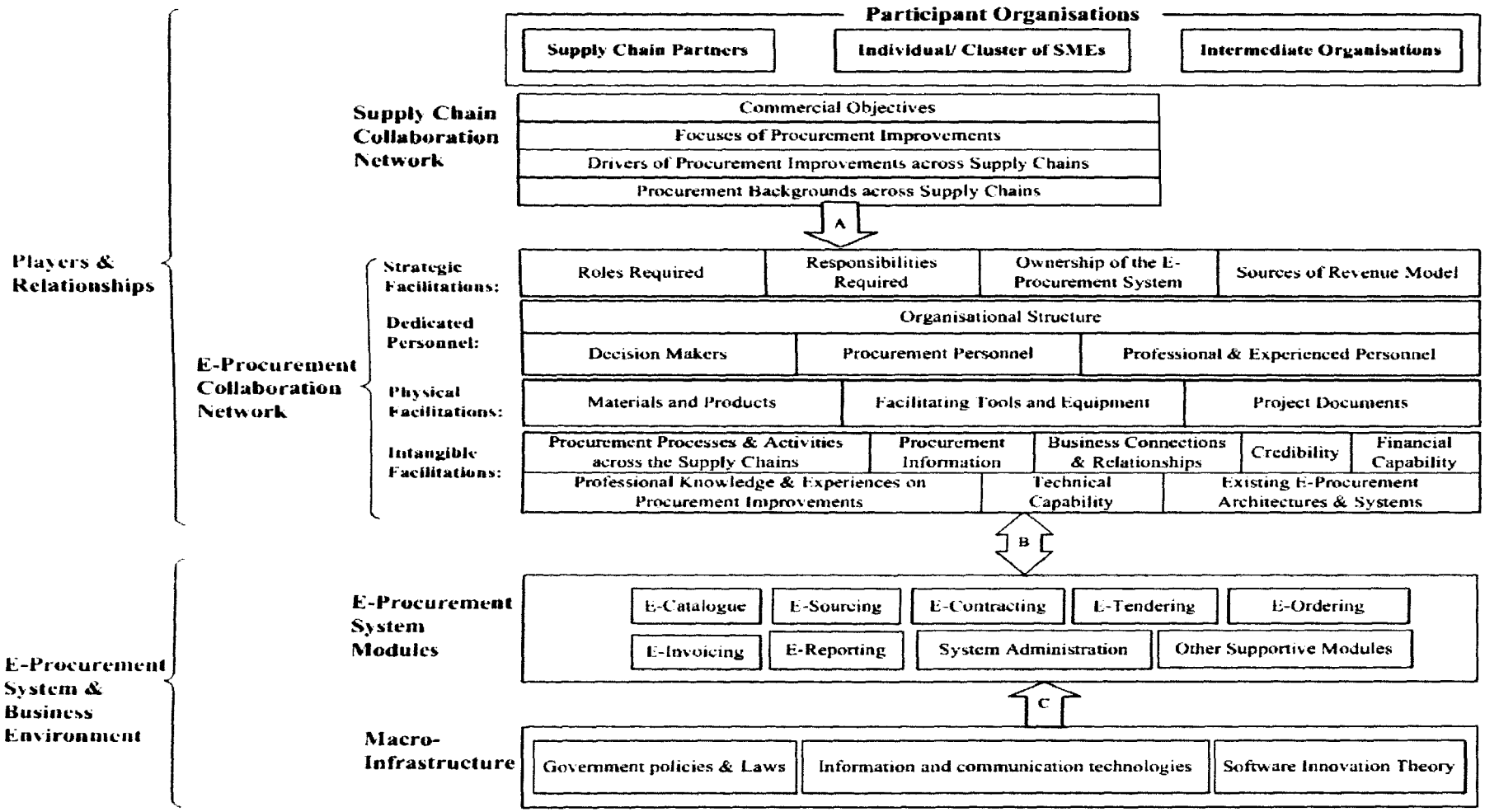
It is a two-ways arrow, and indicates that the elements involved in the 'e-procurement collaboration network' are reflected onto the virtual communities because of the implementation of specific e-procurement systems.

Arrow C:

It is a one-way arrow, and indicates that the contents and process flows contained in the 'e-procurement systems' are subject to the principles and regulations stipulated in macro infrastructure.

In addition to this, the three components, i.e. participant organisations, supply chain collaboration network and e-procurement collaboration network, relate to the category of 'player and relationships'. Meanwhile, the other two components, i.e. e-procurement system modules and macro infrastructure, relate to the category of 'e-procurement systems and business environment'. These two categories serve as elementary backbones to any e-procurement projects.

Figure 6.2: The overall framework



Note: the details of each element involved in the framework are illustrated and explained in below sections in this chapter.

6.5 Participant Organisations

As presented in section 6.4, three categories of participant organisations are involved. In fact, from a broad perspective, all of the three participant organisations can be viewed as 'supply chain partners'. However, from the micro businss perspective, these participant organisations can be divided into the three categories, i.e. 'individual/cluster of SMEs', 'supply chain partners', and 'intermediate organisations'.

The 'individual/cluster of SMEs' are the core actors in the three categories of participant organisations. This category contains one SME or a cluster of SMEs that are independent companies and have common interests in specific areas of procurement improvements. The organisations involved are normally the end clients of the proposed e-procurement system (see the three case studies in Chapter 4). Meanwhile, they may be the initiators and solo owners of the relevant e-procurement projects (see case study two and case study three in Chapter 4).

The 'supply chain partners' include buyers, suppliers, or a combination of buyers and suppliers of the 'individual/cluster of SMEs'. Indeed, these 'supply chain partners' can be categorised into two groups – one is existing/current supply chain partners that already have direct supply chain partnerships with the 'individual/cluster of SMEs'; whilst, the others are potential ones that may establish supply chain partnerships with the 'individual/cluster of SMEs' through the proposed e-procurement system. Indeed, the suppliers input material and offer services to facilitate the manufacturing or services of the 'individual/cluster of SMEs'. Meanwhile, the buyers consume the products and services provided by the "individual/cluster of SMEs'. In this respect, the organisations in this category are directly involved in the major business of the 'individual/cluster of SMEs'. In addition, the organisations involved are normally part of system users of relevant e-procurement systems, but not the owners of the systems (see the three case studies in Chapter 4). With respect to 'supply chain partners', their involvement can largely improve operational efficiencies and reduce relevant costs due to the collaborations across the supply chains.

The 'intermediate organisations' covers a wide range of third parties and even individuals sometimes, for example, warehousing companies, distribution companies, local authorities, banks, financial investment companies, agent companies, consultant companies, software development companies, accountants, lawyers, freelance developers, friends, families, relatives, supply chain partners, and other individuals/companies providing supportive

services. Although they are involved in the business of the 'individual/cluster of SMEs', they normally neither input material or services nor consume the products or services relating to the 'individual/cluster of SMEs'. Instead, they possess skills and expertise, with which the business of the 'individual/cluster of SMEs' can be greatly facilitated and enhanced. The major benefits of their involvement are that they are capable of providing more straightforward suggestions and services instantly because they are more familiar with the situations relating to the supply chain.

6.6 Supply Chain Collaboration Network

The 'supply chain collaboration network' involves two categories of participant organisations, i.e. 'individual/cluster of SMEs' and 'supply chain partners'. In the 'supply chain collaboration network', four elements are involved, representing a 'cause-effect pattern' which illustrates the interactions and connections between the two categories of participant organisations across a supply chain. Each element is explained as follows.

6.6.1 Procurement backgrounds across the supply chains

The procurement backgrounds refer to the relevant organisational set up and processes across the supply chains. The details contain (1) organisational structure, (2) procurement configurations, (3) dedicated personnel, (4) procurement processes and activities in every participant organisation relating to supply chains. (Refer to section 5.3.1 and section 5.3.2 in Chapter 5.)

6.6.2 Drivers of procurement improvements across supply chains

Broadly, there are two major objectives to be achieved through procurement improvements: cost reductions and differentiation. Under these two broad objectives, the drivers generally are centred on several areas of procurement improvements across the related supply chain, such as, the protection and sustainment of businesses, the improvement of operational efficiencies, the reduction of procurement costs, and integration and cooperations across the supply chains. (Refer to section 5.2 in Chapter 5.)

6.6.3 Focus of procurement improvements

The foci of improvement are always diverse owing to different needs of procurement improvements to be fulfilled across the supply chains. However, the majority of these diverse foci indicate an emphasis on process-oriented and collaboration-oriented improvements across supply chains, targeting to provide cost and resources efficiency. For example, the focus can be supplier management, order generation and fulfilment and new product innovation.

6.6.4 Commercial objectives

Each e-procurement project had its own specific commercial objectives. Nevertheless, there are several common categories, e.g. (1) automation of procurement processes, (2) simplification of procurement activities, (3) innovation of processes and activities with the introduction of advanced and latest technologies and management concepts, (4) reductions of procurement costs, (5) improvement of operational efficiencies, and (6) enhancement of the effectiveness and responsiveness of business cooperation. (Refer to section 5.2 in Chapter 5.)

Their interactions are demonstrated by a hierarchy which presents the 'cause-effect pattern' in the 'supply chain collaboration network' (refer to Figure 6.2). Indeed, a series of commercial objectives of an e-procurement project directly reflect the foci of procurement improvements to be achieved; further, the specific foci of procurement improvements targeted are representative of the drivers of procurement improvement across the supply chain; in addition, these drivers derive from problems in the procurement backgrounds across the supply chains.

6.7 E-Procurement Collaboration Network

The relationship between the components, 'supply chain collaboration network' and 'e-procurement collaboration network', is described as follows:

- The participant organisations in 'supply chain collaboration network' are normally involved in 'e-procurement collaboration network', because the 'e-procurement collaboration network' is formed on the basis of the request raised by the 'supply chain collaboration network' (see the three case studies in Chapter 4).

- From the 'supply chain collaboration network' to the 'e-procurement collaboration network', it is a transformation process facilitated by e-procurement technologies (see the three case studies in Chapter 4). Normally, it needs intermediate organisations, such as consultant companies, software development companies, governments, financial companies, etc, to give support to complete the transformation process, because these intermediate organisations possess financial capability, skills, expertise and other essential elements required during the process.

As stated in section 6.4, the 'e-procurement collaboration network' contains all three categories of participant organisations. There are four elements made up of multiple units respectively. These four elements are (1) strategic facilitation, (2) dedicated personnel, (3) physical facilitation, and (4) intangible facilitation. Each element is discussed subsequently.

6.7.1 Strategic Facilitation

In this element, there are four units involved, including the roles required, the responsibilities required, the ownership of the e-procurement system, and the profit models (refer to Figure 6.2).

Roles Required

In terms of the roles required, there are two levels of roles: one is organisational level concerning the roles played by each participant organisation; the other is personnel level in regard to the roles played by the dedicated personnel who belong to each of participant organisations. Table 6.1 presents the details of the two levels of roles and the affiliation between the two levels.

Table 6.1: Roles required in the e-procurement collaboration network

Roles	Individual/Cluster of SMEs	Supply Chain Partners	Intermediate Organisations
Organisational Level	• Requesters of services; • Users of services; • Owners of services; • Customers of intermediate organisations; • Players of industrial supply chains.	• Users of services; • Industrial advisers of services; • Players of industrial supply chains.	• Financial sponsors; • Financial enablers; • Business connectors; • Knowledge providers; • Services providers; • Services implementers; • Technical supporters.
Personnel	• Project organisers;	• Subsidiary interviewees;	• Project organisers;

Level	• Project inspectors; • Interviewees; • Testers of systems; • Users of systems.	• Testers of systems; • Users of systems.	• Project managers; • Interviewers; • Designers of systems; • Developers of systems; • Technicians of maintaining systems and relevant equipment.

Source: see Table 5.7 in section 5.4.2, Chapter 5.

Responsibilities Required

With regards to the responsibilities required, they are defined in accordance with the two levels of specific roles played by participant organisations and dedicated personnel. Identified through cross cases analyses in Chapter 5 (refer to section 5.4.2 in Chapter 5), the responsibilities in the e-procurement collaboration network include the following:

- Initiating an e-procurement project;
- Defining the project objectives;
- Developing project documents;
- Arranging necessary seminars and meetings;
- Appointing dedicated personnel from each participant organisation to take part in the project;
- Allocating responsibilities to the specific personnel;
- Negotiating project costs and other relevant fees;
- Explaining the details concerning business transactions and procurement processes and activities across the related supply chains;
- Collecting requirements of e-procurement systems;
- Investigating the associated business environment;
- Analysing and designing the proposed e-procurement systems;
- Planning project duration, stages, milestones and deliverables;
- Monitoring project progress
- Controlling and reporting project risks and issues;
- Acknowledging project approvals;
- Developing the e-procurement systems;
- Attending user acceptance tests to ensure the quality of the e-procurement systems;
- Configuring technical tools and equipment;

- Implementing the e-procurement systems;
- Providing technical support and maintenance;
- Organising and offering system training;

In addition, for each responsibility listed above, it is normally taken by multiple organisations. Some of them occupy major roles as enabler or directors; whilst, the others occupy assisting roles as players or supporters.

Ownership of the E-Procurement System

With respect to the ownership of the e-procurement system, it represents the organisations that own the proposed e-procurement system. There are two major perspectives to define the ownership, including the perspective of the roles in an e-procurement collaboration network, and the perspective of the number of participant organisations involved.

From the perspective of the roles in an e-procurement collaboration network, there are three types of ownerships described as follows:

- Buyer-ownership: the owner of a specific e-procurement system is an individual company or a collective of companies as buyers across supply chains.
- Supplier-ownership: the owner of a specific e-procurement system is an individual company or a collective of companies as suppliers across supply chains.
- Third-party-ownership: the owner of a specific e-procurement system is an individual company or a collective of companies as intermediate organisations across supply chains.

From the perspective of the number of participant organisations involved in an e-procurement collaboration network, there are two types of ownerships described as follows:

- Solo ownership: the owner of a specific e-procurement system is an individual company which might be either a buyer, or a supplier, or an intermediate organisation.
- Joint ownership: the owner of a specific e-procurement system is a collective of companies that might be either buyer, or suppliers, or intermediate organisations.

Sources of Revenue Model

It illustrates which kinds of revenues which a specific e-procurement system can generate. Basically, there are four major ways earning revenues from e-procurement systems, which are explained as follows:

- Revenues from sales
  The revenues are obtained due to selling products via e-procurement systems.
- Revenues from subscriptions
  The revenues are obtained from subscription fees paid by each user of an e-procurement system. The corresponding calculations are on the basis of the elements or contents of services utilized by each subscribing organisation.
- Revenues from commissions
  The revenues mainly derive from the remuneration for services rendered or products sold through e-procurement systems, calculated on the basis of a percentage of the goods and services sold.
- Revenues from advertising
  The revenues come from the advertisements on e-procurement systems.

6.7.2 Dedicated Personnel

This element contains two levels of units: upper level is the organisational structure in the e-procurement collaboration network; and the lower level includes three units which represent different types of dedicated personnel to be involved in terms of the organisational structure.

Upper Level: Organisational Structure

An organisational structure is established as an underlying foundation to underpin the e-procurement collaboration network, in order to ensure that the collaborations and resources allocated can be utilised in an effective way. The organisational structure applied in the e-procurement collaboration network is quite flat, instead of hierarchical.

Lower Level: Three Types of Dedicated Personnel

Under this organisational structure, three types of dedicated personnel are involved.

- Decision makers

  These include the owners or managing directors of the three categories of participant organisations in the e-procurement collaboration network. They can be regarded as the executive board which takes responsibilities for e-procurement project initiation, direction and monitoring, and making decisions on critical issues (e.g. change requirements, risks, extra financial support, etc.).

- Procurement personnel

  These include the personnel who have knowledge and experience of procurement from two categories of participant organisations. Firstly, the dedicate personnel from the 'individual/cluster of SMEs' and the 'supply chain partners' are normally procurement managers and senior procurement assistants who are quite familiar with the procurement transactions relating to supply chains. Secondly, the dedicated personnel from the 'intermediate organisations' are generally experts and specialists who have professional knowledge and experience of procurement improvements.

- Professional and experienced personnel

  These include the dedicated personnel mostly coming from the 'intermediate organisations'. Moreover, the personnel in this type are considered as external supporters to the 'individual/cluster of SMEs'. These dedicated personnel can be divided into several types as follows:

  - Specialists

    These include the individuals who hold special skills and experiences to facilitate the application of a specific e-procurement system. They usually have special authorisation by governments or business associations. For example, this type of personnel usually includes accountants, lawyers, bankers, and investment consultants.

    Although this type was not examined in this research, it has been investigated and reported by many other researchers.

  - Professional Advisers

    These include the personnel who hold professional knowledge and experience on e-procurement adoptions. Unlike the 'specialists', professional advisers normally have no specialist certificates; but, many of them have higher educations or been trained professionally. For example, this type of personnel

includes researchers, academics, employees in governments, employees in business associations, employees in consultant companies, and employees in technical products and services companies, and so on.

- Other personnel

  These include the individuals associated with the 'individual/cluster of SMEs' and the 'supply chain partners' based on personal relationships. Normally, it is not necessary for this type of personnel to have acknowledged certificates or higher education. For example, it includes friends, families, relatives and others.

  Although this type of personnel was not observed in this research, it has been observed and reported by many other researchers.

6.7.3 Physical Facilitation

This element contains three units, including materials and products, facilitating tools and equipment, and standardised templates of project documents.

Materials and Products

This unit includes the materials and products which are the products to be sold through a specific e-procurement system. The corresponding providers are the 'individual/cluster of SMEs' and the 'supply chain partners'.

Facilitating Tools and Equipment

This unit covers two categories of tools and equipment: one is provided by the 'individual/cluster of SMEs' and the 'supply chain partners'; whilst, the other is provided by the 'intermediate organisations'.

In regard to the former category, it includes the existing tools and equipment facilitating procurement transactions across supply chains which contain the 'individual/cluster of SMEs' and the 'supply chain partners'. Indeed, this category covers a wide range of facilitations.

such as, product catalogues, industrial books and manuals, manufacturing machines, computers, fax machines, telephones, printers, and other supportive tools and equipment.

As to the latter category, it involves the tools and equipment facilitating an e-procurement project. For example, technical equipment (i.e. servers and databases), electronic equipment (e.g. scanners, RFID readers, etc.) and communication tools (e.g. telephones, fax machines, cameras, projectors, etc.).

Project Documents

This unit contains the documents relating to e-procurement project. These project documents are classified into ten categories. The list of these project documents is presented in Table 6.2.

Table 6.2: List of project documents

Category	Document Name
Project Plan	Project plans
	Project change requirement plans
Project Progress	Project progress log
	Periodical work progress reports
Project Issues and Risks	Issues log
	Risks log
Scope Document	Project scope document
E-Procurement System Design Documentation	Functional and Non-Functional Requirements Document
	Change requirements documentation
	Previous procurement process flow charts
	New procurement process design documents
	Class diagrams
	Database design document
	Use cases
	Software architecture document
	User interface design documents
Test Documentation	Test scripts
	Test cases checklists
Technical Documentation	Technical configuration documents
	Source code package
	Database scripts
	Software setup package
Supporting Documentation	Software installation document
	User manual document
Project Contracts	Project contract
	Project change requirements contract documentation
	Project quotation documentation
	Project change requirements quotation documentation
Approval Documentation	Questions and Answers Logs
	Email Approvals

6.7.4 Intangible Facilitation

This element contains eight units, including procurement processes and activities across the supply chains, business connections, credibility, financial capabilities, professional knowledge and experience of procurement improvements, technical capabilities, existing e-procurement architectures and systems.

6.7.4.1 Procurement Processes and Activities across the Supply Chains

The processes and activities focus on the procurement transactions between the 'individual/cluster of SMEs' and the 'supply chain partners'. The details of the relevant processes and activities are presented in Table 6.3. These processes and activities proceed in a cycled pattern. In a procurement lifecycle, it normally starts from sourcing, undergoing tendering, contracting, ordering, delivering, invoicing, and ending with renewal, which is also another starting point of next procurement cycle.

Table 6.3: Procurement processes and activities across supply chains

Process	Description of Activities
Sourcing	It aims to find new suppliers based on production requirements which are specified in request for information (RFI) or request for proposal (RFQ).
Tendering	It aims to select the most appropriate individual or a collective of suppliers through bidding process. The criteria are defined in documents of request for quotation (RFQ) or request for tender (RFT, or ITT).
Contracting	It aims to sign contracts with the selected suppliers in accordance with the results of bidding and negotiations. There are diverse types of contracts, e.g. one-to-one contract, joint contract,
Ordering	It aims to complete ordering documents, starting from browsing catalogues, selecting products and services, generating purchase orders, and ending with sending purchase orders to suppliers.
Delivering	It contains the processes of supplier preparation, shipment and delivery of goods ordered or services requested.
Invoicing	It aims to complete the relevant payment in terms of the goods ordered or the services requested.
Renewal	When the P/S has been consumed and/or disposed of, the contract expires, or the product or service is to be re-ordered, company experience with the P/S is reviewed. If the P/S is to be re-ordered, the company determines whether to consider other suppliers or to continue with the same supplier.

6.7.4.2 Procurement Information

Procurement information mainly represents the interests attracting the attentions of the 'individual/cluster of SMEs' and the 'supply chain partners', who are the main users of specific e-procurement systems in the e-procurement collaboration network. Basically, the procurement information on the e-procurement systems includes a wide range of diverse details, such as, specifications of online goods, specifications of services (e.g. contract,

procurement processes and activities, etc.), details of online procurement documents, details of system users, online market news, the volume and value of online transactions, information about clustering demands, demand and supply information, and regulations applied.

The procurement information can be categorised into several types, such as, general, special, customised.

In terms of general type, it mainly includes the market news, the volume and value of total transactions, regulations applied, and so on. The type of procurement information is open to every user of the e-procurement systems. The corresponding charges are always free; in case they are not free, the charges are generally included in the subscription fees.

With regards to the special type, it mainly includes information about products and services placed online, the details of system users and procurement documents, the details of related contracts, and other contents directly associated with the specific user. In other words, this type of procurement information is proprietary to the specific user of the e-procurement system. Accordingly, the relevant charges are calculated upon the percentage of total transactions made by the specific user.

With respect to customised type, it basically includes the information about demand and supply, sourcing details, tendering specifications, and other contents that possibly bring business opportunities for the specific user. As a result, the relevant charges are included in the subscription fees.

6.7.4.3Business Connections and Relationships

Business connections and relationships have shared characteristics, because they both are established on trust between companies.

Business connections refer to a company's capabilities to access, link and contact as many companies as possible, in order to make it possible to bring more business opportunities. In the e-procurement collaboration network, the success of a specific e-procurement project partly depends on the broadness of business connections and the closeness of business relationships of two categories of participant organisations, i.e. the 'individual/cluster of SMEs' and the 'intermediate individuals/organisations'. For example, the 'individual/cluster

of SMEs' can bring industrial companies to be involved; meanwhile, the 'intermediate individuals/organisations' can bring software development companies if they do not have such capabilities or personnel in house.

Relationships constitute the linkages among participant organisations. Generally, there are several forms of relationships in an e-procurement collaboration network from the aspect of degree of strategic alignment and integration of core competences (refer to section 5.4.2 in Chapter 5). In addition, the Charted Institute of Purchasing and Supply (CIPS) (2009) has identified various types of relationship formed upon the collaboration across multi organisations. Together, all of these types of relationship are presented below:

- Internal contracts – mergers, acquisitions
- Strategic alliances
- Network partnership
- Single supplier/buyer
- Preferred supplier
- Personal relationship
- Adversarial leverage

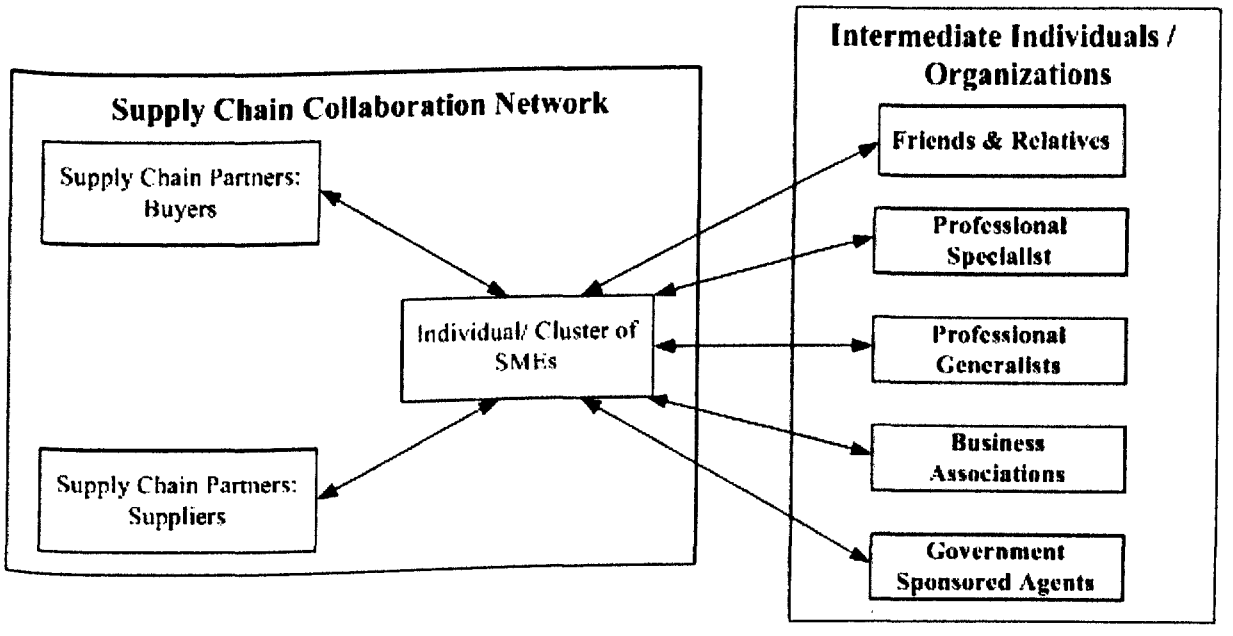
Overall, in the above seven types of relationships, trust become the basis, which indicates that the more trust between the companies the stronger relationships are built.

A roadmap of the relationships among the e-procurement collaboration network is demonstrated in Figure 6.3 below. Within the network, the relationships in the 'supply chain collaboration network' include five types of relationships from network partnership to adversarial leverage; whilst, the relationships between the 'individual/cluster of SMEs' and the 'intermediate individuals/organisations' are mainly established upon network partnership and personal relationship; however, there is generally no direct relationship between the 'supply chain partners' and the 'intermediate individuals/organisations', instead, the two categories of organisations are normally indirectly related through the 'individual/cluster of SMEs'.

In addition, the relationships in each category of participant organisations are mostly network partnership and adversarial leverage. Mostly, the participant individuals or companies in each category collaborate together based on common interests and benefits. As a result, in the case of not being competitors, their relationships are primarily built upon network partnership; in

the other cases where they are competitors, their relationships are consist as both adversarial leverage and network partnership, which indicates that there will be collaboration as well as competition.

Figure 6.3: Roadmap of the relationships in the e-procurement network



6.7.4.4 Credibility

Credibility is one of the most critical factors that will affect business success. Basically, being credible is simply the perception of being trustworthy and believable. In particular, the credibility of an organisation in the e-procurement collaboration network represents trust on which other participant organisations can count. For example, it is helpful to getting financial assistance from local authorities, banks, or investment companies. Also, it is one of the critical criteria for an intermediate organisation chosen to provide specific services.

6.7.4.5 Financial Capability

Financial capability represents the two aspects described as follows:

- The capability of participant organisations, especially the main system requester, to afford the costs or charges incurred due to the e-procurement project.

- The capability of the developed e-procurement system to generate profits to cover the past and future management costs.

The system requesters are mostly SMEs that are generally regarded as lacking of financial capabilities and thus possibly have difficulties in affording the costs related with e-procurement projects.

In the case that SMEs cannot afford the relevant costs, they normally evaluate the expected benefits (e.g. profits, etc.) to be delivered by the e-procurement system. If the expected profits cannot cover the expected costs, they will seek for extra financial supports from various organisations, e.g. local authorities, business associations, banks, investment companies, and so on. In the case that they can afford the relevant costs, they still evaluate the expected benefits to examine the feasibility of the proposed e-procurement system. After all, SMEs normally have limited financial resources and less than large firms. As a result, any decision relating to financial investment is rather significant and critical to SMEs, because possible failure might lead to further risks or even totally disaster to them.

6.7.4.6 Professional Knowledge and Experience of Procurement Improvements

Professional knowledge and experiences are one of the underlying foundations to underpin the procurement improvements focused in a specific e-procurement project. These knowledge and experiences include many aspects as follows:

- Industrial knowledge and experiences

  These knowledge and experiences are mainly provided by the 'supply chain collaboration network'.
- Supply chain management
- Procurement management
- Procurement transformation and adoption
- Project management
- Risk management
- Change management
- Software engineering

6.7.4.7 Technical Capability

In the 'individual/cluster of SMEs' category, the companies have no dedicated departments or personnel to support or resolve technical issues in regard to e-procurement systems. Such capability gap are normally fulfilled by the companies in the 'intermediate organisations' category in the e-procurement collaboration network.

6.7.4.8 Existing E-Procurement Architectures and Systems

As indicated above, the gaps of technical capabilities in the 'individual/cluster of SMEs' can be fulfilled by the 'intermediate individuals/organisations'. In addition, it will be more efficient if there are existing e-procurement architectures and systems in the 'intermediate individuals/organisations'.

6.8 E-Procurement System Modules

This component contains nine elements which are main system modules in terms of e-procurement systems. Most of these system modules are divided in accordance with various procurement processes and activities, such as, e-sourcing, e-tendering, e-ordering, and e-invoicing; whilst, the remaining are categorised based on procurement functions, such as, e-catalogue, e-contracting, e-reporting, system administration, and other supportive modules.

More details of each module are presented in Table 6.4.

Table 6.4: Nine e-procurement system modules in e-procurement systems

System Module	Descriptions	Functions	Related Contents
E-Sourcing	It covers the processes of identifying new suppliers for a specific category of procurement requirements using Internet technology.	• Generate specifications of goods and services; • Generate request for information for selecting suppliers; • Obtain feedbacks from suppliers; • Compare various suppliers based upon pre-defined criteria; • Select eligible suppliers based on the comparison results.	• Specifications of goods and services required; • Criteria for eligible suppliers.
E-Tendering	It covers the processes of sending requests for information and prices to suppliers and receiving the	• Generate request for proposal (RFP) or request for quotation (RFQ) for selecting suppliers; • Send RFP or RFQ to eligible	• Product specifications, including manufacturing requirements, product

	responses of suppliers using Internet technology.	suppliers pre-selected in sourcing process; • Obtain suppliers' feedback; • Compare various suppliers based upon pre-defined criteria; • Select specific suppliers based on the comparison results.	name, units required, leadtime, deadlines, and so on; • Products specifications (e.g. product ID, code, supplier details, etc.) • Request for proposal; • Request for quotations.
E-Ordering	It covers the processes and activities relating to ordering.	• Generate purchase orders (POs); • Send POs to the suppliers pre-defined in tendering process; • Receive suppliers' feedback on confirmation of the POs received; • Receive invoices from suppliers; • Receive ordered goods and services with relevant delivery notes or dispatch notes sent out by supplier; • Carry out quality check for the received goods or services; • Sign off suppliers' delivery notes or dispatch notes if there is no problem with the received goods or services. Otherwise, a course of actions are carried out based on relevant contracts.	• POs; • Invoices; • Delivery notes, or dispatch notes; • Credit notes (optional), in case that there are problems with the received goods or services.
E-Invoicing	It covers the payment process.	Payments are made based on the results of quality check and the received invoices in buyer side. If there are problems relating to the received goods or services, a course of actions are carried out based on relevant contracts. According to relevant contracts, buyers may have choices described as follows: • Credit notes are generated for buyers, so that buyers can use credit notes as another form of payment in the future. • Buyer may have rights to have another delivery of the same goods or services ordered. • Buyer may have rights to have compensations from relevant suppliers.	• POs; • Invoices; • Delivery notes, or dispatch notes; • Credit notes (optional).
E-Catalogue	It provides electronically based catalogues to allow users to browse and search products.	• Structuring products into categories; • Browser and search products; • Providing brief and detailed specifications of products; • Linking procurement documents (e.g. request for quotations, purchase orders, etc.) via products	• Standardised or customised structure of products; • Product specifications (e.g. product ID, code, supplier details, etc.).
E-Contracting	It covers the system functions concerning contracts management.	• Upload contracts signed between buyer and supplier; • Certain critical details are extracted from the contracts to	• Online contracts; • Critical details extracted from the contracts.

		formulate restrictions which can automatically monitor the documents related with ordering process.	
E-Reporting	It covers the system functions in terms of generating procurement documents.	A series of procurement documents are generated across the e-procurement system, such as RFI, RFP, RFQ, PO, Invoices, Delivery Notes, Dispatch Notes, Credit Notes, Contracts, etc.	
System Administration	It covers the system administration functions.	It contains system maintenance of stored data, and functions implemented on the e-procurement systems.	
Other Supportive Modules	It covers other system functions generally pervasive in every e-procurement system.	• Log in and Log out; • Search; • Emails; • Instant messages.	

6.9 Macro Infrastructure

Four elements are included in this component. There are government policies and laws, information and communication technologies (ICT), and software innovation theory.

As discussed in section 6.4, the major contribution of these four elements is to provide a macro infrastructure to be followed when a specific e-procurement system is to be established by an e-procurement collaboration network which consists of the companies, such as, individual/cluster of SMEs, supply chain partners, and intermediate organisations.

6.9.1 Government Policies and Laws

The core of e-procurement application is to not only get rid of many traditional restrictions (e.g. regional and geographical dimension, temporal dimension), but also break through business barriers. Nevertheless, the deployment of any specific e-procurement system needs to follow the policies, laws, business regulations and rules, and Internet laws and regulations stipulated by authorities, such as government, business organisations, international business organisations, Internet and e-business standards organisations, and so forth.

6.9.2 Information and Communication Technologies

The major technologies applied in e-procurement application are information and communication technologies (ICTs), such as, EDI, XML, HTTP and Web services.

6.9.3 Software Innovation Theory

The e-procurement system used by a collaboration network is similar to a physical product that is subject to life-cycle and innovation theory. Similarly, e-procurement system have cycles facilitated by continuous improvements and upgrade in line with changing customers' demands on the specific e-procurement system and the continuous developments in technologies.

6.10 Implementation Stages

This section presents the stages to implement the framework. In total, six stages are involved, including preparation, initiation, analysis, design, implementation, and closure. Furthermore, four functions are involved in monitoring the overall implementation process. The implementation stages are based on the principles specified in Prince2 project management. The Figure 6.4 below illustrates the overall implementation process.

6.10.1 Stage One: Preparation

This stage is to prepare prerequisites necessarily to initiate an e-procurement project. This stage includes three major steps, such as, clarifying project targets, initiating e-procurement project proposal, and evaluating project feasibility.

The participant organisations in this stage are the 'individual/cluster of SMEs' and the 'supply chain partners' in an e-procurement collaboration network.

If a specific e-procurement system is evaluated to be feasible, a brief project proposal will be written by the main system requester, the 'individual/cluster of SMEs'.

6.10.2 Stage Two: Initiation

This stage is triggered once the project proposal is accepted by 'intermediate organisations' in the e-procurement collaboration network. Three steps are involved in this stage, including outline project approach, appointing a project implementation team, and establishing contracts.

The attendee-companies in this stage are the three categories of participant organisations, e.g. the 'individual/cluster of SMEs', the 'supply chain partners', and the 'intermediate organisations'.

One of the major outputs of this stage is the contracts which provide security to ensure the e-procurement project is successful.

6.10.3 Stage Three: Analysis

This stage is to analyse the requirements or demands proposed by main system requester and prospective system users. Accordingly, the attendee-companies in this stage are the three categories of participant organisations. Amongst these participant organisations, the 'individual/cluster of SMEs normally serves as main system requester, and the 'supply chain partners' are usually to system users.

This stage involves one step, clarifying new procurement process and system functions.

The chief output of this stage is one of the project documents, functional and non-functional system specifications, which comprehensively detail the requirements proposed by system requester and system users.

6.10.4 Stage Four: Design

This stage is to design a prototype of the proposed e-procurement system, in accordance with the system specifications determined in stage three. A prototype is essential at this stage, as it represents the perceptions of system designers and developers who are normally not employees of the system requesters or system users. Based on the prototype, the e-procurement collaboration network is able to decrease or even eliminate incongruence among system requesters, system users and system providers.

Therefore, it is necessary for the three categories of participant organisations to participate in this stage. In this stage, one step, evaluating e-procurement system prototype, is included.

The chief output of this stage is the prototype of the proposed e-procurement system.

6.10.5 Stage Five: Implementation

This stage is for system developers to develop and implement the proposed e-procurement system. It contains three steps, developing the e-procurement system, delivering the e-procurement system with supporting documents, and evaluating the delivered e-procurement system. The attendee companies are normally consultant and software development companies in the category of 'intermediate organisations'. Moreover, it is essential for the 'individual/cluster of SMEs' and the 'supply chain partners' to be involved because they need to inspect and verify the quality of the proposed e-procurement system.

Accordingly, the major output of this stage is the proposed e-procurement system.

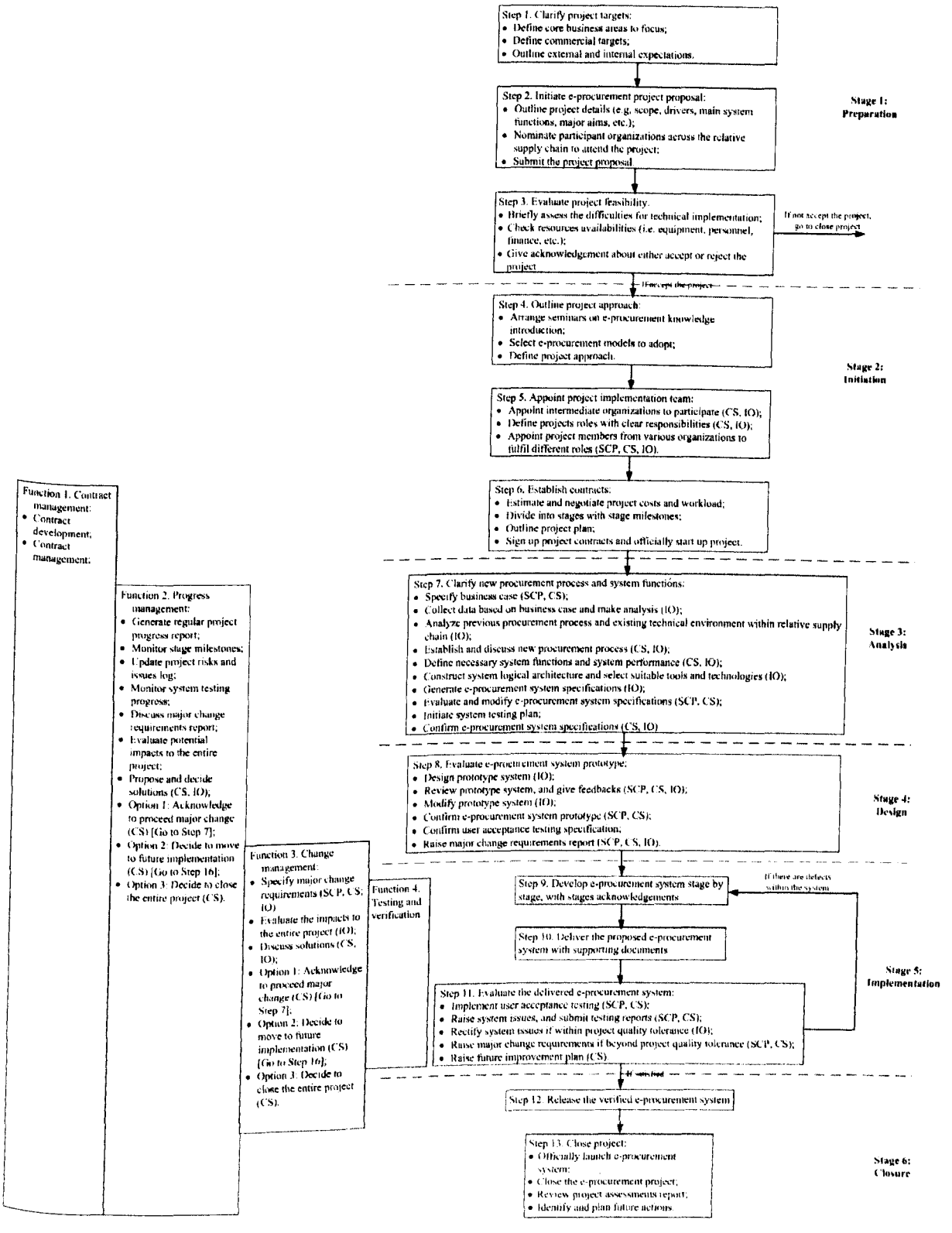
6.10.6 Stage Six: Closure

This stage is to close the e-procurement project once the proposed e-procurement system is accepted and acknowledged officially by system requester. It contains two steps, releasing the verified e-procurement system, and closing project.

The attendee companies normally include system requester and system providers, the 'individual/cluster of SMEs', and consultant and software development companies in the category of 'intermediate organisations'.

Also, the future plan for continuous improvements may be outlined at the end of this stage.

Figure 6.4: Overall implementation stages of the developed framework



6.11 Chapter Summary

This chapter presents the developed framework with explanation of the methodology applied for its development, outlines its applicability, details the five major components involved, and introduces its implementation stages.

The developed framework is characterised by generalisation, combination of knowledge and practices, SME-oriented, and application of the principles specified in Prince2 Project Management.

In order to confirm the generalisability of the framework, it is applied to case four in Chapter 7. Case four is based on e-procurement project relating to the food sector. That is, unlike the three cases examined in Chapter 4, case four is relating to the food sector, rather than the aerospace sector. Further, the relevant e-procurement system relating to case study four was a more extensive and complicated system than the three cases in Chapter 4, leading to more insights to add into the framework developed in this chapter.

Chapter 7 Framework Validation

7.1 Introduction

This chapter address the application of the framework in an e-procurement project which aims to establish an e-procurement system for a cluster of buyers in the food sector.

This relates to the implementation stage (that is, stage five) of the methodology for developing the framework (see section 6.2 in Chapter 6).

As presented earlier, the framework was developed based on the three cases relating to the aerospace sector investigated in Chapter 4. It is necessary to apply the framework into a fourth case study relating to a different sector, food sector, and validate through the fourth case study afterwards. The corresponding findings may provide further insights to assist more generalisation of the framework.

The application procedure is based on the principles of the framework. Specifically, case study four allows for deep and comprehensive analysis of the components and the stages contained in the framework.

7.2 Application of the holistic Framework into Cases Study Four

This section explores how the framework is applied in case study four.

This section is organised as follows:

- Brief introduction of case study four;
- Participant organisations;
- Supply chain collaboration network;
- E-procurement collaboration network;
- E-procurement system modules;
- Macro infrastructure;
- E-Procurement system implementation stages.

7.2.1 Brief Introduction of Case Study Four

Case study four is to establish an e-procurement system for a cluster of buyers that are located in the same region in the UK and all based in the food sector. The e-procurement project was proposed by a regional food association of buyers for the same region with more than 600 members, inclusive of over 80% SME members, had direct connections with the regional food association. The primary objective of the project was to boost the regional food industry; whilst, the focus of the project was to provide facilitations for most of their SME members to obtain reduced prices for consumable goods.

Bearing in mind that each company provides various food products and services, the proposed e-procurement system can be expected to be complicated. To ensure the success of the project, multiple phases of implementation were identified because the proposed e-procurement system was targeted to gradually involve all members of the regional food association.

As a result, this case study is based on the first phase relating to e-procurement (see Appendix E). In the first phase, fifteen organisations were involved, comparing of nine members and the regional food association. Among the nine members, they were small, medium, and large organisations. Meanwhile, the product focused on was consumable goods, corrugated packages/boxes. This can be regarded as indirect materials/goods and attracted general interests of the nine members in this phase. The core benefits to be delivered to the nine members were reduced prices of corrugated packages/boxes. As a result, the e-procurement system was focused on the buyer-side of e-procurement transactions.

7.2.2 Participant Organisations

The specific participant organisations are presented in Table 7.1 below. The table also specifies the details of each participant organisation. The fifteen participant organisations can be classified into the three categories defined in the framework as follows:

- Nine of them were categorised into the 'individual/cluster of SMEs'. However, unlike the three cases in Chapter 4, the companies in this group were not all SMEs, instead, five were SMEs, three were large firms, and one was a multinational firm. Correspondingly, the name of this category is changed as 'individual/cluster of SMEs'.
- One was categorised as 'supply chain partners'.
- Five were categorised as 'intermediate organisations'.

Table 7.1: Participant Organisations in case study four

Company	Type of Company	Specific Category of Participant Organisation
Company 1 Company 2 Company 3 Company 4 Company 5 Company 6 Company 7 Company 8 Company 9	• Nine members of the regional food association, having common interest in corrugated packages/boxes; • Amongst the nine members, five of them were SMEs; three of them were large firms; whilst, one of them was a multinational firm.	Individual/cluster of supply chain companies
Large manufacturing company	Potential Supplier of the nine members	Supply chain partners
Regional Food Association	Business association	Intermediate organisation
Research Institute	Business adviser especially on Procurement improvement and supply chain management	
Consultant Company	Business adviser	
Sourcing Supplier Agent	Business adviser especially on supplier sourcing	
Software development company	Technical supporter and provider of e-procurement system	

7.2.3 Supply Chain Collaboration Network

The supply chain collaboration network comprised of the nine members and a large manufacturing company as a potential supplier of the nine members.

Firstly, in terms of the 'procurement backgrounds across supply chains', the details relating to organisational structures and procurement configurations of each of the participant companies were examined and are presented in Table 7.2. In addition, the roles played by each involved company and the relevant relationships across the supply chains are illustrated in Table 7.3.

Table 7.2: procurement backgrounds across the supply chain in case study four

Specific Category of Participant Organisation	Participant Organisations across the Supply Chains	Is there separate procurement department?	How many employees executing procurement functions?	How many procurement experts?	Is there any e-procurement system already in use to facilitate procurement process?	Are there mature standards for processing procurement data?	What kinds of tools employed to process procurement documents?	What is the major way used to communicate with each other?
Individual/ cluster of supply chain companies	Five SMEs	• No in One SME; • Yes in Four SMEs.	one to ten employees in every SME	One to two experts in every SME	No in Five SMEs, but, there were simple websites in three of them. Their websites just simply introduced their companies.	No	Microsoft Office Excel	• Telephone; • Email; • Fax; • Instant messages through their websites.
	Three Large Firms	Yes	More than ten employees in every large firm	Two to five experts in every large firm	No	Yes in Two large firms; No in One large firm	Owned ERP systems	• Telephone; • Email; • Fax; • Emails and messages through their ERP systems.
	One Multinational Firm	Yes	Multiple employees	Multiple experts	Yes	Yes	Owned ERP and e-procurement systems	• Telephone; • Email; • Fax; • Emails and messages through their e-procurement system.
Supply chain partners	Large manufacturing company	Yes	Multiple employees	Multiple experts	Yes	Yes	Owned ERP and e-procurement systems	• Telephone; • Email; • Fax; • Emails and messages through their e-procurement system.

Source: Confidential Company List, FoodPort project document, FoodPort Project Team, 2007.

Table 7.3: Roles and relationships across the supply chains in case study four

Specific Category of Participant Organisation	Company	Role in E-Procurement Collaboration Network
Individual/cluster of supply chain companies	Company 1	• Buyers across the supply chains; • Potential buyers of the large manufacturing company.
	Company 2	
	Company 3	
	Company 4	
	Company 5	
	Company 6	
	Company 7	
	Company 8	
	Company 9	
Supply chain partners	Large manufacturing company	• Potential suppliers across the supply chains; • Potential suppliers of the involved fifteen members.

Source: Confidential Company List, FoodPort project document, FoodPort Project Team, 2007.

Secondly, with regard to the drivers of procurement improvements across the supply chains, the participant regional food association identified the following:

- To boost the food economy in the region, especially providing extra help for their SME members;
- To allow their SME members to obtain reduced prices when they acquire consumable goods;
- To consolidate business connections in the region by facilitating collaboration between the SME and other organisations.

With regard to the foci of procurement improvements, they were determined by the regional food association in accordance with the three primary drivers stated above. Because SME members were primarily concerned, the foci of procurement improvements were weighted on the areas of procurement SME members could obtain the best benefits. As a result, a series of seminars and meetings were arranged especially for SME members, although larger companies were also took part. The foci of procurement improvements were quite broad and extensive, almost including all relevant procurement activities relating to the SME members in the region. In order to make the final target achievable, the regional food association set the focus of procurement improvements in the first phase of the cycle of procurement, starting from sourcing suppliers, to contracting, to suppliers' tendering, to ordering, and ending with invoicing. As a result, a specific e-procurement system suited to the food sector

was to be established and centred on facilitating multiple business activities in the region, especially promoting procurement activities for their SME members.

Finally, with respect to the commercial objectives, they were proposed by the regional food association. According to the project scope document, they were specified as follows:

- To assist most of SME members to easily find new suppliers;
- To involve appropriate large suppliers in terms of the demands of most of SME members;
- To assist SME members to formulate procuring clusters for decreased prices of specific consumable goods commonly acquired;
- To introduce SME members with innovative and advanced technologies on procurement process improvements;
- To facilitate most of SME members to automate their routine procurement activities.

The large manufacturing company as a supplier agreed to join the project because they were very interested in the estimated annual consumptions of corrugated packages/boxes, so that they could greatly expand their market share. The involvement of a few large corporations, as buyers, contributed a large percentage to the estimated annual consumptions of corrugated packages/boxes; meanwhile, they could obtain lower procuring price of corrugated packages/boxes, which was the most attractive element for their involvement of the project.

7.2.4 E-Procurement Collaboration Network

This section investigates how the e-procurement collaboration network was formed and which elements were involved in case study four.

This section is organised as follows:

- Strategic facilitation;
- Dedicated personnel;
- Physical facilitation;
- Intangible facilitation.

7.2.4.1 Strategic Facilitation

As presented in the developed framework (see Figure 6.2 in Chapter 6), this element comprises of four elements: roles required, responsibilities required, ownership of the e-procurement system, and sources of revenue.

Roles Required

The participant organisations in the e-procurement collaboration network were already identified in section 7.2.2 in this chapter. Also, the fifteen companies are classified into the three categories of participant organisations as illustrated in Table 7.1. Further, the roles played by each participant organisation are demonstrated in Table 7.4 below.

Table 7.4: Roles in the e-procurement collaboration network in case study four

Specific Category of Participant Organisation	Company	Role in E-Procurement Collaboration Network
Individual/cluster of supply chain companies	Company 1	• System advisers; • System users; • System testers.
	Company 2	
	Company 3	
	Company 4	
	Company 5	
	Company 6	
	Company 7	
	Company 8	
	Company 9	
Supply chain partners	Large manufacturing company	• System adviser; • System user; • System tester.
Intermediate organisation	Regional Food Association	• System requester; • Owner of the e-procurement system; • Initiator of the e-procurement project; • Financial sponsor of the e-procurement project; • Primary business connector of the e-procurement project.
	Research Institute	• System provider and consultant; • Organiser of the e-procurement project.
	Consultant Company	• Specialist consultant of the e-procurement project.
	Sourcing Supplier Agent	• Specialist consultant of the e-procurement project.
	Software Development Company	• System developer; • Technical supporter of the e-procurement project.

Source: Confidential Company List, FoodPort project document, FoodPort Project Team, 2007.

Responsibilities Required

With regard to the responsibilities required in the e-procurement collaboration network, each participant organisation was assigned various tasks, as presented in Table 7.5 below.

Table 7.5: Tasks taken by the participant organisations in case study four

Tasks	Participant Organisations						
	Individual/cluster of supply chain companies	Supply chain partners	Intermediate Organisations				
			Regional Food Association	Research Institute	Consultant Company	Sourcing Supplier Agent	Software Development Company
Initiating an e-procurement project			√ *				
Defining the project commercial objectives	√		√ *				
Composing project documents			√ *	√ *	√ *	√ *	√ *
Arranging necessary seminars and meetings	√	√	√ *	√ *	√	√	√
Appointing the dedicated personnel from each participant organisation to take part in the project	√	√	√ *	√ *	√	√	√
Appointing responsibilities to the specific personnel			√ *	√ *			
Negotiating project costs and other relevant fees	√ *	√ *	√ *	√ *	√ *	√ *	√ *
Explaining the details concerning business transactions and procurement processes and activities across the related supply chains	√ *	√ *					
Collecting requirements of e-procurement systems	√ *	√ *		√ *			
Investigating the associated business environment	√	√		√ *	√	√	√
Analysing and designing the proposed e-procurement systems	√	√		√ *	√	√	√
Planning project durations, stages, milestones and deliverables	√	√	√ *	√ *	√	√	√ *
Monitoring project progress			√ *	√ *			√ *
Controlling and reporting project risks and issues			√	√ *	√	√	√ *
Acknowledging project approvals	√ *		√ *	√ *			
Developing the e-procurement systems				√ *			√ *
Attending user acceptance tests to ensure the quality of the e-procurement systems	√ *	√ *	√	√			√
Configuring technical tools and equipment				√ *			√
Implementing the e-procurement systems	√	√	√	√			√ *
Providing technical supports and maintenance				√			√ *
Organising and offering system trainings				√ *			√

Note: √ * indicates the company is acting as the main role; √ indicates the company is acting as the supportive role.

Ownership of the E-Procurement System

As presented in Table 7.4, the owner of the e-procurement system was the regional food association which was deemed as a third party from a supply chain perspective. Moreover, it was owned by only the regional food association; therefore, it was applied a solo ownership. The benefits of applying the model of solo ownership into the e-procurement system are described as follows:

- It simplified the complexity relating to determining which group of participant organisations should be responsible for the system;
- It decreased the concerns from the perspective of the members of the food association. The system owner was the regional food association, indicating that the system were to fair to all perspective system users and developed in terms of all perspective users, instead of a specific group of system users;
- It indicated that the regional food association should take the full responsibility for the e-procurement system, and further the regional food association need to maintain and provide support to the system if there is any problem happened.

Sources of Revenue

The sources of revenue were mainly from sales transactions in the e-procurement system. The system users (e.g. nine members and other potential users, etc.) were to be charged a certain percentage of sales they made online.

7.2.4.2 Dedicated Personnel

According to the analyses of the roles and the responsibilities required in the e-procurement collaboration network (see section 7.2.4.1 in this chapter), can be inferred the following statements concerning organisational structure in case study four:

- The organisational structure is quite flexible and flat, instead of hierarchical.
- It is quite difficult to classify a particular role for each participant organisation, because each of them played different roles in terms of a specific responsibility

involved. Sometime, it is very hard to clarify the boundary of the roles played by the fifteen companies because their roles overlapped in the e-procurement collaboration network.

With regard to the three types of dedicated personnel involved in the framework, they are presented in Table 7.6.

Table 7.6: Different types of dedicated personnel relating to case study four

Participant Organisations		Number of dedicated personnel	Decision Makers	Procurement Personnel	Professional & Experienced Personnel		
					Specialists	Professional Advisers	Other Personnel
Individual/ cluster of supply chain companies	Company 1	In each company, there were at least two personnel dedicated in the e-procurement project.	√	√			
	Company 2		√	√			
	Company 3		√	√			
	Company 4		√	√			
	Company 5		√	√			
	Company 6		√	√			
	Company 7		√	√			
	Company 8		√	√			
	Company 9		√	√			
Supply chain partners	Large manufacturing company	several	√	√			
Intermediate Organisations	Regional Food Association	4	√			√	
	Research Institute	8	√		√	√	
	Consultant Company	3	√		√	√	
	Sourcing Supplier Agent	2	√		√	√	
	Software Development Company	11	√		√	√	

7.2.4.3 Physical Facilitation

The three elements involved in this component are presented below.

Materials and Products

The products focused in the e-procurement system were corrugated packages and boxes. These products were one of the commonly used materials by most of the members of the regional food association. The participant consultant company did an intensive survey and spend analysis on all related indirect goods. According to their analysis, the annual consumption of corrugated packages and boxes in the region was quite huge, because nearly every food company in the region needed them for packaging.

Facilitating Tools and Equipment

In support of the corrugated packages and boxes, a range of machinery tools and equipment were utilised by the members of the regional food association. However, they were mainly related with operations, rather than the e-procurement system.

The facilitating tools and equipment related with the e-procurement system were actually quite simple and included servers, computers, and projectors.

Project Documents

The project documents involved in case study four are presented in Table 7.7. It is obvious that every project document involved in the framework was applied in case study four.

Table 7.7: Project documents utilised in case study four

Category	Document Name	Case study four
Project Plan	Project plans	√
	Project change requirement plans	√
Project Progress	Project progress log	√
	Periodical work progress reports	√
Project Issues and Risks	Issues log	√
	Risks log	√
Scope Document	Project scope document	√
E-Procurement System Design Documentation	Functional and Non-Functional Requirements Document	√
	Change requirements documentation	√
	Previous procurement process flow charts	√
	New procurement process design documents	√

	Class diagrams	√
	Database design document	√
	Use cases	√
	Software architecture document	√
	User interface design documents	√
Test Documentation	Test scripts	√
	Test cases checklists	√
Technical Documentation	Technical configuration documents	√
	Source code package	√
	Database scripts	√
	Software setup package	√
Supporting Documentation	Software installation document	√
	User manual document	√
Project Contracts	Project contract	√
	Project change requirements contract documentation	√
	Project quotation documentation	√
	Project change requirements quotation documentation	√
Approval Documentation	Questions and Answers Logs	√
	Email Approvals	√

7.2.4.4 Intangible Facilitation

The eight elements in this component are investigated one by one in terms of case study four. The details are presented subsequently.

Procurement Processes and Activities across the Supply Chains

In case study four, the procurement processes and activities included sourcing, tendering, contracting, ordering, and invoicing.

Procurement Information

In case study four, the procurement information provided by the e-procurement system was classified as two types, i.e. general and special.

For instance, each system user was able to browse product descriptions through an integrated catalogue and latest news published by the regional food association. Moreover, for each system user, the e-procurement system contained the information about their products and

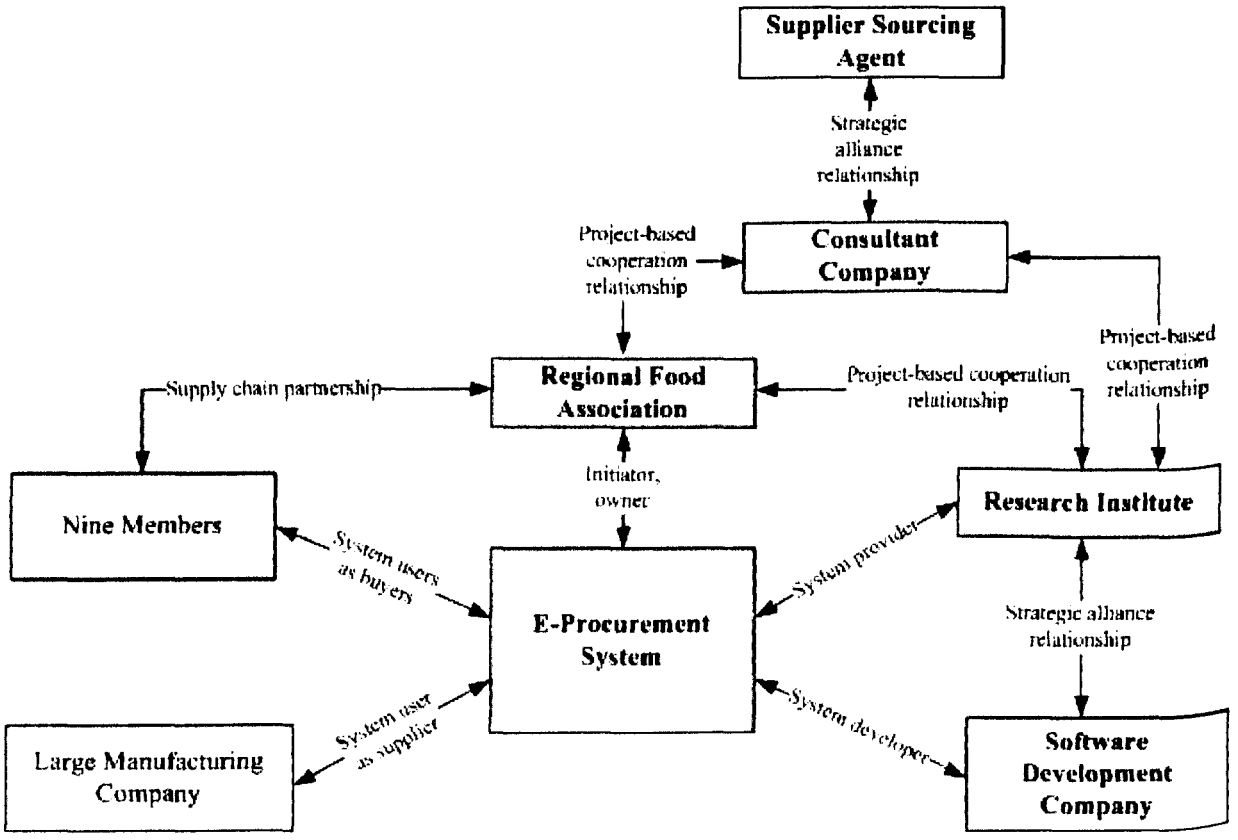
services, their organisational profiles and procurement documents, the details of related contracts, and other relevant contents.

Business Connections and Relationships

As presented in Table 7.4, the business connections were mainly facilitated by regional food association, which held more than 600 companies' details and information. These companies were the members of the regional food association, as well as supply chain partners in the food sector; therefore, it was easier for them to be connected in supply chain partnership. As such, nine members were interested in the project proposal and took part in the project.

The relationships among the e-procurement collaboration network are illustrated in Figure 7.1 below.

Figure 7.1: Relationships among the e-procurement collaboration network



Credibility

In the e-procurement collaboration network, the regional food association relied on its influence and credibility to convince the nine members to join the e-procurement project. The research institute largely depended on its university background for credibility to obtain the position of system provider. The software development company was involved because of its strategic alliance relationship with the research institute. Moreover, the consultant company was involved largely due to its worldwide reputation as a first class consultant company. The supplier sourcing agent took part owing to its strategic alliance with the consultant company. In addition, the large manufacturing company participated because of its reputation as a large supplier of corrugated packages and boxes.

Financial Capability

In case study four, the owner of the e-procurement system was the regional food association that provided start-up capital for the project. The capital was sufficient to afford the relevant consultancy fees, costs of system development and implementation, and maintenance fees.

In addition, the charges for each system user were affordable for most of SME members of the regional food sector.

Professional Knowledge and Experiences on Procurement Improvements

In case study four, the fifteen companies involved are examined in terms of specific knowledge and experience provided to the e-procurement collaboration network. The details are presented in Table 7.8 below. It is obvious that different companies provided different knowledge and experiences on procurement improvements because they were specialists in diverse areas. As a whole, the entire e-procurement collaboration network was able to make up the gaps of individual companies.

Table 7.8: Professional knowledge and experiences on procurement improvements in case study four

Participant Organisations		Industrial knowledge and experiences	Supply chain management	Procurement management	Procurement transformation and adoption	Project management	Risks management	Change management	Software engineering
Individual/ cluster of supply chain companies		√							
Supply chain partners	Large manufacturing company	√							
Intermediate Organisations	Regional Food Association	√							
	Research Institute		√	√	√	√	√	√	√
	Consultant Company		√	√	√		√	√	√
	Sourcing Supplier Agent		√	√	√				
	Software Development Company				√	√	√	√	√

Technical Capability

In case study four, most of the nine members had technical capability, for example, each of them had dedicated IT personnel to give technical support internally. However, they did not have the capability to establish an e-procurement system. Similarly, in the region, most of companies did not have sufficient technical capability to improve their procurement processes and activities.

Under these circumstances, the regional food association invested a large amount of capital to enable the research institute to establish the proposed e-procurement system, because the regional food association did not have the capability itself. However, there were no dedicated system engineers or personnel in the research institute; therefore, the software development company was hired to make up for the technical capability gaps of the research institute.

As a whole, the e-procurement collaboration network possessed sufficient technical capability in terms of the commercial project.

Existing E-Procurement Architectures and Systems

In case study four, the e-procurement system was developed on the basis of several mature e-procurement systems owned by the software development company. Moreover, the specific e-procurement system utilised an architecture already developed by the research institute. As a result, the duration for developing and implementing the e-procurement system was greatly shortened.

7.2.5 E-Procurement System Modules

The system modules utilised in the e-procurement system are examined in accordance with the elements involved in the framework, as presented in Table 7.9 below. It is clear that most of system modules contained in the framework are involved in the e-procurement system, indicating that the e-procurement system in case study four provided relatively comprehensive procurement services to the system users.

Table 7.9: E-Procurement system modules utilised in case study four

System Module	System Function of Procurement Activities	Case study four
E-Sourcing	Generate specifications of goods and services;	
	Generate request for information for selecting suppliers;	
	Obtain the feedbacks from suppliers;	
	Compare various suppliers based upon pre-defined criteria;	
	Select eligible suppliers based on the comparison results.	
E-Tendering	Generate request for proposal (RFP) or request for quotation (RFQ) for selecting suppliers;	√
	Send RFP or RFQ to eligible suppliers pre-selected in sourcing process;	√
	Obtain suppliers' feedbacks;	√
	Compare various suppliers based upon pre-defined criteria;	√
	Select specific suppliers based on the comparison results.	√
E-Ordering	Generate purchase orders (POs);	√
	Send POs to the suppliers pre-defined in tendering process;	√
	Receive suppliers' feedback on confirmation of the POs received;	√
	Receive invoices from suppliers;	√
	Receive ordered goods and services with relevant delivery notes or dispatch notes sent out by supplier;	√
	Carry out quality check for the received goods or services;	√
	Sign off suppliers' delivery notes or dispatch notes if there is no problem with the received goods or services. Otherwise, a course of actions are carried out based on relevant contracts.	√
E-Invoicing	Link to other documents (i.e. purchase orders, delivery notes)	√
	Print invoice	√
	Generate credit notes	√
E-Catalogue	Structuring products into categories;	√
	Browser and search products;	√
	Providing brief and detailed specifications of products;	√
	Linking procurement documents (e.g. request for quotations, purchase orders, etc.) via products	√
E-Contracting	Upload contracts signed between buyer and supplier;	√
	A certain critical details are extracted from the contracts to formulate restrictions which can automatically monitor the documents related with ordering process.	√
E-Reporting	Request for information (RFI)	
	Request for proposal (RFP)	

	Request for quotation (RFQ)	√
	Purchase order (PO)	√
	Delivery Notes	√
	Dispatch Notes	√
	Invoice	√
	Credit Note (CN)	√
System Administration	organisation maintenance	√
	user maintenance	√
	Link users to organisations	√
Other Supportive Modules	Log in, Log out	√
	Search (inclusive of simple and advanced search)	√
	Emails	√
	Instant messages	√

7.2.6 Macro Infrastructure

7.2.6.1 Government Policies, Laws, Business Regulations and Rules, Internet Laws and Regulations

The procurement processes and activities implemented in the e-procurement system in case study four followed government policies, laws, business regulations and rules, internet laws and regulations.

7.2.6.2 Information and Communication Technologies

The major technologies applied in the e-procurement system in case study four included XML, Visual Studio, HTTP, and Oracle, which all belong to information and communication technologies (ICTs).

7.2.6.3 System Innovation Theory

As addressed in the introduction of case study four (see section 7.2.1), the case study was based on the first phase of the project. Apart from the first phase, three other phases were planned as well. In other words, the establishment of the e-procurement system follows the life cycle of software (i.e. e-procurement system) innovation theories.

7.2.7 E-Procurement System Implementation Stages

The developed e-procurement system followed the e-procurement system implementation stages defined in the framework. In fact, the six implementation stages were all experienced. More details are analysed stage by stage in the following subsections.

7.2.7.1 Stage One: Preparation

In this stage, the project targets were clarified to develop a specific e-procurement system as an online marketplace, which aimed to provide decreased prices for most of the SME members of the regional food association. Accordingly, the project proposal was drafted by

the regional food association, with the outputs of a series of seminars and meetings involving some of their members.

The project proposal was submitted to the research institute, and hence evaluated as feasible. This can be regarded as the official starting point of the project.

7.2.7.2 Stage Two: Initiation

In this stage, the project approach was jointly determined as outsourced development by the regional food association, the research institute, and the consultant company. At that moment, the research institute already owned mature systems, similar with the proposed e-procurement system required by the regional food association.

Also, the software development company had sufficient experience in developing the systems according to the regional food association's requirements. As a result, the project implementation team was formed, involving the personnel in the research institute and the software development company. Some of members of the regional food association also joined to take responsibility for system testing.

In addition, project contracts were signed off to ensure the commitments of each participant organisation in the e-procurement collaboration network.

7.2.7.3 Stage Three: Analysis

In this stage, the research institute was in charge of collecting system requirements from the nine members of the regional food association and the large manufacturing company. Indeed, the nine members represented the buyer side of the proposed e-procurement system; whilst, the large manufacturing company represented the supplier side of the proposed e-procurement system.

All system requirements were collected through semi-structured interviews and recorded. The details contained the following:

- Previous procurement transactions, such as, processes and activities;

- Samples of routine documents, such as, catalogues and procurement documents in paper format.

Based on the interview records and collected samples, functional and non-functional requirements were generated by the research institute, mainly specifying high level system requirements. Thus, the corresponding system testing plan was generated.

Moreover, the document specifying functional and non-functional requirements was acknowledged by the regional food association, triggering the start of stage four for designing the proposed e-procurement system.

7.2.7.4 Stage Four: Design

The research institute designed a prototype of the proposed e-procurement system. The document containing functional and non-functional requirements was passed to the software development company. Based on the technical knowledge and experiences, the software development company gave comments on the prototype. Thus, the research institute made modifications to the prototype based on technical suggestions.

Then, the modified prototype was reviewed by the regional food association and some of the nine members. Their suggestions were absorbed into the prototype which was closer to their expectations. At the end of this stage, the prototype was approved by the regional food association, triggering the starting point of stage five for implementing the proposed e-procurement system.

7.2.7.5 Stage Five: Implementation

In this stage, the software development company developed the proposed e-procurement system on the basis of the approved prototype in stage four and the functional and non-functional requirements.

During the development process, the software development company reported weekly progress to the research institute. The questions and problems raised by the software development company were resolved by the research institute. In the case that the research

institute did not know the exact answers, they sought for answers from the regional food association.

7.2.7.6 Stage Six: Closure

This stage is to close the e-procurement project once the e-procurement system was accepted and acknowledged officially by system requester. It contains two steps, releasing the verified e-procurement system and closing project.

The attendee companies normally included system requester and system providers, such as, the 'individual/cluster of SMEs', and consultant and software development companies in the category of 'intermediate organisations'.

Also, the future plan for continuous improvements was outlined at the end of this stage.

7.3 Validation of the Framework

According to the application of the framework into case study four (see section 7.2 in Chapter 7), a series of validation steps have been carried out in terms of each component of the framework. All of the evaluation was based on the data collected through interviewing fifteen participant organisations during the procedure of developing and implementing the relevant e-procurement system. The corresponding results are presented in this section, component by component.

7.3.1 Validation of the Component of Participant Organisations

The validation of the component of participant organisations is carried out through examining three aspects, including the number of participant organisations, the details of participant organisations, and the readiness or intention of involvement upon the relevant e-procurement project, as shown in Table 7.10.

Table 7.10: Evaluation of the participant organisations in case study four

Aspect	Summary	Individual/ Cluster of SMEs	Supply Chain Partners	Intermediate Organisations				
				Governments & Business Association	Consultant Companies	Banks & Other Financial Companies	Software Development Companies	Individuals
Number of participant organisations	Fourteen	Nine	One	One	Two	-	One	-
Details of participant organisations	Various types of organisations were involved.	Manufacturing companies in the food sector: • One international company • Three large companies • Five SMEs	One international company providing corrugated packages	Local food association	One internationally well-known consultant company; One research organisation	-	One IT services provider	-
Readiness of being involved upon the relevant e-procurement project	Being interested in being involved, with different drivers of involvement.	• One international company: interested because of the potential of decreased procuring price • Three large companies: interested because of potential of decreased procured price, as well as the opportunity of buying from international suppliers. • Five SMEs: interested because of the adoption of e-procurement into their internal operations, the potential of decreased procuring price, the opportunity of buying from international suppliers, and the chance of improved procurement with external support.	The international company was interested in being involved because of the potential of enlarging their business coverage.	-	-	-	-	-

Source: see Appendix E.

According to the evaluation shown in Table 7.10, it illustrates the following:

- In the category of 'individual/cluster of SMEs', it may contain companies which are not SMEs. Indeed, it is limited to be only involving SMEs in cluster of organisations;
- In the category of 'supply chain partners', it verifies that it may include potential suppliers which can form business partnership upon the e-procurement project;
- In the category of 'intermediate organisations', although two types of organisations, namely banks and other financial companies, and individuals, were not involved in case study four, they still belong to this category because other studies have examined.

Overall, according to case study four, the category of 'individual/cluster of SMEs' needs to be renamed as 'individual/cluster of organisations' which covers any type of organisations inclusive of SMEs.

7.3.2 Validation of the Component of Supply Chain Collaboration Network

The validation of the component of supply chain collaboration network is carried out through observing three aspects, including the readiness of answering interview questions, the customer satisfaction with understanding the relevant supply chain, and the effectiveness of the 'cause-effect pattern'.

A set of interview questions were prepared for various interviewees because they represent different angles of the project and their opinions have greatly effect to the e-procurement system. Since all of the questions were asked during interviews, the responsive rate was high because all of questions were answered, leading to a thorough understanding of the relevant procurement transactions across the supply chain. Accordingly, a series of project documents were generated to describe the four elements of the component, such as the commercial objectives, foci of procurement improvements, drivers of procurement improvement across the supply chain, and the relevant procurement backgrounds. In terms of the 'cause-effect pattern' among the four elements, most of the participants agreed on the interactions among them (see Appendix E).

Overall, the evaluation of this component was mainly based on the feedback of the participant organisations. The four elements of this component and the 'cause-effect pattern' among them are verified in case study four.

7.3.3 Validation of the Component of E-Procurement Collaboration Network

According to the establishment of the e-procurement collaboration network, most of attendees gave feedback concerning the following:

- The identification of the four elements, namely strategic facilitation, dedicated personnel, physical facilitation, and intangible facilitation, and their corresponding units provides a standard principle when the e-procurement collaboration network was formed across multiple organisations;
- The units contained in each element enable the participant organisations to easily understand not only the direction of the overall project but also the detailed plan and tasks involved.
- It provides essential knowledge especially for participant SMEs because some of them had no direct experience of e-procurement adoption.
- The duration of the project was three months, indicating less time spent than the previous three projects investigated in Chapter 4, in terms of the complication and comprehension of the fourth project.

As a result, the identification of the component with its subsequent elements and units was proved as valid and effective according to customer satisfaction among the participant organisations and shortened time spent for the whole project.

7.3.4 Validation of the Component of E-Procurement System Modules

According to the evaluation of the e-procurement system relating to case study four, the system users, including the cluster of food manufacturing companies (as system buyers), the one international supplier (as system supplier), and the research organisation (as system administrators), gave the following feedback:

- The system involves four major functions such as sourcing, tendering, ordering, and invoicing. From system users' perspective, these system functions were necessary to be implemented in the first phase, because they were considered as fundamental functions to support their relevant procurement activities;
- In the first phase, the system functions were designed as essential complexity, indicating that the necessary system modules were included and to be upgraded in the

second and third phases. Most of system users were satisfied with the arrangement because of the three-month implementation duration was acceptable. If all system functions were implemented at one time, it would take more than three months, leading to lack of interest of being utilising the e-procurement system;

As a result, the identification of the component with its subsequent elements was proved as valid and effective according to customer satisfaction among the participant organisations and shortened time spent for the whole project.

7.3.5 Validation of the Component of Macro Infrastructure

According to the establishment of the e-procurement collaboration network and conduction of the relevant project, most of attendees gave feedback as follows:

- The identification of the macro infrastructure and the corresponding elements provides a standard set of regulations for all the involved organisations in the project;
- It provides essential knowledge especially for participant SMEs because some of them had little experience of e-procurement implementation, as well as collaboration of multiple organisations;
- They decrease the risks in the case of multiple organisations' collaborating upon the project.

As a result, the identification of the component with its subsequent elements and units was proved as valid and effective according to customer satisfaction among the participant organisations.

7.3.6 Validation of Implementation Stages

According to the implementation stages in terms of case study four, it was divided multiple stages and subsequent tasks to be accomplished. Most of attendees gave feedback concerning the following:

- The implementation stages can be regarded as a roadmap to give general guidance for each participant organisation during the overall project conducts;

- In particular, for some of SMEs involved in the project, they were satisfied with the implementation stages because they were aware which tasks they were involved, and which other organisations they were supposed to contact and collaborate with. Indeed, some of the SMEs have no experience with being involved in e-procurement adoption projects.
- Each stage and task provides criteria for each participant organisation because every involved company had a general idea about their responsibilities in the overall e-procurement collaboration network.

As a result, the identification of the component with its subsequent elements and units was proved as valid and effective according to customer satisfaction among the participant organisations and shortened time spent for the whole project.

7.4 Discussions of the Validation

This section presents two aspects of the discussions about the framework validation:

- Success and failure aspects in case study four;
- Findings of the framework validation.

7.4.1 Success and Failure Aspects in Case Study Four

Part of the success of the project was indicated by the involvement of the participant organisations and the techniques utilised to carry out the project. In order to establish the e-procurement collaboration network, all of the participant organisations successfully leveraged their individual advantages:

- The regional food association, as a regional business association, was the initiator of the project. This organisation provided several key elements for the project, such as financial support, business connections with its members, and its credibility, which persuaded some members to join in the project.
- The research institute was the organiser of the project and the designer of the proposed e-procurement system. This organisation contributed several elements to the project, including its credibility in providing professional knowledge on supply chain

management to SMEs, its business connections with the software development company and some existing and mature e-procurement systems to facilitate the development and implementation of the e-procurement system.

- The consultant company was the main adviser for the project. This organisation provided several key elements, such as its credibility as a first class consultancy with experience in SMEs' procurement improvement, business connections with the supplier sourcing agent, its ability to undertake an extensive spend analysis of the relevant region, and facilitation of the key product selection of corrugated packages/boxes.
- The supplier sourcing agent, in particular, was assisted by the adviser to find appropriate suppliers of corrugated packages/boxes, because the adviser was a specialist in this area.

In addition to this, several noteworthy points, resulting in the success of the project, are described as follows:

- Nine members of the regional food association, as buyers, and a large manufacturing company, as a supplier, were involved in the project, providing actual procurement transaction scenarios as references of system design;
- The e-procurement system requirements were collected through nine members, as well as the large manufacturing company, providing suggestions for the design of the system;
- The e-procurement systems, owned by the research institute, assisted in the process of collecting requirements. This reduced the time required for system analysis and design;
- The project documents were generated on providing templates, reducing the time required for the entire project.

Failure aspects are summarised as follows:

- The system functions were designed in a complicated way, lacking standardisation across different individual SMEs. In practice, although every company has diverse features, it is impossible to design a holistic e-procurement system to suit every company's special requirements.

- No concessions were negotiated on the products provided online among the nine SME companies. As presented earlier, the key products were corrugated packages/boxes which were analysed by the consultant company through a complicated spend analysis process. However, each of the nine members had specific requirements for various types of corrugated packages/boxes. Therefore, it was difficult to aggregate the annual demand quantity of a specific type of corrugated packages/boxes.

7.4.2 Findings of the Framework Validation

According to the framework validation, there are several findings observed in case study four. Each of them is discussed below.

The initiator of the project was the regional food association, a local business association with connections to more than 600 member companies. Its credibility attracted nine members in the first phase and more members wanted to take part in subsequent phases of the project. As a result, the involvement of SMEs in the project will be greatly encouraged by local authorities.

Although SME members were direct system users of the e-procurement system, the involvement of a few large corporations had substantial implications for the project. As a whole, it was estimated that a large quantity of corrugated packages/boxes were to be consumed by the nine members. Therefore, the large manufacturing company, as a supplier, was interested in joining in the projects. As a result, the influences of large corporations as part of system users need to be examined, because of their potential leverage and contribution to the whole cluster of multiple organisations.

Each company had a specific role in the e-procurement collaboration network and represented various viewpoints. To implement the e-procurement system, a series of tasks was allocated to specific companies (see Table 7.5 in Chapter 7). For each task, some companies had main roles; whilst, other companies adopted supportive roles. As a result, it is essential to clearly define the specific responsibilities undertaken by each participant organisation in an e-procurement collaboration network.

The requirements of the three categories of participant organisations were taken into consideration, resulting in the creation of an e-procurement system suitable for various types

of user. The success of an e-procurement system partly depends, therefore, on whether system requirements are collected from relatively comprehensive sources.

The compatibility of the e-procurement system was greatly enhanced because elementary procurement processes (i.e. sourcing, tendering, ordering, and invoicing) were taken into account when the system was designed in the first phase (see section 7.3.4). In other words, the system was designed in a sustainable way, which made it possible to further improve and develop in subsequent phases of the project. As a result, the success of an e-procurement system partly relies on whether system plans are made in a sustainable way to underpin further improvements and developments.

7.5 Chapter Summary

This chapter presents the framework application in case study four and validation through case study four, which was based on a project to primarily establish an e-procurement system for a regional cluster of organisations, including SMEs, in the food sector.

In terms of the framework validation, a series of discussions are carried out and several findings are observed:

- The involvement of SMEs in e-procurement projects will be greatly encouraged by local authorities;
- The influences of large corporations as system users cannot be overlooked, although the framework aims to fill knowledge gaps for SMEs;
- It is essential to clearly define the specific responsibilities undertaken by each participant organisation in an e-procurement collaboration network;
- The success of an e-procurement system partly depends on whether system requirements are collected from relatively comprehensive sources, and whether system plans are made in a sustainable way to underpin further improvements and developments.

Chapter 8 Conclusions and Future Work

8.1 Introduction

This chapter summarises the research findings that have been observed. It also highlights the contribution to knowledge and the limitations of the research work. The final section contains the recommendations for future research in this area.

8.2 Summary of Research Findings

This section presents the answers to five research questions raised in Chapter 1. A summary is provided to conclude the whole research.

Question 1:

Is there a need for a holistic framework that enables a structured approach to be used in order to support and enhance knowledge for SMEs seeking strategic and practical e-procurement system implementation?

There is a need for such a framework for several reasons identified in this research:

- It is essential to obtain the most from SMEs because they make great contributions to the economy and the society.
- Procurement transactions constitute around 40% to 60% of total costs of most of SMEs.
- The adoption of e-procurement technologies by SMEs has been found to lag far behind those of many large corporations.
- The research area on a holistic framework is still immature, especially for SMEs implementing e-procurement applications.

Question 2:

Is there a need for external support for SMEs attempting to implement e-procurement applications?

It has been widely accepted that the success of e-procurement adoptions largely depends on the level of collaboration and integration across independent organisations. Several aspects are essential to ensure success: (1) financial capability, (2) technological capability, (3) human resources, (4) knowledge and expertise of procurement improvements and supply chain management, and (5) experience and perceptions of e-procurement adoptions. In this research, it examined four case studies relating to four relevant e-procurement projects involving cluster of SMEs. Consequently, a framework has been developed upon individual and cross cases analyses (see Chapter 4 and Chapter 5), and then validated through case study four (see Chapter 6). As a result, the five aspects have been proved as insufficient capability in the involved SMEs and essential to ensure the success of the entire e-procurement adoption when cluster of organisation, including SMEs, attempt to implement e-procurement systems onto their supply chains.

In addition to this, many researchers have investigated the limitations of SMEs, such as (1) limited resources (e.g. finance, technology, human resources, advanced knowledge and experience, etc.), (2) lack of bargaining power, (3) high transactional and investment costs, (4) difficulties in influencing the global market because of localisation characteristics, and (5) difficulties in identifying a standardised solution to fit all SMEs because of their sheer diversity.

In particular, these limitations make it more difficult to fulfil the five requirements in the increasingly changing and intensely competitive business environment.

Question 3:

How do SMEs obtain effective support from external organisations if required?

In order to offer effective support to SMEs, it is necessary for collective external organisations (i.e. governments, business associations, intermediate organisations, research institutes, etc.) to collaborate. Because each SME has individual and unique requirements, when implementing e-procurement applications, the collective external organisations need to

apply a certain methodology or framework to closely investigate their situations, analyse their specific problems and, hence, customise solutions.

Based on the four case studies examined in this research, each of them are unique in terms of the participant organisations, the relationship and partnership upon the relevant supply chains, the requirements relating to the e-procurement systems, and other details relating to the relevant e-procurement projects (please refer to Chapter 4 and section 7.2 in Chapter 7 for details of each case study). Although the framework can be applied into the four relevant e-procurement projects, the details relating to conducting each project were different, in terms of the specific participant organisations, the relationship and partnership among the formed e-procurement collaboration network, the requirements relating to the e-procurement systems, and the specific tasks and milestones involved in the project plans.

Indeed, there will not be any one-size-fits-all solution for all SMEs. Therefore, the methodology or framework applied by the collective external organisations needs to be continuously improved.

Question 4:

Which elements does the framework need to take into consideration?

This research establishes a framework comprised of five components: (1) participant organisations, (2) supply chain collaboration network, (3) e-procurement collaboration network, (4) e-procurement system modules, and (5) macro infrastructure. Each component contains multiple elements. Each element comprises several units.

Overall, these components are taken into consideration because they are normally required when SMEs implement e-procurement applications.

Question 5:

Is there a need for a methodology to be deployed when SMEs attempt to implement e-procurement applications?

Broadly, there is a need for such a methodology because most SMEs lack sufficient knowledge and experience of implementing e-procurement applications. The implementation stages are formed to facilitate SMEs' application of the framework established in this research.

In summary, this research explores three case studies from the aerospace sector. A range of findings has been investigated, based on each case study; and a series of cross-case analysis results have been presented. These cross-case analysis results have been converted into the five components contained in the holistic framework for SMEs, when they implement e-procurement applications with external support. In addition, the framework has been validated in case study four, which concerns the food sector rather than the aerospace sector. More insights have been gained from the framework validation procedure.

8.3 Contribution to Knowledge

This research makes the following contributions:

- A holistic framework is established and provides a new way of thinking about how SMEs can obtain effective external support for efficient implementation of e-procurement applications across their relevant supply chains.
- This research applies a new approach for implementing the framework. This approach includes identification of key players, their characters, roles, responsibilities required and relationships formed based upon e-procurement projects. These are proposed as generic in nature and applicable to organisations across the supply chains outside the aerospace industry.
- Identification of the challenges faced when clustering SMEs with the expectation of aggregating e-procurement activities in particular and collaboration networks in general.

8.4 Research Limitations

Overall the research has achieved the objectives that it set out to accomplish. Some limitations for further enhancement of the research are presented below.

- The major research methodology utilised in this research is a case study research method with three techniques (i.e. documentary, participant observation, and interviews) on the basis of qualitative research. It is, therefore, recommended that more research methods and techniques are used to make the research more comprehensive from various perspectives.
- Extensive literature relating to other scholars' studies provides a knowledge base for this research. It is recommended that more case studies from the business world are considered so that more practical viewpoints can be included in future research.
- Four case studies, relating to the aerospace and food sectors, were used in the establishment of the framework. It is therefore recommended that more cases relating to various industrial sectors are used for further validation and testing of the framework.
- Three of the five components involved in the framework concern participant organisations and their interrelationships with SMEs implementing e-procurement applications. The framework is thus established from the viewpoints of the roles played and the resources provided by each participant organisation. It is therefore recommended that more viewpoints are considered in further research.

8.5 Future Work

In consideration of the research limitations identified above, several recommendations are provided for future work:

- More business cases are to be explored. For example, the cases can include different sized private organisations' e-procurement adoptions, government and local authorities' e-procurement adoptions, and the key performance indicators (KPIs) in financial reporting systems.

- Based on the components and elements involved in the framework, it is recommended that relevant questionnaires, based on a wide scope of surveys, are needed to increase the validity of the framework.
- The factors influencing the success of SMEs' e-procurement adoptions are to be investigated, based on the results of questionnaires.
- More case studies, relating to various industrial sectors, are to be undertaken, so that more practical aspects and immediate business and technical requirements can be accommodated in the framework.
- SMEs themselves are to be given more attention, in more details, on their e-procurement applications. As a result, more insights can be gained from an end-client aspect, leading to more viewpoints being taken into account in future.
- More attention is to be given to macro infrastructure, including government policies and laws, business regulations and laws, regional and global business environments, information and communication technologies, and the life cycle theories on e-procurement applications.

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Appendix A: Interview Questions

General Aspects	Questions
Supply Chain Situations	Which industry segment the supply chain, including the case company, is standing in?
	What products or services does the supply chain provide?
	Besides the case company, how many organizations are involved in the supply chain?
	Which role does the case company play in the supply chain?
	What are the relationships between the case company and its business partners across the supply chain?
External Procurement Procedure	What is the routine procurement process incurred between the case company and its business partners across the supply chain?
	What are the purchasing activities between the case company and its supply chain partners?
	How is product flow processing across the supply chain?
	How is the information flow undergoing across the supply chain?
	How is the financial flow processing across the supply chain?
Internal Procurement Contexts	What products are provided by the case company?
	Is there a separate purchasing department in the case company?
	How many employees are serving purchasing activities within the case company?
	What kind of information technology has been utilized in the case company?
	Is there any e-procurement system already in use within the case company?
	How is a request for quotation (RFQ) processed within the case company?
	How does the case company select appropriate suppliers to fulfil a customer's request?
	How is a purchase order (PO) processed within the case company?
	How does the case company control purchasing budget?
	How does the case company communicate with its supply chain partners?
Requirements on procurement improvements	Which specific area on procurement section needs to be improved across the supply chain?
	What are the focuses on procurement improvements, either automation, or reengineering traditional procurement process, or simplification, or others?)
	What general approach is expected, either building in-house, or directly purchasing from existing e-procurement systems in market?
Requirements on system functions	What kinds of functionalities need to be implemented in the proposed e-procurement system?
	What the requirements are about system performance?
	What are the specific requirements to implement organization and users profile function?
	What are the specific requirements to implement search function?
	What are the specific requirements to implement business information exchanging process?
	What are the specific requirements to implement supplier matching process?
	What are the specific requirements to implement request for quotation process?
	What are the specific requirements to implement customer report function?

	What are the specific requirements to implement catalogue function?
	What are the specific requirements to implement purchasing process?
	What are the specific requirements to implement purchasing budget control function?
	What are the specific requirements to implement instant communication function?

Appendix B

Case Study One Project Document

1: Introduction

This document contains an overview of the requirements for a solution development project scoped and proposed by AiMeS. This document will form the direction for the design and development of the proposed solution. The solution will be based on a developed prototype (See Appendix A). This document details the background and motivation for the solution and underlines the different operating configurations, development tool options and architecture for the solution to provide the most flexible service to users. The next phase will be to agree on the specific development toolset and develop a detailed design document with an updated project plan.

2: Background

OEM primes within the Aerospace sector have developed Internet hubs/portals to disseminate purchase orders and receive invoice and dispatch notes from their supply base. The benefit of the hubs, for the primes, is that they can streamline the procedures and associated costs with processing orders. Exostar (Exostar, 2005) and SupAir world are two of the largest hubs that are currently being pushed by BAE Systems and Airbus respectively. In addition to SupAir world, Airbus also promotes 'e-Purchasing'. E purchasing delivers and receives electronic purchase orders and invoices/dispatch notes via e-mails; the differences between the hubs/systems are outlined in Table 1.

OEM Prime	Description
Airbus	
Scenario A	Airbus has developed a central hub, SupAir world, which integrates with their (Airbus) internal systems. SupAir world is a central location for suppliers to receive purchase orders and complete dispatch advice notes and invoices. Information can be printed or downloaded from the hub and used as required
Scenario A II	Airbus has also introduced a new EDI service that delivers purchase orders to its suppliers via e-mail. Suppliers use this signal for their own

	systems and return (e-mail) invoices and dispatch advice notes to Airbus. Purchase orders, invoices and dispatch advice notes are created following Airbus's standard
Exostar	
Scenario B	Exostar is a central hub used by OEM primes such as BAE Systems. Exostar provides a broader range of tools that extend its usefulness beyond a central facility for suppliers to receive purchase orders and complete dispatch advice notes and invoices. Exostar also provides supply chain collaboration and electronic auctions

Table 1: OEM prime hubs/systems

Each hub adheres to a developed standard for information exchange, xCBL 4.0 for Exostar (xCBL) and a custom standard for Airbus. Despite establishing and promoting the standards used by each hub, the implementation of the standards has caused a number of issues for many Small to Medium sized Enterprises (SME) suppliers, namely

- Translating invoice/dispatch information into the standard(s)
- Viewing/converting information from the purchase order
- Confusion with working with the standard
- Uploading the information from the standard into their internal systems

Help from the OEM primes to support SME information system development to resolve these issues has been restricted because of the number of companies involved in the supply chain.

3: Proposal

The purpose of the Bridge is to develop an application or series of applications that provide SME suppliers with the ability to

- View information from the OEM prime hubs, irrespective of the standard used (CSV, length delimited or XML)

- Provide a mechanism to modify the 'view' of the information from the OEM - a one size fits all approach is counter productive and inflexible
- Provide the integration capability to extract information from two identified (supported) systems: Redthorn and Sage line 50/100
    - An additional integration capability may be required to write hub information flows into a supported local repository

The aim is to provide the Bridge as a 'service' that can fulfil an SME's wish to use its capabilities in a Hosted or Distributed (hosted and managed locally) configuration (See Figure 1). The hosted configuration provides the service through the Internet, incorporating the backend facilities of the Redthorn 10g platform. The distributed alternative empowers an SME to benefit from the service, but incorporates their backend systems (Redthorn and Sage line 50/100 initially supported).

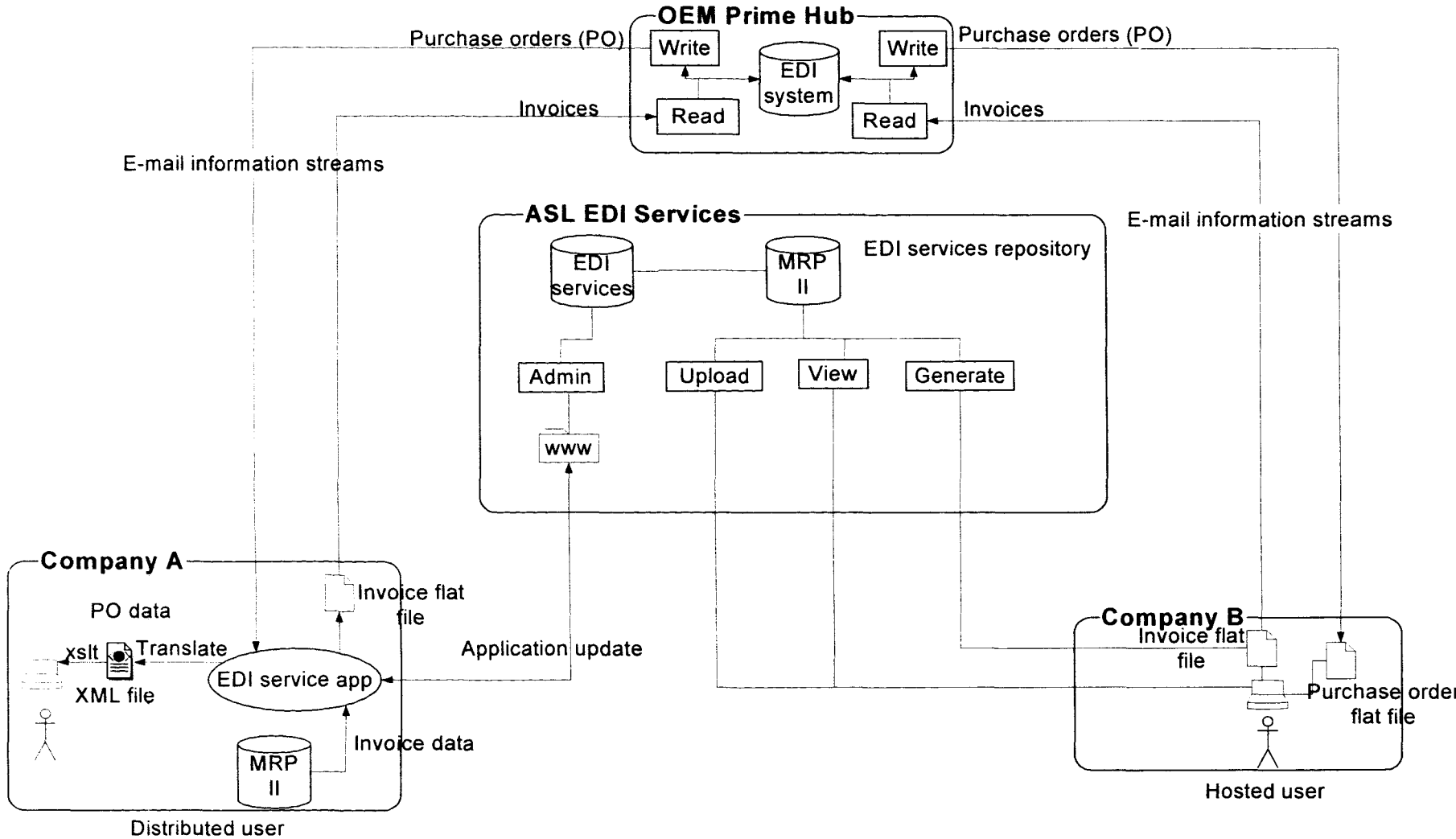


Figure 1: Bridge 'service' overview

4: User cases

Irrespective of the OEM prime that an SME supplies, although it is not uncommon for a supplier to use both hubs, the ability to upload and view purchase orders, and generate invoice and dispatch advise notes remains the same. What will change are the tools and the approach used to develop and maintain the hosted and distributed application(s) (see Figure 2).

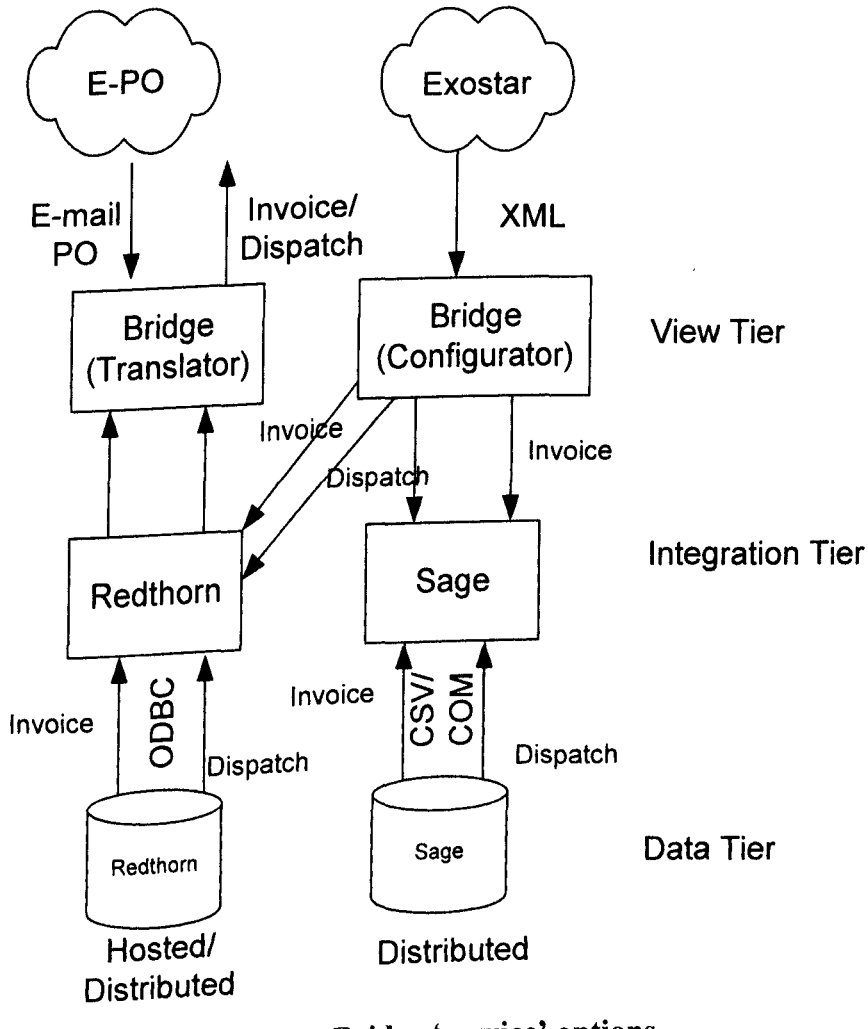


Figure 2: Bridge 'service' options

For a distributed user (see Figure 1), a locally installed version of the Bridge will be used to upload a purchase order file. This process translates/extracts data fields from the original order file (i.e. purchase order number, purchase order line), providing the data in a viewable form. This process converts the original purchase orders onto an xml file.

There are two distinct approaches to generating invoices and dispatch notes; they reflect an integrated and standalone approach. With the standalone approach the xml version of the purchase order is used when an invoice or dispatch advise note needs to be raised. By selecting the xml file, completing the data entries in the generation form and confirming the action will produce the required output for a specific OEM prime. The integrated approach will interact with the supported data repository and provide a checklist of potential invoices/dispatch notes awaiting confirmation before translating. The distributed application must also facilitate selecting and emailing (only applicable to scenario A II - see Table 1) the generated invoices and dispatch advice notes.

The hosted option (see Figure 1) provides the same functionality described for the distributed option, but removes the need for a user to own and maintain a data repository. The hosted approach supports the Redthorn 10g system. A hosted user will receive purchase orders from the hub, this file must be uploaded into the site and the contents of the order stored in the repository. In this approach there is no standalone method to generate invoices/dispatch notes because there is a hosted data repository. All invoices and dispatch notes will be generated online by querying the data repository and confirming translation. Information generated from the translation will be updated in the repository and available as a download.

5: Proposed tool set & architecture

The functionality of the Bridge in the hosted and distributed platforms remains constant, but the tools used in the implementation will vary, see Table 2. For the distributed application the different tiers (View and Integration) can be developed using a range of .Net tools. Although an important consideration is the maintenance aspect of the application once it has been locally installed. For this purpose the Smart Client model (Smart Client 2005) within the .Net framework has been identified because it provides specific advantages

- Despite the application needing to be launched from a web browser, the application can operate offline
- Updates made to the application will be cascaded through the Internet to the distributed applications, when the application is next used
- Any information (files, repository queries) required by the application at runtime can be delivered through the Internet

Hosted	Distributed
User Interaction	User Interaction
• ASP .NET	• Windows forms or
	• ASP .NET with C# or
	• ASP .NET with VB
Core class generation	
• ASP .NET with C#	• ASP .NET with C# or
	• ASP .NET with VB
Distribution	
• Web browser (IE, Netscape, Firefox or other)	• Smart Client (Smart Client 2005)

Table 2: Toolset

The hosted application can be developed using the ASP .Net approach and can be accessed through a web browser. See Figure 3 for a depiction of the Bridge elements. Although, at present, the application is focused on satisfying the requirements of Airbus & Exostar, and integration with Redthorn the Sage line 50/100, the infrastructure and application needs to be adaptable to incorporate other OEM portals and integrate with other systems.

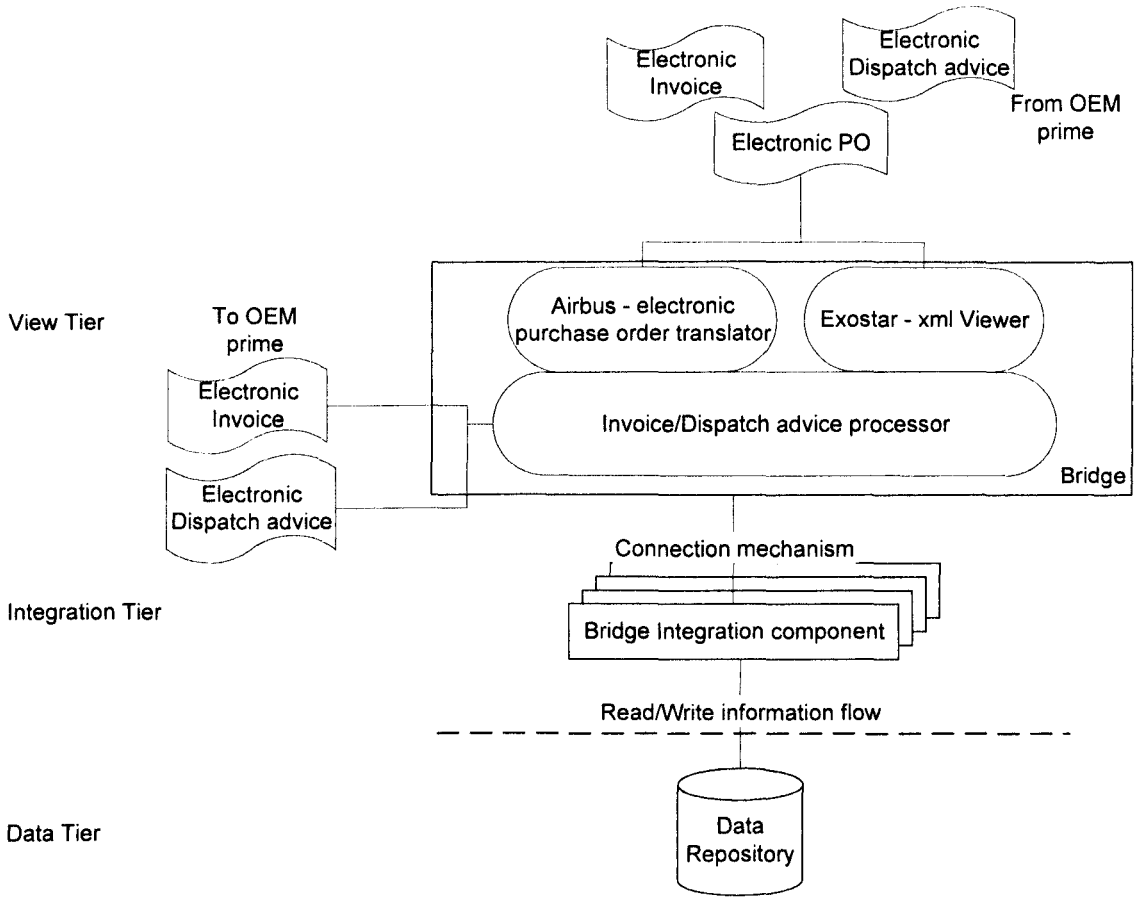


Figure 3: Bridge elements

6: Functionality checklist

The elements within Figure 3 represent the core components for the Bridge; each element consists of sub elements, the major sub elements are outlined in Table 3.

Element
Upload selected file
Views
Airbus purchase order • Extract identified elements for the purchase order text file • Display contents • Print (hard copy) contents
Exostar xml viewer • View selected xml file in a tree structure • Select identified elements from xml file • Test view (HTML view of file contents) • Generate xml file (XML file of file contents • Generate xsl file used in translating the xml file • View and amend xsl file • Save amended xsl file
Invoice/Dispatch processor • View pending invoice details from data repository

• View pending dispatch details from data repository • Capture invoice details • Capture dispatch details • Build invoice file • Build dispatch file • Commit invoice/dispatch details • Access invoice file • Access dispatch file
Integration • Connect to data repository • Extract invoice data • Extract dispatch data • Commit data to data repository

Site/Application administration
• Login
• Register
• Capture details
  ○ User address details
  ○ Map profile
• Select OEM prime customers
• Update details
  ○ User OEM prime customers
  ○ Map profile
• List details
  ○ Map profile
  ○ Map download
• Launch application

Table 3: overview of Bridge elements

7: Current status

Some proof of concept preliminary work has already been carried out; the result was a Java Swing application that was delivered (distributed) to clients through the Java Web Start launcher (Java, 2004). The main purpose of the application was, given two sources of information: purchase order or invoice/dispatch data and a map file. The application contained the logic to generate invoice/dispatch flat files (in accordance to the Airbus specification). The application also enabled users to view OEM prime and translated purchase orders. The elements of the Bridge against the current functionality of the proof of concept can be seen in Table 4, a detailed discussion of the proof of concept application can be found in Appendix A.

Element	Features
Upload selected file	Select files

	• Dialog to select files (e-mailed purchase orders, translated purchase orders)
Views	Viewer • View translated purchase orders (txt)
Airbus purchase order • Extract identified elements for the purchase order text file • Display contents • Print (hard copy) contents	Interpret map • Translate e-mail purchase orders to XML files
Exostar xml viewer • View selected xml file in a tree structure • Select identified elements from xml file • Test view (HTML view of file contents) • Generate xml file (XML file of file contents • Generate xsl file used in translating the xml file • View and amend xsl file • Save amended xsl file	Viewer • View translated purchase orders (xml)
Invoice/Dispatch processor • View pending invoice details from data repository • View pending dispatch details from data repository • Capture invoice details • Capture dispatch details • Build invoice file • Build dispatch file • Commit invoice/dispatch details • Access invoice file • Access dispatch file	Interpret map • Generate invoices • Generate dispatch advice Email • Email invoice and dispatch files Retrieve map • Invoice • Purchase orders • Dispatch advise • Supplier details • Supplier details for invoice files • Customer details
Integration • Connect to data repository • Extract invoice data • Extract dispatch data • Commit data to data repository	

Site/Application administration
• Login
• Register
• Capture details
  ○ User address details
  ○ Map profile
• Select OEM prime customers
• Update details
  ○ User OEM prime customers
  ○ Map profile
• List details
  ○ Map profile
	Web site developed using Java Server Pages and Java Servlets

○ Map download • Launch application	

Table 4: Proof of concept features list

Appendix C

Case Study Two Project Documents

0 Background Info.

The purpose of this document is to define from the user's perspective, how it is intended that a system should be developed to Aerogistics Ltd and AiMeS requirements.

1.1 Business Problem To Be Solved

Single small medium sized enterprises (SMEs) purchasing consumable products from suppliers tend to pay higher prices than larger companies. It is the intention of Aerogistics, via the Procuro System to group all of these SMEs and effectively group the companies in a large buying club which would then gain the lower prices for goods associated with larger companies. Deals have already been completed with major consumable product suppliers. These deals have culminated in lower prices being achieved for products bought through the Procuro system. Essentially, Procuro will allow a user to buy products in one place (Procuro and its large catalogue, constituted from several smaller supplier catalogues) from a number of suppliers. The one-stop-shop benefit is further enhanced by the lower prices mentioned previously.

Therefore the fundamental function of the system will be to hold a large catalogue (made up from several smaller supplier catalogues). The catalogue will enable users to browse the system for any products sold by any of the smaller catalogues (which look like one large catalogue to the end user). The basic problem to be solved to this end is to create a system which can facilitate this.

'Customer Users' of the system will be the 'buyers' (people who purchase items on behalf of their company). 'Administrative users' will be the Aerogistics staff.

Customer users will need to use the system in order to purchase products i.e. create a Purchase Order (PO) or Blanket Purchase Order (BPO) from the Procuro catalogue at the low prices established by the Aerogistics company. Customer uses will also need to use the system to produce a 'Request for Quote' (RFQ) which will then automatically be sent to a pre-defined list of suppliers based on certain criteria.

Some customer users will only use the system as a price list.

To clarify;
Purchase Order (PO) can be defined as - Information sent to a vendor to request product or service; typically includes item, item code, item source, due date, quantity, price, discounts, vendor information, and ship-to information.
Request for Quote (RFQ) – A document used to solicit vendor responses when a product has been selected and price quotations are needed from several vendors.
When the 'large catalogue' is mentioned, it refers to the catalogue displayed by the Procuro

system. Customer users will see this as one large catalogue; however, the 'large catalogue' will be made up from a number of smaller product catalogue sourced from a number of suppliers.

To summarize the benefits of the business case and thus the validity of the project:

- Suppliers to Procuro sell more products.
- Procuro customers receive lower cost products.
- Aerogistics take a rebate on the amount of money saved by the Procuro customers.

1.2 High Level System Definition

The solution is defined to allow Aerogistics Ltd's customers a central point to access a concatenated catalogue (large catalogue made up from a number of smaller supplier product catalogues) of consumables to actively purchase products at lower prices due to an aggregation of procurement from all of Aerogistics' customers. The solution will also offer a place for customers of the system to post Respond for Quotes (RFQs) to multiple potential suppliers.

All customer users of the system will have secure access to the system and will be restricted to viewing data from their organisation only. Administrator users will have access to all parts of the system.

Customer users of the system will be given functionality to:

- Search concatenated supplier catalogues and generate Purchase Orders (Pos).
- Have a quick buy facility to allow customers to buy products by entering only product numbers.
- Complete PO transactions online and print them if required.
- Complete BPO transactions online and print them if required.
- Compose Requests for Quotes and send them automatically via Email and print them if required.
- Store favourite products to allow users to quickly add these products to a PO.
- Maintain their own accounts i.e. (view, add, edit, delete)
    - View, add, edit, delete registered delivery and invoices addresses etc.
    - view, add, and edit an archive of past Pos
    - view an archive of past RFQs

Administrator users of the system will be given functionality to:

- View, add, edit, delete user accounts including administrator accounts.
- View, add, edit, delete multiple suppliers' product catalogues
- View, add, edit, delete a range of management reports. (defined in

more detail in section 3.2.2.3)

1.3 Benefits summary

The operational benefits of this solution to Aerogistics Ltd and their user base will be:

- A concatenated catalogue of suppliers' catalogues for consumables and raw materials allowing a 'one stop shop' for cut price goods thanks to a system of aggregated procurement.
- An RFQ facility will allow organisations to more effectively reach more potential suppliers via an e-Community of pre-approved suppliers.
- (Second version of the solution) Raw materials availability will allow SMEs access to raw materials visibility of stock, lead time and back order information where they previously would have had no access.
- Aerogistics management will have the ability to produce reports on all transactions on the solution. This will enable them as a company to better serve the customers of the system and produce better deals from the end suppliers via real-time data from the system. Reports would include on-going data analysis.

1.4 Document Purpose

Functional requirements and non-functional requirements are laid out in this document. Functional requirements are defined as the functionality to support business processes (what the system will be tasked with doing). Non-functional requirements are non-tangible aspects of the system such as response times and stresses, as well as number of concurrent users.

1.5 Project Vision

The vision for the project is the creation of an online e-Procurement system which will allow aggregated procurement of a concatenated catalogue from multiple suppliers for consumables and raw materials. The solution will also contain an RFQ facility which will allow users to add RFQs (adding RFQs is the limit of this particular functionality with regards to the system at this time.)

1.6 Solution Overview

The solution will be developed as a 'fully functional live' web service in two phases of development. The first phase will be to develop a version of the system which will deal with consumables and raw materials catalogues. Once this phase of development has been completed, the project board will likely have suggested improvements. The second phase of development will then be to improve phase

one and also add facilities to deal with generating reports and integration with Aventa System of Redthorn Company which is one of customers of Aerogistics.

The proposed solution for phase one will provide functionality in six main areas:

- Concatenated consumables catalogue
- Concatenated raw materials catalogue
- Request for quotes facility
- Process purchase orders facility
- Process blanket purchase orders facility
- Administration functionality

Users of the proposed solution will comprise of Aerogistics management and organisations wishing to achieve lower prices on consumable products and raw materials via an aggregated e-Procurement platform.

It has been identified that this functionality may be of particular relevance to SMEs looking to have 'a bigger voice with suppliers'.

The raw materials version of the solution will appeal to the SMEs by giving them a visibility of raw material availability which they have not had and require in order to more effectively run their businesses. Currently there is a limited amount of raw material on the market, larger companies have priority on this material and take precedence over smaller companies who actually have orders in place. Procuro will aggregate the buying of these raw materials which will in turn give the SMEs an increased level of service due to the increased buying power of the smaller companies.

1.7 Assumptions

The design in this document is based upon AiMeS' current understanding of business processes. Where further detail is collected in the two phases of development for this project, the design may require modification.

Catalogues will be imported in to the system using XML. The structure of the catalogues will follow:

- Image
- Datasheet
- Supplier
- Supplier Product Code
- Product Description
- Manufacturer Name
- Manufacturer Part Code
- Price
- Specification

- Type
- Size/Description
- Release Approval body
- Condition
- Certification available
- Testing Certification
- Grade of finish
- Supplier Stock (not compulsory)
- Back order quantity (not compulsory)
- Due Date (not compulsory)
- Standard Lead Time (not compulsory)

- Catalogues will contain a number of categories which relate to product types. All products will have an attributed category. The Categories will be as follows:
  - Abrasives
  - Electrical
  - Health & Safety
  - Maintenance & Repair
  - Metal Working
  - Office, Audio Visual, IT
  - Process Control & Automation
  - Storage Handling & Workshop
  - Test Equipment
  - Air Tools
  - Hand Tools
  - Machine Tools
  - Power Tools
  - Welding
  - Adhesives
  - Lubricants
  - Stationary
  - Janitorial
  - P.P.E
  - Raw Material
  - Paint

1.8 Dependencies

The Procuro system will be dependent upon the construction of several supplier catalogues and their re-formatting into a common format as defined in the assumptions (1.7) part of this document. The dependency occurs in the form of parser programs/drivers which will need to be written for each supplier catalogue. The parsers/drivers will be required to take a file of types including xls, mdb, pdf etc and re-format them in a way as directed by AIMES for each catalogue. The end result should be an XML file for each supplier catalogue which will then be used by the Procuro system as a separate supplier catalogue. These parser programs are going to be separate entities from the Procuro system but do demonstrate its dependency. The parsers will be on a different quote so should not be included in the Procuro quote.

Any delay in the development of these will have a direct impact on the delivery time of the system to our client.

It is likely that the catalogues will be updated monthly (approx.). Depending on the number of changes, individual items will be added or deleted, or indeed; the whole supplier catalogue will be replaced.

1.9 Definitions – Glossary

PO – Purchase Order

RFQ – Request for quote

BPO - Blanket Purchase Order

2.0 Technical Architecture

2.1 Software features

It is envisaged that phase 1 will be an application developed using component based technologies. The choice of technology in this phase is to develop a solution using ASP.NET web technologies.

2.3 Hardware features

The first phase of the proposed solution will initially be hosted at the AiMeS hosting facility and will comprise of the setup illustrated in the following diagram seen below. The Oracle database server is attached to a 12 disk RAID array for the physical data storage. This is protected behind a firewall to the application and web servers, which are all Windows 2003 Servers.

2.4 Software architecture and system context

This solution envisages the development of an ASP.NET web service hosted on the Windows 2003 Platform. Oracle 10g will be used as the core database, providing a secure, reliable and highly scalable enterprise solution.

3.1 Non Functional Requirements

3.1.1 Usability

Requirement No.	Description
3.1.1.1	Improved usability from previous version of Procuro, including more intuitive forms and faster catalogue searching. The maximum catalogue search time should be 3.5 seconds. The intuitiveness of the forms will be decided upon receipt of the high level design and signed off by the client; in this case Aerogistics Ltd.
3.1.1.2	Easy to use navigation system for searching through the concatenated catalogues. The ease of use of the navigation system will be decided upon receipt of the high level design and signed off by the client; in this case Aerogistics Ltd.
3.1.1.3	Improved speed (response times) / reliability. 3.5 second delay between screen changes on average.

3.1.2 Volumetrics

Requirement No.	Description
3.1.2.1	The database should suffer no significant performance lag when it contains up to 1.5million product records. (3.5 seconds should be the maximum time taken for the system to respond to the user regardless of the number of records held in the database. This is based on using a 512Kbps internet connection.)
3.1.2.2	The system should be able to handle over 3000 customer users and 15 administrative users.
3.1.2.3	The system should suffer no significant performance degradation when 1000 concurrent users are on the system and are searching the catalogues with multiple queries. (3.5 seconds response times max.)
3.1.2.4	In order to not only verify the respond time less than 3.5 seconds but also facilitate to track original data, the database should be divided into two sub-databases: • Live Database: it stores the latest data, including the following: o the latest version of each Draft PO, Sent PO and Completed PO o the latest version of each Draft, Live, Exceeded, Expired and Completed BPO

	○ *the latest version of each Draft, Sent, Replied RFQ* *With the growth of the Live Database, in order to ensure the respond time less than 3.5 second,* historical data will be transferred to another database every 2 years. • Archived Database: it contains original data, including the following: ○ Each version of amended POs in "Sent" status ○ Each version of amended BPOs in "Live" status With the growth of the Archived Database, in order to ensure the respond time less than 3.5 seconds, historical data will be transferred to another database every 2 years.

3.1.3 Look and Feel

Requirement No.	Description
3.1.3.1	Consistent look and feel to be accomplished by employing a clear and easy to use web template across all aspects of the proposed solution.
3.1.3.2	Corporate presence to be maintained throughout by use of a logo in the design of the web template.
3.1.3.3	Site navigation to be accommodated using a navigation panel located in a single area throughout the application. The panel must provide access to all relevant areas of the application at all times. The panel will include data validation prompts confirming a user's wish to move to a different part of the application should they already have a form on screen that includes unsaved data etc.
3.1.3.4	The use of the 'browser back button' must not produce 'page cannot be displayed' issues. Should a user click their browser back button, the solution must not lose any unsaved data or display an unexpected Internet Explorer error.
3.1.3.5	The solution must be compatible with all major web browsers. The site design and functionality must remain identical regardless of the browser used to view the solution. Such browsers include: • Internet Explorer • Mozilla based browsers such as Netscape Navigator, Opera and Firefox
3.1.3.6	The solution will provide a user login function whilst also containing basic details and a corporate presence matching the rest of the system for interested parties.

3.1.4 Data integrity Requirements

3.1.4.1	Customer users must only be allowed to view and manipulate their own data.

3.1.4.2	Customer administrators must only be allowed to view and manipulate their own data and that of users from the same organization.

3.1.5 Security Requirements

3.1.5.1	Once a user has logged in to use the system, all data transactions will take place using an encrypted connection known as 'Secure Socket Layer session'. This requirement provides security levels common to those used in most online banking and shopping systems.
3.1.5.2	All users will have the ability to change their passwords to aid memorisation.
3.1.5.3	The solution must allow for automated retrieval of lost usernames and passwords.
3.1.5.4	The solution will not automatically log out any users who are logged in for any amount of time.
3.1.5.5	Access to secure areas of the site will be prevented to users who have not logged in. For example, a user who has bookmarked a secure area of the site will be required to log in before being able to access that page.

3.1.6 Technical Requirements

3.1.6.1	The solution must be hosted on servers that are adequately secured using firewalls, anti-virus protection and backup procedures.
3.1.6.2	Availability must be insured so that the solution is always usable during projected peaks and troughs of demand.

3.2 Functional Requirements

3.2.1 High Level Customer User Requirements

Requirement No.	Description
3.2.1.0	User authentication - Users require secure access to sensitive data. Authorised users require a username/password with a facility to retrieve lost authentication data.
3.2.1.1	Account maintenance (view, add, edit, delete account information) - A facility to view and update current account information. This information will include: unlimited number of delivery addresses, unlimited number of invoice addresses, General Contact details.
3.2.1.2	Customer Administrator Facility: A facility to allow Customer Administrators to manage all PO, BPO, and RFQ whichever is created by their own or

	other users in their own organizations. In other words, Normal Customers can ask Customer Administrators to amend or delete any PO, BPO, and RFQ for them.
3.2.1.3	RFQ Facility - A facility to allow customers to fill in an RFQ form and email to suppliers selected by category.
3.2.1.4	Favourite Purchase Items - A facility to allow customers to add their favourite items (selected by themselves) to be stored so that they can quickly be selected and added to a Purchase Order.
3.2.1.5	Aggregated Catalogue - A large aggregated catalogue made up from a number of suppliers' catalogues. From the catalogue, a customer will be able to search for Purchase Items and add them to a Purchase Order and a Blanket Purchase Order if required.
3.2.1.6	Generate PO (shopping cart) - A facility to allow customers to view the purchase items they have selected. The facility should separate the Items and group them by supplier. Customers' own PO numbers should be able to be input on each PO. A notes facility should also allow notes to be written next to every Purchase Item.
3.2.1.7	Generate Blanket PO – A facility to allow customers to produce blanket POs indicating to suppliers a commitment to purchase a certain amount of goods over a defined period of time.

3.2.1.1 Customer – Manage Accounts Requirements

3.2.1.1.1	Should only be accessible by customer users.
3.2.1.1.2	There are two sub-categories of customer users as follow: • Customer Administrator They can do the following: o They can manage their own user accounts (see details in Point 3.2.1.1.3). o They can add, update, and delete Normal Customers in their own Organizations. In other words, they can manage other user accounts in their Organizations. o They can view, add and update any PO, BPO, and RFQ which are created by their own and delete draft PO, BPO and RFQ. o They can view, add and update any PO, BPO, and RFQ in their own Organizations which are created by other users, and delete draft PO, BPO and RFQs. • Normal Customer They can do the following: o They can manage their own user accounts (see details in Point 3.2.1.1.3). o They can view, add and update any PO, BPO, and RFQ which are created by their own, and delete draft PO, BPO and RFQ.
3.2.1.1.3	Users will be able to manage (view, add, edit, delete) their account details. Their details are: • Company Name • Login Name • Password

	• General Contact Name • General Contact Number • Secondary Contact Name • Secondary Contact Number • Unlimited Invoice Addresses • Unlimited Delivery Addresses • Unlimited 'Department Codes' • Enable System Administrators to save extra discount rates to the account. (This data should not be displayed to customer users, including Customer Administrators and Normal Customers.) All this information should be editable. The user should be able to view, add, edit and delete invoice addresses and delivery addresses

3.2.1.2 Customer – Customer Administrator Requirements

3.2.1.2.1	Should only be accessible by Customer Administrator.
3.2.1.2.2	Customer Administrators can do the followings: • View all PO, BPO, and RFQ in their own organizations. • Update all PO, BPO, and RFQ in their own organizations. • Delete any draft PO, BPO, and RFQ in their own organizations. In particular, Normal Customers can do the followings: • View all PO, BPO, and RFQ which are created by them. • Update all PO, BPO, and RFQ which are created by them. • Delete any draft PO, BPO, and RFQ which are created by them. (Note: • Please refer to Point 3.2.1.1 "Customer – Manage Accounts Requirements". • The difference on operation privilege between Customer Administrators and Normal Customers should be noticed!)
3.2.1.2.3	The functionality should be accessed through "Administration" Part in User Interface.

3.2.1.3 Customer – Requests For Quotes Requirements

3.2.1.3.1	Should only be accessible by customer users.

3.2.1.3.2	*Any Customer Users (i.e. Customer Administrator, and Normal Customer) should be able to create and view RFQ. (Please see details in Point 3.2.1.2 for the different privilege for the two types of customer users.)* All RFQs should be stored (see details in Point 3.1.2.4 for what kind of database will be chosen automatically by the system for storing RFQ).
3.2.1.3.3	Users should be able to write an RFQ and attach some associated files (such as diagrams etc) to the RFQ. For each line item, the users should be able to select from a list categories. (From the categories chosen, the system selects the list of email address that each line item will be sent to. This email address should be editable by administrative users.) Whilst there can be multiple categories per RFQ, there can only be one category per line item. • Each requested line item will be assigned only one category, multiple suppliers could be specific. • For each requested line item, it should be specified its own required date. • For each requested line item, the buyer will have the flexibility to specify a UNIT for it by manually filling in. • Any attachments will be related to each requested line item, not the over all RFQ making the suppliers receiving more well organized information for the item. • An RFQ email template is assigned so that the format of the outgoing RFQ is improved. (Please see details in Point 3.2.1.3.4 "Customer – Request For Quotes Requirements".) • When the supplier receives the RFQ and replies to it, he will be able to input detailed information for each requested line item by filling in the text boxes in the a pop up window, opened by a link in the email.
3.2.1.3.4	RFQ Email Template: **Subject:** Procuro enquiry **[code]** for [buyer **organisation name**] **Text:** The following item(s) could not be found in the online Procuro catalogue. Please advise your best price and delivery for: **[Quantity]** **[Units]** of **[Description]**, category **[Category]**, required date **[Required Date]** (for each line item in a RFQ, the information should be displayed in the RFQ Email.) Further details can be found in the attached documents **(Optional)** If you require any further information, please contact **[user name]** on **[Telephone number]** or e-mail to **[e-mail address]**. Please respond to this e-mail within 24 hours and in your response, you **must** include: The Procuro enquiry code and your company name as the subject

	Description (including any sizes, specifications, part numbers, manufacturers etc where applicable) Each price Leadtime Quantity Units Any approval details Any MOQs Any delivery charges Any additional notes If you wish this item to be added to your standard catalogue on Procuro, please contact Aerogistics Ltd. Thank you, **Procuro Administration**
3.2.1.3.5	Users should have their RFQs automatically archived within the system. They should be able to add, view, alter/re-send, and delete them. In particular, only "Draft" RFQ can be deleted.
3.2.1.3.6	RFQ Process & Status (see Figure 7 RFQ Process & Status in section 3.3 High Level Process Flow): There are 3 processes for RFQ: • Generate RFQ • Send RFQ • Reply to RFQ Accordingly, there are 3 status for RFQ: • Draft • Sent • Replied Generate RFQ: When a RFQ is generated or created, it will be in "Draft" status. Send RFQ: After confirmed by buyers or administrators, the RFQ will be in "Sent" status. Reply to RFQ: A "Sent" RFQ will be sent to one or more suppliers. Once it has been replied, it will be in "Replied" status.
3.2.1.3.7	Coding Regulations for RFQ: The code of RFQ should begin with "R" and a 10-digit number. For example, the code of a RFQ should be

	R0000000001 and increased by 1 in the future.

3.2.1.4 Customer Favourites Requirements

3.2.1.4.1	Should only be accessible by customer users.
3.2.1.4.2	The favorites will list all of the user's favorite products (as selected by them). The user will be able to select the product, enter a quantity and 'add the products to a purchase order' from viewing their favorites.
3.2.1.4.3	Users will be able to easily remove the products from the favorites list.

3.2.1.5 Customer Catalogue Requirements

3.2.1.5.1	Should only be accessible by customer users.
3.2.1.5.2	The catalogue will offer the user a very simple, fast, intuitive search facility. The search function will consist of one input box enabling the user to enter words and characters which are then compared to every field in the catalogue. All records which contain a field which contain the search words or characters should be displayed. Any products found to match the search criteria which have more than one sub-type (such as diameter, release specification) should have these sub-types included in the search so that the customer can more quickly and easily find exactly what they require. The results should be displayed in order of relevance (most relevant first). The customer user should be able to sort the catalogue by its 'titles' i.e. manufacturer etc. The default search will always search the whole catalogue. If a search of the catalogue produces zero results, the customer user should be prompted to submit an RFQ.
3.2.1.5.3	For each Purchase item which is displayed, the user should be able to select a quantity and 'add the purchase item to a PO'.
3.2.1.5.4	The catalogue should also allow users to add 'found' products to a list of favorite products.
3.2.1.5.5	The catalogue should incorporate a 'fast buy' feature which allows users to enter a list of 'Supplier Product Code' and 'quantities'. This will enable users to quickly purchase products which they know the Product ID for.
3.2.1.5.6	Once a set of search results are displayed, the user should be able to use a 'search within' facility which allows users to search only within the displayed results of their last search. This should be kept separate from the central search facility.
3.2.1.5.7	The customer users should be able to use the catalogue requirements from any part of the system.
3.2.1.5.8	Products within the catalogue will belong to a category. The user should be able to select a category for searching or browsing but by default the system should search the whole catalogue (all catalogues available to that customer user).
3.2.1.5.9	A possibility could be for an advanced search where the user can input more specific search requirements such as 'search only within specified categories' etc.
3.2.1.5.10	The users should be able to apply a filter to all results. The filters should include: manufacturer, supplier, category, and release specification.

3.2.1.5.11	The catalogue structure is defined in section 1.7.

3.2.1.6 Customer – Generate Purchase Order Requirements

3.2.1.6.1	Should only be accessible by customer users.
3.2.1.6.2	Any Customer Users (i.e. Customer Administrator, and Normal Customer) should be able to create PO. (Please see details in Point 3.2.1.2 for the different privilege for the two types of customer users.) Once the user has added products from the catalogues to a PO, they should be able to view the PO and confirm it. All POs should be stored (see details in Point 3.1.2.4 for what kind of database will be chosen automatically by the system for storing PO).
3.2.1.6.3	The PO will display: • A delivery address from the list of delivery addresses associated with the user. • An invoice address from the list of invoice addresses associated with the user. • The customer's own purchase order number • All products will be grouped by 'supplier'. • All products will have a '(planned) quantity' displayed next to them, this should be editable. • There are 5 additional types of quantities for each product: o Delivered quantity o Rejected quantity o Cancelled quantity o Not-delivered quantity This field will be filled in automatically by the system. o Auto-delivered quantity This field will be filled in automatically by system. • Each product (line item) should have its own Status. There are 4 status as below: o Undelivered o Partly delivered o Completed o Auto-completed • Each product should have own due date. • All products should have a notes box next to them so that the user can add any notes they wish. • The PO should display a Sub-total under each group (by supplier) of products. The equation for COST should be followed as below:

	*Cost=Price*Quantity*(1-Supplier.Discount)*(1-Product.Discount)* • *A grand total for all products should also be displayed.* • The user will be able to print the purchase order. • The user should have a facility to send the PO electronically to the suppliers. When the users select this option, the system should send an email order to the different suppliers including only the products which are associated with that supplier.
3.2.1.6.4	When generating a PO, the customer user should be able to select from a list of 'departments' (A list of department codes set by the user in Point 3.2.1.1 "Customer – Manage Accounts Requirements"). The user should also be able to select a 'none' option for a department code for when the user wishes not to specify a 'department'.
3.2.1.6.5	Relationship between Item in PO and BPO: First, details of items are explained as below: In Point 3.2.1.6.3 "Customer – Generate Purchase Order Requirements", the types of quantity and status of an item have been defined. Detailed descriptions are explained as follows: • Types of Quantity o (Planned) Quantity This quantity is to record how many to be planned to receive (how many are ordered). o Delivered Quantity It records the quantity which has been delivered by suppliers. o Rejected Quantity It records the quantity which has been rejected during the delivery procedure. o Cancelled Quantity It records the quantity which has been cancelled to deliver by suppliers. o Not-delivered Quantity It records the quantity which has not been delivered by suppliers. o Auto-delivered Quantity It records the quantity which has been converted into "completed" by system after 1 month of the due date of the item. • Status o Undelivered When "Not-delivered Quantity" is equal to "Planned Quantity", the status of the item is in "Undelivered". o Partly Delivered Once the Not-delivered Quantity does not equal the Planned Quantity and the Not-delivered Quantity greater than "zero", the status of the item will be in "Partly Delivered". o Completed

	This status is one of the final statuses of an item. It is executed manually by users. When "Not-delivered quantity" is equal to zero, the status of item is in "Completed". When an item is in the "Completed" final status, it can not be amended any more. o Auto-completed It is one of the final statuses of an item. It is executed automatically by system. When an item is in the final status, it cannot be amended any more. After 1 month of the due date of an item, the system will automatically convert its status into "Auto-completed". In this case, the item should be tagged with the number of "Auto-delivered Quantity". Moreover, since the status of the item is already in final status, it can not be amended any more. Then, relationship between the items in a PO and the BPO are detailed as following: When the status of all line items in a PO has been in final statuses (i.e. Completed Status, and Auto-completed Status), the status of the PO will be automatically converted into "Completed" status. Otherwise, the PO would stay in "Sent" status. Moreover, in a PO, if some of line items have been in final statuses, even though the status of the PO has been in "Sent" status, these line items can not be amended any more. Once, the PO is in "Completed" Status, it will not be changed any more. More frankly, when a PO is in "Draft" Status, it can be amended. When it is in "Sent" status, it still can be amended except system information about PO. When it is in "Completed" status, it will not be changed any more.
3.2.1.6.6	Relationship between PO and BPO: The line item of a PO can come from a BPO. Accordingly, the source of the line item should be specified as "BPO", and the "Planned Quantity" of the line item in the PO should be initially deducted from the BPO. When the status of the item changes into one of final statuses (i.e. Completed, and Auto-completed), the Left Quantity of the items in the BPO should be finally modified respectively. Additionally, the BPO can link to the POs in order to find out which item has been referred and how many quantity of the item has been converted into "Auto-completed" by the system. In particular, the operation for deducting items' quantity from BPO is triggered by one or more associated "Sent" POs. If amendments to items' quantity in the associated "Sent" PO happen, the corresponding amendments should be made to the BPO. When the related POs have been converted into "Completed" status, the "Left Quantity" and "Delivered Quantity" of items in BPO will be adjusted respectively.
3.2.1.6.7	Coding Regulations for PO: • The code of PO should begin with "P" and a 10-digit number. For example, the code of a PO should be P0000000001 and increased by 1 in the future. • After amended with items' records (e.g. items' due dates and quantity have been modified), the PO should be

	recorded the version number, i.e. P0000000001_v1. Here, "v1" means version 1 which refers to the revision time of the PO is 1. The original PO should be saved as "Archived" to be viewed later on.
3.2.1.6.8	PO Process & Status (see Figure 5 PO Process & Status in section 3.3 High Level Process Flow): There are 6 processes related to a PO: • Generate PO • Send PO • Amend PO • Archive PO • Lock & Unlock PO • Complete PO Correspondingly, there are 5 status related to a PO: • Draft • Sent o Locked o Unlocked • Archived • Completed: it is the Final Status of PO. <u>Generate PO</u>: When a PO is generated or created, it is in "Draft" status. In the "Draft" status, the default setting about how to inform suppliers in the future is by email. <u>Send PO</u>: When submitted after confirmation by creators (i.e. buyers or administrators), the PO will be in "Sent" status. When a PO is in "Sent" status, the quantity of items will be correspondingly deducted from the associated BPOs. Moreover, the part of items which have been in "Completed" or "Auto-completed" status can not be amended any more. <u>Complete PO</u>:

Once the status of all line items in a PO has been in "Completed" or "Auto-completed" status, the PO will be automatically converted into "Completed" status. Otherwise, the PO should be still in "Sent" status.

In the "Completed" PO, the quantity of each item in the associated BPO will be adjusted respectively according to the "Delivered Quantity" in the PO.

Amend PO:

While a PO is in "Draft" or "Sent" status, it can be amended.

Once users confirm to amend a "Sent" PO, the PO will be locked automatically by the system. In other words, once the PO has been locked, it will be unavailable for users to update each type of quantities of items. Until users confirm their modifications, they can update the quantities (e.g. "Delivered Quantity", "Rejected Quantity", and so on) of items since the PO has been unlocked.

Generally, the creators (i.e. buyers or administrators) want to modify the contents in the PO which is already in "Sent" status. After the modifications are confirmed, the PO should still be in "Sent" status. During the procedure, the PO should be in "Sent" status all along.

Users can add items, delete new added-items, update items' quantity, update items' due date and add notes, but can not edit the items which were automatically changed to "Auto-completed" by the system one month after their due dates.

If the user has forgotten to submit the PO, the PO will be locked and the system should prompt him when he logs in next time.

For Amending PO, the below steps should be followed:

- Click "Amend" button
- System prompts a dialogue window which says whether want to continue amending the PO
- If click "Yes" which means to confirm to amend the PO, the PO can be editable. Moreover, it will be locked by the system.
- Process modification
- When finishing modification, user clicks "Submit" button to confirm the modifications. The PO will be unlocked and simultaneously sent to relevant suppliers.
- If user does not confirm the modifications, the changes will be saved by the system. However, the PO should be

	still in "Locked" status and can not be sent to supplier. Once user logs in next time, the system will remind the user to confirm the modifications to the PO since the PO is still in "Locked" status. Lock & Unlock PO: Once a "Sent" PO is amended without confirmation by users, it will be locked automatically by the system, which means it will be suspended to not allow users to update the quantity of items (i.e. delivered quantity, rejected quantity, and so on). Only if users confirm the modification to the PO, it will be unlocked and can be available to update again. At this stage, if users want to amend BPO related with the PO, the BPO can be amended. Moreover, when amending the associated BPO, the system will remind users that which item can be modified and how many quantity of item can be modified. Archive PO: Once a "Sent" PO is confirmed to be amended, the original one should be save and archived in Archived Database in order to track in the future.

3.2.1.7 Customer – Generate Blanket Purchase Order Requirements

3.2.1.7.1	Should only be accessible by customer users.
3.2.1.7.2	Any Customer Users (i.e. Customer Administrator, and Normal Customer) should be able to create Blanket POs from any products within their catalogues. (Please see details in Point 3.2.1.2 for the different privilege for the two types of customer users.) Once the user has added products from the catalogues to a BPO, they should be able to view the BPO and confirm it. All BPOs should be stored (see details in Point 3.1.2.4 for what kind of database will be chosen automatically by the system for storing BPO).
3.2.1.7.3	The Blanket PO will display: • A delivery address from the list of delivery addresses associated with the user. • An invoice address from the list of invoice addresses associated with the user. • The customer's own blanket purchase order number • All products will be grouped by 'supplier'. • A due date directly associated with each line item in a BPO. • All products will have a "Maximum Cost" displayed next to them, this should be editable. • All products will have a '(Planned) Quantity' displayed next to them, this should be editable.

	• Except in "Draft" status, all products will have 'Left Quantity' and 'Delivered Quantity' displayed next to them, they should be editable automatically by associated POs. • All products will have a 'Status' displayed next to them, this should be editable. • All products should have a notes box next to them so that the user can add any notes they wish. • The user will be able to print the blanket purchase order. • The user should have a facility to send the Blanket PO electronically to the suppliers. When the users select this option, the system should send an email order to the different suppliers including only the products which are associated with that supplier. The email should indicate that it is a Blanket PO with its identified BPO code and not a PO that has been sent to them.
3.2.1.7.4	When generating a Blanket PO, the customer user should be able to select from a list of 'departments' (A list of department codes set by the user in 3.2.1.1 manage accounts requirements). The user should also be able to select a 'none' option for a department code for when the user wishes not to specify a 'department'.
3.2.1.7.5	Customer users will then be able to select a blanket PO and generate POs from the Blanket PO. Products not included within the blanket PO should also be allowed. However, products from within the blanket PO should be logged as being 'removed' from the blanket PO. The blanket PO should then display that the amount left within the blanket PO has been reduced. Once all of the items and their quantities have been purchased via a PO, the blanket PO should be flagged as 'complete'. All emails sent as POs which include items from a Blanket PO should indicate in the 'notes' section that this item was part of a blanket PO and also indicate the blanket PO's identified code.
3.2.1.7.6	Relationship between the items in PO and BPO: First, details of items in BPO are explained as below: In Point 3.2.1.7.3, the types of quantity and status of an item have been defined. Detailed descriptions are explained as follows: • Types of Quantity o (Planned) Quantity This quantity is to record how many to be planned to receive. o Left Quantity It records the quantity which has not been referred by POs. In other words, the Left Quantity is the available quantity which can be referred by other POs in the future. o Delivered Quantity It records the quantity which is from summing the Delivered Quantity of the related POs up. • Status o Undelivered Once the BPO has been sent to suppliers, the status of items in the BPO will be endowed as "Undelivered". o Partly Delivered

	When "Delivered Quantity" is bigger than zero and smaller than "Planned Quantity", the status of item is in "Partly Delivered". o Completed This status is the final status of an item in a BPO. It is triggered and executed automatically by system. When "Left Quantity" is equal to zero and "Delivered Quantity" is equal to "Planned Quantity", the status of item is in "Completed". Then, relationship between items and BPO are detailed as following: When the status of all line items in a BPO has been in final status "Completed", the status of the BPO will be automatically converted into "Completed" status. Moreover, in a BPO, if some of line items have been in final status, even though the status of the BPO has not been in "Completed", they can not be amended any more.
3.2.1.7.7	Relationship between BPO and PO: For details, please see the explanations in Point 3.2.1.6.6 "Customer – Generate Purchase Order Requirements".
3.2.1.7.8	BPO Process and Status (see Figure 6 BPO Process & Status in section 3.3 High Level Process Flow): There are 8 processes related with a BPO: • Generate BPO • Send BPO • Exceed BPO • Expire BPO • Amend BPO • Lock and Unlock BPO • Archive BPO • Complete BPO Accordingly, there are 7 status related with a BPO: • Draft • Live o Locked o Unlocked • Archived • Exceeded • Expired • Completed Generate BPO: When a BPO is generated or created, it is in "Draft" status. Send BPO:

When submitted after confirmation by creators (i.e. buyers or administrators), the BPO will be in "Live" status.

Exceed BPO:

In a BPO, there is a maximum cost already defined as a budget. If the total cost of the BPO beyond it, the BPO will be automatically converted into "Exceeded (on Cost)" status by the system.

Expire BPO:

In a BPO, there is a "Due Date (or Expired Date)" directly related with each line item. If the system date is beyond one of Due Dates, the BPO will be automatically converted into "Expired (on Due Date)" status by the system.

Complete BPO:

BPO's items have own status. If the status of all line items in a BPO has been in "Completed" status, the BPO will be automatically completed with the status of "Completed".

The status of each line item of a BPO will be converted into "Completed" when the Left Quantity is "zero" and "Delivered Quantity" is equal to "Planned Quantity". The Left Quantity of each line item will be deducted and adjusted by the items in associated one or more POs.

Amend BPO:

In a "Draft" and "Live" BPO, it can be amended.

Once users confirm to amend a "Live" BPO, the BPO with its associated POs will be locked automatically by the system. In other words, once the BPO has been locked, it will be unavailable for users to update each type of quantities of items. So does its associated POs. Until users confirm their modifications, they can update the quantities of items of the BPO and the associated POs since the BPO has been unlocked.

There are 2 ways for Amending BPO described as below:

- When a BPO is in "Exceeded" or "Expired" status, it can be amended manually by buyers or administrators. In this case, the BPO will be returned to "Live" status.
- Call it "Amend":
  Generally, the creators (i.e. buyers or administrators) want to modify the BPO which is already in "Live" status. After the modifications are confirmed, the BPO should still be in "Live" status. During the procedure, the BPO should be in "Live" status all along.
  Users can add items, delete new added-items, update items' quantity, update items' due date and add notes. The POs from the BPO in any status can not be edited or delivered when the "Live" BPO is amending. Only if the BPO was submitted by user, all actions revive for BPO and its POs. The system will check the due date between BPO and POs (each POs due dates <= BPO due date) and will also check the quantity between them. If the user has forgotten to submit the BPO, the system should prompt him when he login next time.

For Amending BPO, the below steps should be followed:

	• *Click "Amend" button* • *System prompts a dialogue window which says whether want to continue amending the BPO* • If click "Yes" which means to confirm to amend the BPO, it can be editable. Moreover, the status of the BPO and its associated POs will be in "Locked". • Process modification • When finishing modification, user clicks "Submit" button to confirm the modifications. The BPO and the associated POs will be returned to its original status and simultaneously the BPO will be sent to relevant suppliers. • If user does not confirm the modifications, the changes will be saved by the system. However, the BPO and associated POs should be still in "Locked" status and the BPO can not be sent to supplier. Once user logs in next time, the system will remind the user to confirm the modifications to the BPO since it and associated POs are still in "Locked" status. <u>Lock & Unlock BPO</u>: Once a "Live" BPO is amended without confirmation by users, it will be locked automatically by the system, which means it will be suspended to not allow users to amend it again. Simultaneously, the associated POs should also be locked to disable any modifications to them, but the POs' status should be different from their locked status while they are being amended in themselves. Only if users confirm the updates to the BPO, it will be unlocked and can be amended in the future. Moreover, the associated POs can go back to the original status as well. <u>Archive BPO</u>: Once a "Live" BPO is confirmed to be amended, the original one should be save and archived in Archived Database in order to track in the future.
3.2.1.7.9	Coding Rules for BPO: • The code of BPO should begin with "B" and a 10-digit number. For example, the code of a BPO should be B0000000001 and increased by 1 in the future. • Other coding rules will be similar with PO. (Please see details for PO Coding Regulation in Point 3.2.1.6.7 "Customer – Generate Purchase Order Requirements".)

3.2.2 High Level Administrative User Requirements

Requirement No.	Description
3.2.2.0	User authentication - Users require secure access to sensitive data. Authorised users require a username/password with

	a facility to retrieve lost authentication data.
3.2.2.1	User Configuration - A facility to add/edit/delete users and their own details
3.2.2.2	Catalogue Management - A facility to add/edit/delete supplier catalogues, and singular purchase items.
3.2.2.3	Reporting Tool - A facility to allow users to generate reports on the data held within the system. The facility will allow pre-built templates to be ran and displayed.
3.2.2.4	All POs Administration tools – A facility to allow administrative users to fully search all POs which have passed through the system. The facility should allow the full range of activities to occur with any of the POs.
3.2.2.5	Configure RFQ requirements – A facility to allow administrative users to maintain RFQ categories and email addresses to which RFQs from suppliers will be sent.

3.2.2.1 Administration – Configure Users Requirements

3.2.2.1.1	Should only be accessible only by Administrative users.
3.2.2.1.2	Administrative users should be divided into two categories: • Super Administrator • Administrator They should be able to add users, edit users, and delete users. For Super Administrators, they should be able to delete any users (including super administrators, administrators, and customer users) except themselves. For Administrators, they should be able to delete any users (including administrators, and customer users) except themselves and Super Administrators. Particularly, all delete functions in the system should provide an 'are you sure' message to allow the users to confirm deletions.
3.2.2.1.3	When adding users. The following customer information must be input: • Company Name • Login Name • Password • General Contact Name • General Contact Number • Secondary Contact Name • Secondary Contact Number • Unlimited Invoice Addresses • Unlimited Delivery Addresses • Unlimited 'Department Codes' • Enable administrators to save extra discount rates to the account.

	Administrative users should also be able to add administrative users: The following administrative user information must be input: • Name • Contact Number • Login Name • Password • Position
3.2.2.1.4	Edit users – administrative users should be able to edit users: All user information should be editable.
3.2.2.1.5	A list of customer users should be displayed to administrative users. The administrative users should be able to generate POs and Blanket POs on behalf of the customer.

3.2.2.2 Administration –Catalogue Management Requirements

3.2.2.2.1	Should only be accessible only by Administrative users.
3.2.2.2.2	Should allow administrative users to view catalogues, add catalogues, edit catalogues, and delete catalogues (Catalogue maintenance). Users should be able to view single items, add single items, edit single items, and delete single items. When an item is added or deleted, the administrative user should be able to only allow particular customer users to see the added item. The same occurs when an item is deleted; an administrative user should be able to specify that the item is only removed for particular suppliers.
3.2.2.2.3	Each catalogue will have a supplier name and unlimited email address attributed to it. This information must be editable. Also, each supplier will require a particular email format which should be able to be set-up by the administrative user. This should also be editable at any stage. The exact fields specified in the email will be defined at development stage.
3.2.2.2.4	Customer Users should only be able to have access to catalogues which an administrative user has selected for them from a list of catalogues. This list should be editable by an administrative user at any point. All searches etc for a customer will only be conducted upon the catalogues selected for that customer. Catalogues not selected for a customer user should be totally hidden from them.
3.2.2.2.5	Administrative users should be able to edit the prices for any products within any catalogue. The system should allow the change to a price only to be applied to particular customers.

3.2.2.3 Administration – Reporting Requirements

3.2.2.3.1	Should only be accessible only by Administrative users.
3.2.2.3.2	Should allow administrative users to run a set of pre-set reports: • Total monthly spend by supplier • Level of spend for supplier between dates

	• Total spend by customer
3.2.2.3.3	A reporting tool will allow administrative users to generate their own reports. These reports should not be restricted in any way and allow any reports required to be generated by the user. Users should be able to save the reports they generate and thus add a template to the suite of templates available. The reports should be able to be exported to Excel and HTML.

3.2.2.4 Administration – All POs Administration Tool Requirements

3.2.2.4.1	Should only be accessible only by Administrative users. The users should be able to fully search all of the POs which have gone through the system. The users should be able to carry out all available functions on the POs.
3.2.2.4.2 (refer to 3.2.1.1.4)	In a PO, each line item should be specified its own Due Date. An item's status should be automatically converted into "delivered" by the system 30 days after the item's due date within the system, unless already manually changed. Also, for the items which have not truly delivered, they should be tagged with the quantity converted into "delivered" by the system. Once the status of all line items is in "delivered", the PO will be automatically converted into "Completed" status. Once, the PO is in "Completed" Status, it will not be changed. More frankly, when a PO is in "Draft" Status, its contents can be amended. When it is in "Sent" status, its contents cannot be amended except the ones related with item, e.g. item's quantity (delivered quantity, not delivered quantity, rejected quantity, and not needed quantity), due date, supplier, source, and so on. When it is in "Completed" or "Cancelled" status, it will not be changed any more.

3.2.2.5 Administration – Configure RFQ requirements

3.2.2.5.1	Administrative users should be able to add, edit, view, and delete a list of categories which apply to RFQs. Administrative users should be able to add a list of email addresses to each category. The email address should have a name associated with it for identification purposes. After a customer user produces an RFQ and selects the only one category for each line item, the system should send the RFQ to the appropriate email addresses. If there are more than one category in the RFQ and the email addresses to which the RFQ should be sent is replicated, the system should only send one email to that address.
3.2.2.5.2	An archived list of all RFQs should be stored on the system along with information such as 'sent time', 'username' etc.

Appendix D

Case Study Three Project Document

Definitions

Work Package	A work package is a collection of technical drawings / documents which detail the manufacturing required to create a specific end part (or set of parts). See Appendix B for an example of a drawing. Aerogistics will receive a "Work Package" from a customer. The work package maybe split into smaller packages and sent out to a number of Aerogistics' Suppliers in order to obtain competitive quotations on the cost to manufacture these parts. (e.g. the cost of materials / treatments etc)
Drawing	A technical illustration/blueprint detailing the manufacturing required in order to produce a specific part. One drawing may consist of several parts. Maybe in .pdf or .doc format.
RFQ	Request for Quotation. When Aerogistics receive a work package, each drawing will undergo a technical review to determine what manufacturing operation(s) it requires. Based on this, an RFQ (including the drawings) will be sent to potential suppliers capable of manufacturing the part.
Part	A component required by a customer. Requires manufacturing illustrated in a drawing or detailed in other documents.
Percentage Mark-Up	Once all the quotations for a work package have been received, Aerogistics will choose their preferred quotation(s) and allocate a percentage mark-up (usually 15-20%) to the price before sending it to the customer. i.e. This percentage could be variable by material / treatment etc.
Quotation / Quote	Once a supplier receives and reviews an RFQ, they will decide whether they can perform the manufacturing and if so, submit a "quote" back to Aerogistics detailing the prices they will charge to manufacture the parts / material / treatments etc. This may include partial quotes in that the supplier may not wish to quote on some items.
Quote Status (Dead / Lost / Live / Won / Draft)	These terms apply to quotes that have been sent to the customer and fall into the following categories: ▪ Lost – a "Lost" quote means that the customer has viewed it, but chosen to offer the job to another company. ▪ Live – A "Live" quote is one which is currently active (in the sense that it is neither won nor lost yet.) as the customer is in the process of reviewing the quotation. ▪ Won – A "Won" quote is one where the customer has agreed to commission Aerogistics to facilitate the manufacturing of the work package. ▪ Dead – A "Dead" quote is one which has been abandoned. It is no longer active. ▪ Draft – A "Draft" customer quotation is one that Aerogistics is compiling, but has not yet been sent to the customer.

Breakdown Costs	The supplier will submit a "Price Per Unit" for each part to be manufactured. However, on some occasions, the work required to manufacture a part is "broken down" into discrete pieces of work which can be performed independently. For example, the manufacture of a part could be "broken down" into Machining, Treatment and Materials with individual prices allocated to each. The sum of these costs tends to equal the Price Per Unit.
Query	If a supplier has any questions relating to an RFQ, they should submit a "query" through the system in order to resolve their issue. Responses and queries must be traceable.

1. Background Information

1.1 Business Problem To Be Solved

A key area of Aerogistics' business is to facilitate the manufacturing of parts on behalf of their customers. A customer will issue Aerogistics with a "package" of work to be completed and Aerogistics will source this work from one or more of their approved suppliers at the best possible price.

1.1.1 Summary of Current Process

- Aerogistics will receive a work package from a customer via fax / e-mail / post.
- An Aerogistics engineer will perform a technical review on each drawing within the work package to determine what manufacturing is required to produce the parts depicted.
- An Aerogistics employee will enter initial work package details into a "Work Package" spreadsheet
- Work package drawings and / or related documents are posted onto the Aerogistics website for Suppliers to access
- Based on the technical review findings, another employee will compile a list of suppliers who they view capable of manufacturing the parts
- RFQ(s) (with attached drawings) are composed and faxed / e-mailed / posted to each potential supplier
- Suppliers will review RFQ (and drawings) and e-mail / post / fax their price quotations back to Aerogistics if they wish to be considered for the work
- Aerogistics will call each supplier on a daily basis to remind them of the RFQ
- Once quotations are received, Aerogistics will manually extract the prices into a new spreadsheet to make price comparisons
- Suppliers are usually selected based on the cheapest quotation prices
- An Aerogistics percentage mark-up will be calculated manually
- An Aerogistics quotation will be manually compiled for the customer in another new spreadsheet
- The Aerogistics quotation will then be faxed / e-mailed to the customer

- Customer will review the quotation and decide whether to commission the work to be performed.

1.1.2 Summary of Current Process Issues

- Manually intensive and lengthy spreadsheet driven process with no automation – has led to a proliferation of non-value adding activities
- All information retrieval is manual and paper based
- Duplication of information
- Complex and lengthy chain of communication between Aerogistics and Suppliers.
- Numerous unnecessary steps (e.g. phone calls and e-mails) that lead to inefficiencies and delays can be removed
- No visibility of information – a small number of key Aerogistics' employees possess vital information which is not always shared in a timely fashion.
- No dynamic reporting capability to provide management reports or up-to-date KPI's.
- Compulsory information is often left incomplete and time is wasted locating information that is stored in numerous spreadsheets.

1.2 Project Vision and Benefits Summary

The project vision is to automate the current process, specifically developing an online tendering platform, named AeroTender, which electronically handles all the functions of the tendering process such as storing work packages, sending RFQ's, receiving quotations and analysing best offers.
The solution will provide a 'fully functional live' web service, with the following benefits:

- Removal of multiple spreadsheets
- All data centrally held enabling vital information to be disseminated throughout Aerogistics
- Efficient information exchange with no reliance on key individuals for information
- No duplicated information and data entry (in paper copies and spreadsheets)
- Decreased administration costs and paperwork
- Centralised online system – leading to improved control of RFQ's and quotations
- Clear visibility of all quotations received and real time status of information
- Removal of phone calls

The AeroTender system should be developed to the requirements specified in this document.

1.3 Solution Overview

The proposed solution will provide functionality for Aerogistics and Suppliers in the areas of:

Aerogistics

- A database of suppliers and their capabilities (View / Add / Amend details)
- Entering a new work package
- Uploading zip files of drawings or supporting documents
- Entering drawing / part requirements – (A database of drawings and parts)
- Auto-matching the requirements of drawings / parts to suppliers with the appropriate capabilities
- Reviewing the auto-matched supplier list and editing the supplier selection
- Creating RFQ(s) for work packages to be sent to the suppliers selected
- Submitting a quotation (on behalf of a supplier)
- Comparing all quotations received from suppliers
- Preparing a quotation for a customer – with automated calculations
- Viewing details of existing work packages
- Creating management reports
- Handling enquiries - viewing / responding to supplier enquiries
- Amending / Deleting / Archiving work packages (Administrator only)
- Creating / Amending / Deleting Supplier and General Aerogistics users accounts with usernames and passwords (Administrator only)

Suppliers

- Receiving an RFQ
- Acknowledging receipt of an RFQ and committing a date for response
- Downloading individual / multiple files of drawings or supporting documents as zip files
- Submitting a query
- Receiving a query response
- Submitting a quotation

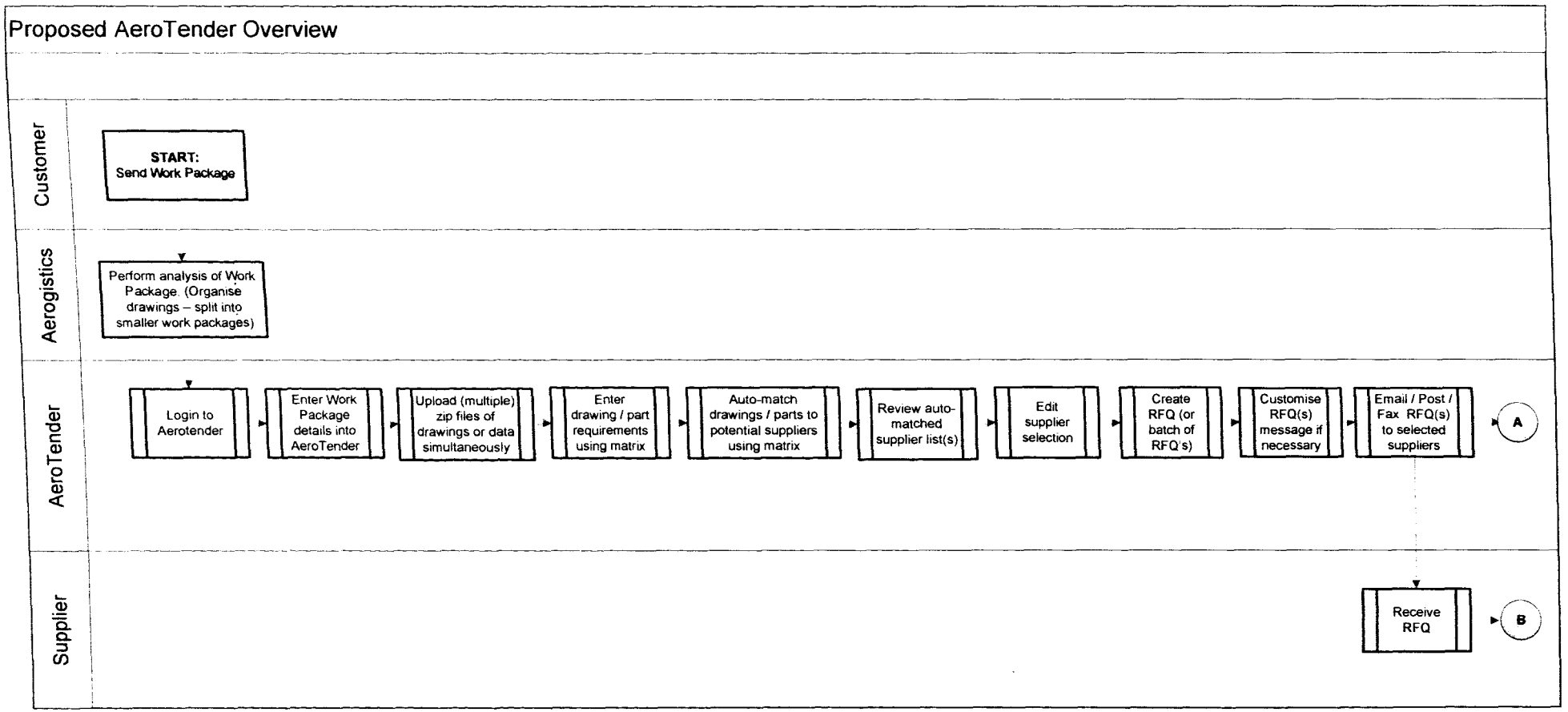


Figure 1- Proposed AeroTender Overview

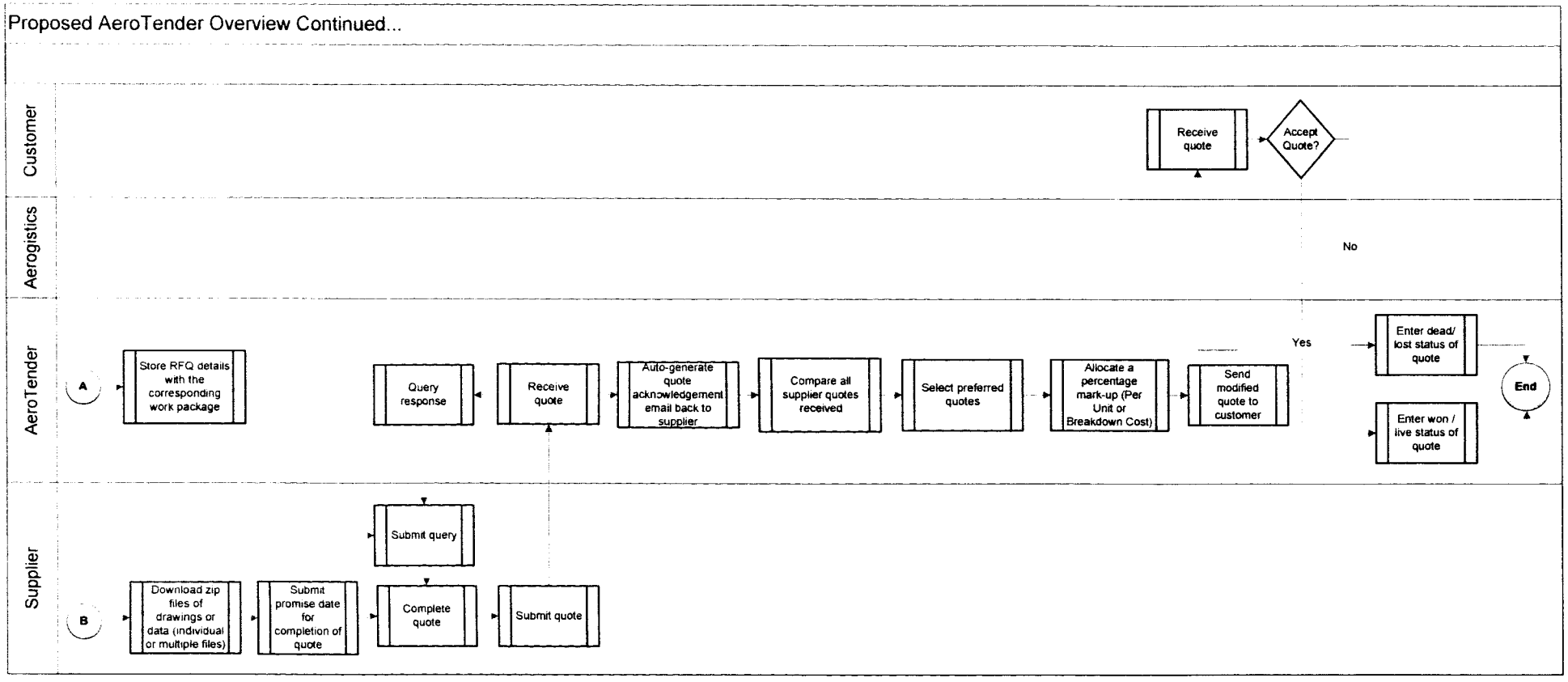


Figure 1- Proposed AeroTender Overview Continued...

1.4 Dependencies

Relevant data from an existing SRM system needs to be transferred as a .csv file and imported into the new AeroTender system. The migration of this data (i.e. names, contacts, addresses and email details of suppliers) will be required for the new process. Once migration of this data has occurred, Aerogistics will need to manually assign the capabilities for each supplier.

Given the current 1mb Internet connection at the Aerogistics site, the system should support the uploading of zip and unzip files through the browser. Files sizes could be as large as **35** mb whatever the file is zip or unzip, but the majority of files tend to be around 2mb.

1.5 Assumptions

The requirements in this document are based upon AIMES' current understanding of Aerogistics business processes. If the business processes change substantially, the requirements may require modification.

The process flow depicted in Figure 1 – "Proposed AeroTender Overview" is how the system is envisaged. It is assumed that this is the complete workflow; however AIMES is willing to discuss any additional functionality that the developer believes will benefit / complement the system.

It is expected that documents e.g. drawings and supporting files, will be stored on the application server in a secure location, due to the number of drawings that will require storage in the AeroTender system.

2. Non Functional Requirements

2.1 Usability

	Description
2.1.1	The system must be intuitive and allow quick searching (Three second response time to searches)
2.1.2	Easy to use navigation system
2.1.3	Fast response times / reliability. A three second delay between screen changes on average.
2.1.4	The use of the 'browser back button' must not produce 'page cannot be displayed' issues. Should a user click their browser back button, the solution must not lose any unsaved data or display an unexpected Internet Explorer error.

2.2 Volumetrics

	Description
2.2.1	The system performance should not be affected when it contains 25,000 drawings (as drawings and supporting documents should not be stored on the database). This is based on an average of 2,000 drawings received on a monthly basis.
2.2.2	Three seconds should be the maximum time taken for the system to respond to user interaction regardless of the number of work packages and drawings held in the system. This is based on using a 512Kbps internet connection.
2.2.3	The system should be able to handle at least 600 suppliers and 7 General Aerogistics staff. (See Administration section of Functional Requirements.)
2.2.4	The system should suffer no significant performance degradation when 300 Suppliers / General Aerogistics staff concurrently access the system. (Three seconds response times max.)

2.3 Look and Feel

	Description
2.3.1	Consistent look and feel to be accomplished by employing a clear and easy to use web template across all aspects of the proposed solution.
2.3.2	Corporate presence to be maintained throughout the system by use of a logo in the design of the web template that should appear on every screen.
2.3.3	Site navigation to be accommodated using a navigation panel located in a single area throughout the application. The panel must provide access to all relevant functionality of the application at all times. The panel will include data validation prompts confirming a user's wish to move to a different part of the application should they already have a form on screen that includes unsaved data etc.
2.3.4	The solution must be compatible with all major web browsers. The site design and functionality must remain identical regardless of the browser used to view the solution. Such browsers include: ▪ Internet Explorer ▪ Mozilla based browsers such as Netscape Navigator, Opera and Firefox
2.3.5	The solution will provide a user login function whilst also containing basic details and a corporate presence matching the rest of the system.

2.4 Data Integrity Requirements

	Description
2.4.1	Users must only be allowed to view and manipulate data relevant to them
2.4.2	For access rights, see Administration section of Functional Requirements
2.4.3	For drawings and related documents e.g. pdf's and .docs not stored on the database, (but on the application server) it must be ensured that these are securely stored and backed-up.

2.5 Security Requirements

	Description
2.5.1	All users will have the ability to change their passwords to aid memorisation.
2.5.2	The solution must allow for automated retrieval of lost usernames and passwords.
2.5.3	The solution will not automatically log out any General Aerogistics staff or supplier users who are logged in for any amount of time.
2.5.4	Access to system functionality will be prevented if users have not logged in. For example, a user who has bookmarked an area of the site will be required to log in before being able to access that page.

3. Functional Requirements

3.1 Administration

	Description
3.1.1	There will be three types of user: ▪ General Aerogistics – (Primary users of main functionality) ▪ Suppliers – (Limited functionality) ▪ Administrator – (Key Aerogistics employee – full access)
3.1.2	An Administrator user will have full access to the system with the capability to: ▪ Create / Amend / Delete Users (both General Aerogistics and Suppliers) ▪ Amend an existing work package ▪ Delete an existing work package ▪ Archive data
3.1.3	Suppliers will have the capability to: ▪ Receive a RFQ ▪ Acknowledge receipt of an RFQ and commit a date for responding with a quote **(Receipt of an RFQ of commit date with e-mail responding)** ▪ Download individual / multiple files of drawings or supporting documents as zip files ▪ Submit a query ▪ Receive a query response ▪ Submit a quote
3.1.4	General Aerogistics will have the general capability to: ▪ Edit their own password ▪ Enter a new work package ▪ Upload zip files of drawings or supporting documents ▪ Enter drawing/part requirements ▪ Review the auto-matched supplier list and edit the supplier selection ▪ Create RFQ(s) for a work package to send to one or more suppliers

	▪ Submit a quote (on behalf of a supplier) ▪ Compare all quotes received from all suppliers ▪ Prepare a quote for a customer ▪ View details of existing work packages ▪ Create management reports ▪ View enquiries from suppliers and respond to enquiries ▪ Maintain suppliers database - add / amend suppliers in the system (names, contacts, addresses, emails, capabilities)
	Functions 3.1.3 – 3.1.4 are described in more detail later in this document.

3.2 Login

	Description
3.2.1	User authentication – Each user will have a unique username and password to gain access to the system.
3.2.2	There will be a single sign-in point for both Aerogistics and Suppliers.
	[Need Confirm] We'll add getting password function in the login page for the user who has forgot the password. Yes this is correct

3.3 Navigation

	Description
3.3.1	The system should contain a standard navigation bar on every screen
3.3.2	The navigation bar should have a consistent layout in every screen
3.3.3	The navigation bar should be tailored for each type of user (e.g. A supplier should only see/access functionality relevant to their tasks).
3.3.4	The navigation bar should provide access to every function available to a particular user

3.4 Supplier Details and Capabilities

	Description
3.4.1	The functionality detailed in 3.4 is only accessible by General Aerogistics and Administrator users
3.4.2	The following detail will be held for each supplier: ▪ 'Company Name' – A text string name of the company (manually enter) ▪ 'Company Code' – An Aerogistics unique alphanumeric supplier identifier (an auto-generated number based on Company Name. Standard naming format will be the first 3 letters of the company name followed by an incremental number. E.g. Aerogistics would be AER1, Aerospace Engineering would be AER2) ▪ 'Contact Name' - A text string name of the main contact within the company (manually enter) ▪ 'Email' – A text string email address – (Cannot add more than 5 email address per company) **[Need Confirm]One supplier can have 5 emails, and max quantities of email is 5, one main e-mail whilst have 4 CC e-mail – Yes this is correct** ▪ 'Phone Number' – A numeric telephone number ▪ Industry **[Need Confirm] It's List Box and can multi-select. – Yes this is correct** o 'Aerospace' – tick box o 'Nuclear' – tick box o 'Oil & Gas' – tick box o 'Pharmaceutical' – tick box o 'Commercial' – tick box o 'Other' – A free type box ▪ Approvals **[Need Confirm] It's List Box and can multi-select – Yes this is correct** o 'Airbus' – tick box o 'Boeing' – tick box o 'Goodrich' – tick box o 'Rolls Royce' – tick box o 'Bombardier' – tick box o 'CAA' – tick box o 'ISO' – tick box ▪ 'Machinist' - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can multi-**

select – Yes this is correct

- mill - large – high
- mill - large – low
- mill - medium – high
- mill - medium – low
- mill - small – high
- mill - small – low
- turn - large – high
- turn - large – low
- turn - medium – high
- turn - medium – low
- turn - small – high
- turn - small – low
- turn & mill - large – high
- turn & mill - large – low
- turn & mill - medium – high
- turn & mill - medium – low
- turn & mill - small – high
- turn & mill - small – low
- Not Applicable

- Fabrication - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct**
  - Large
  - Small
  - Not Applicable
- Assembly - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct**
  - Welding
  - Fastening
  - Not Applicable
- Material - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can multi-**

	select – Yes this is correct ○ Nickel Alloys ○ Stainless Steel ○ Titanium ○ Magnesium ○ Aluminium ○ Carbon Steel ○ Copper ○ Plastic ○ Rubber ○ Mix ○ Not Applicable ▪ Proprietary - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct** ○ AGS ○ See Catalogue ○ Not Applicable ▪ Treatments - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can multi-select – Yes this is correct** ○ K&F ○ Heat Treat ○ Shot Peen ○ Metal Spray ○ Not Applicable ▪ Specialist - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can multi-select – Yes this is correct** ○ Casting ○ Forgings ○ Moulds ○ Plastics ○ Tube Manipulation

	○ Spinning ○ Electron Beam Weld ○ Laser ○ Water Jet ○ Rolling ○ Not Applicable ▪ Springs & Pressings - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can multi-select – Yes this is correct** ○ Flat Springs ○ Coil Springs ○ Pressings ○ Not Applicable ▪ Quality - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct** ○ 0 Low ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 High ▪ Cost - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct** ○ 0 High ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 Low ▪ Delivery - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only**

	single select – Yes this is correct ○ 0 Long L/T ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 Short L/T ▪ Rating - select from drop down menu. Options in drop down are: **[Need Confirm] It's List Box and can only single select – Yes this is correct** ○ 0 Poor ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 Good ▪ Notes – enter manually Aerogistics will maintain suppliers' details. Suppliers can access the "Forget Password" functionality, but they will not maintain their own details.
3.4.3	User should be able to amend existing supplier details
3.4.4	User should be able to add new suppliers
3.4.5	User should be able to search for suppliers. Searches should be based on the following criteria: • Company Code • Company Name • Contact Name • Industry • Approvals • Machinist • Fabrication • Assembly

	• Material • Proprietary • Treatments • Specialist • Springs & Pressings • Quality • Cost • Delivery • Rating
3.4.6	User should have the ability to add additional options to the drop down lists within 3.4.2. Any additions should be mirrored in the matching drop-down menus within 3.7.3 - Drawing/Parts Requirements section
3.4.7	When selecting drop down options, allow multiple selections to be made if necessary. For example, hold "Ctrl" key to make multiple selections.
3.4.8	System should notify the user if a selection from a drop down menu has not been made (to ensure that a choice is always made.) **[Question] Because all selections must be selected, so, should we set all the default selection as "Not Applicable" ? if no appropriate options for user or user do not select a option, the system will be use the default selection. – Yes do this.**

3.5 Enter a New Work Package

	Description
3.5.1	The functionality detailed in 3.5 is only accessible by General Aerogistics and Administrator users
3.5.2	Each work package should include the following details: ▪ 'Work Package Reference' – An Aerogistics unique alphanumeric work package identifier (an auto-generated number) ▪ 'Customer RFQ Reference' - A unique alphanumeric customer reference number (manually entered)

	▪ 'Customer' – A text string name of the customer who sent the work package (a drop down menu of all customers. An "Add" button will allow new customers to be added into the system.) **[Question] What information should be collected for customers? Name, address, telephone, email…., please give us clear description. – Just collect customer name** ▪ 'Date Received' - The date that the work package was received (manually enter or calendar selection – day\month\year format) **[Need Confirm] Date Received can not be later than current date - Yes this is correct** ▪ 'Received By' – A text string name of the person that received the work package (manually enter) ▪ 'Deadline' - The final date that the customer must receive their quotation from Aerogistics (manually enter or calendar selection) - This is not necessarily the deadline Aerogistics pass on to suppliers – Aerogistics may ask suppliers to submit their quote several days before the customer deadline. **[Need Confirm]Customer email will be displayed after customer selected from drop down list – No, do not display customer email** **[Need Confirm]All fields above must be entered - Yes this is correct**
3.5.3	All details entered here should be stored (and displayed where appropriate) in all subsequent areas of the system

3.6 Upload Drawings

	Description
3.6.1	The functionality detailed in 3.6 is only accessible by General Aerogistics and Administrator users
3.6.2	The upload / download process will be as follows: Administrator or General Aerogistics will: 1. Zip individual / multiple drawings or related document files 2. Use web interface to upload zip files for a given work package (When a user is selecting drawings, they should be able to quickly find / search for the desired drawings) **[Question] We can offer the function to sort the drawing list to help find the desire drawing quickly, if you want a search function, please list out the filters. – Put a sort on the drawing list.** 3. A server side application extracts files from zip and stores each file separately (not storing on the database) Suppliers can then:

	4. Download individual files separately 5. Multiple files can be selected easily and downloaded as a zip (also have "Select All" option.
3.6.3	For each work package, user should be able to know what drawings are associated with it
3.6.4	Aerogistics should be able to view and delete uploaded drawings where necessary
3.6.5	Once drawings are uploaded, user can change the name of each drawing if required. **[Need Confirm] user can change the drawing's alias name in the Add Drawing/part page, not at upload Drawing page. - Yes this is correct**

3.7 Add Drawing / Part Requirements

	Description
3.7.1	The functionality detailed in3.7 is only accessible by General Aerogistics and Administrator users
3.7.2	Each drawing may contain one or more parts. User should be able add the part details (described in 3.7.3) on a per drawing basis
3.7.3	User should be able to add the following details for each part: • Part Number – enter manually. System should inform user if number entered already exists in the database. If it already exists, allow the user to select this part and modify the remaining data if necessary **[Need Confirm]The part number is unique within one work package, but it can be same between different work packages - Yes this is correct. But remember that a customer may have requested quotations for a part in different quantities, e.g. Price for Part A at quantity 10 and Part A at quantity 25** ▪ Quantity – enter manually ▪ Supply Complete – tick box **[Need Confirm] If select "Supply Complete" here, when compare all quotations, Aerogistics can select only one supplier's quote for this part. Is this right? -Yes this is correct** **[Need Confirm] The validation for the below drop down menus is the same with the 3.4 section above, is it right? And all the list items can be added by General user, but can't amend. Only admin user can amend and delete when them no used, after the added other users can discover the change -Yes this is correct**

- Industry – select from drop down menu. Options in drop down are:
  - Aerospace
  - Nuclear
  - Oil & Gas
  - Pharmaceutical
  - Commercial
  - Other
  - Not Applicable
- Approvals – select from drop down menu. Options in drop down are:
  - Airbus
  - Boeing
  - Goodrich
  - Rolls Royce
  - Bombardier
  - CAA
  - ISO
  - Not Applicable

Requirement

- Machinist - select from drop down menu. Options in drop down are:
  - mill - large – high
  - mill - large – low
  - mill - medium – high
  - mill - medium – low
  - mill - small – high
  - mill - small – low
  - turn - large – high
  - turn - large – low
  - turn - medium – high
  - turn - medium – low
  - turn - small – high

	○ turn - small – low ○ turn & mill - large – high ○ turn & mill - large – low ○ turn & mill - medium – high ○ turn & mill - medium – low ○ turn & mill - small – high ○ turn & mill - small – low ○ Not Applicable ▪ Fabrication - select from drop down menu. Options in drop down are: ○ Large ○ Small ○ Not Applicable ▪ Assembly - select from drop down menu. Options in drop down are: ○ Welding ○ Fastening ○ Not Applicable ▪ Material - select from drop down menu. Options in drop down are: ○ Nickel Alloys ○ Stainless Steel ○ Titanium ○ Magnesium ○ Aluminium ○ Carbon Steel ○ Copper ○ Plastic ○ Rubber ○ Mix ○ Not Applicable ▪ Proprietary - select from drop down menu. Options in drop down are: ○ AGS ○ See Catalogue

	○ Not Applicable ▪ Treatments - select from drop down menu. Options in drop down are: ○ K&F ○ Heat Treat ○ Shot Peen ○ Metal Spray ○ Not Applicable ▪ Specialist - select from drop down menu. Options in drop down are: ○ Casting ○ Forgings ○ Moulds ○ Plastics ○ Tube Manipulation ○ Spinning ○ Electron Beam Weld ○ Laser ○ Water Jet ○ Rolling ○ Not Applicable ▪ Springs & Pressings - select from drop down menu. Options in drop down are: ○ Flat Springs ○ Coil Springs ○ Pressings ○ Not Applicable Commercial Sensitivity ▪ Quality - select from drop down menu. Options in drop down are: ○ 0 Low ○ 1 ○ 2 ○ 3 ○ 4

	○ 5 High ▪ Cost - select from drop down menu. Options in drop down are: ○ 0 High ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 Low ▪ Delivery - select from drop down menu. Options in drop down are: ○ 0 Long L/T ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 Short L/T ▪ Notes – enter manually There will be a "Reset" button to clear fields.
3.7.4	When selecting drop down options, allow multiple selections to be made if necessary. For example, hold "Ctrl" key to make multiple selections.
3.7.5	System should notify the user if a selection from a drop down menu has not been made (to ensure that a choice is always made.)
3.7.6	User should have the ability to add additional options to the drop down lists without losing previous data. (Any additions should be added to the matching drop down menus in 3.4.2 Supplier Details & Capabilities section.)

3.8 Auto-Match Drawings to Potential Suppliers

	Description

3.8.1	The functionality detailed in 3.8 is only accessible by General Aerogistics and Administrator users
3.8.2	Once the user has entered all the drawing / part requirements for the work package in 3.7.3, the system should be able to automatically match these requirements to suppliers with the corresponding capabilities in the 3.4.2 Supplier Details & Capabilities section. For example, all parts which require an 'Airbus' approval and a Machinist of 'mill-large-high' should be matched to the suppliers that have an 'Airbus' approval and can machine 'Mill-large-high'. A list of all matched suppliers should be generated.
3.8.3	User should be provided with a list of potential suppliers for the work package (or discrete parts of the work package depending on part requirements). For example, if a group of parts require 'Welding' then they may have a different list of potential suppliers than a group of parts that require 'Heat Treat'.
3.8.4	User should be able to review and edit the supplier list(s) generated. For example, accept the suppliers they wish to send an RFQ to and reject suppliers they deem unsuitable.

3.9 Create RFQs

	Description
3.9.1	The functionality detailed in 3.9 is only accessible by General Aerogistics and Administrator
3.9.2	Should allow user to send unique RFQ's to each of the suppliers identified in section 3.8 ("Auto-Match Drawings to Potential Suppliers"): A standard RFQ will be automatically generated for each supplier, with the following details automatically populated: ▪ 'Supplier Name' - The name of the RFQ recipient ▪ 'Work Package Reference'- An Aerogistics unique work package identifier ▪ ~~'Individual RFQ Reference' - A unique RFQ reference number auto-generated~~ – REMOVED! ▪ 'Date Sent Out' - The date that the RFQ is being sent out (automatically display current date – day/month/year format. Read only) ▪ 'Sent Out By' - The user logged into the system responsible for sending the RFQ (Read Only)
3.9.3	Based on the drawings / parts that the suppliers will receive, the e-mail should be auto-populated with the following fields: ▪ Drawings Number(s) o Part Number(s)

	○ Supply Complete (Yes / No) **[Need Confirm] Should above information, Drawing number, Part Number, Supplier Complete, be displayed in the mail? – Yes it should be displayed**
3.9.4	The user will manually enter the following RFQ details: ▪ 'Deadline' - The final date that Aerogistics must receive a quotation from the supplier, manually entered / from calendar and used in later reports as a monitor of supplier performance – (the system should allow late quotes to be received for up to 2 days after the stated deadline date. Once this extra time expires, quotations cannot be received. Aerogistics will only compare quotes and choose their preferred suppliers after this extra time.) ▪ A text area for a personalised message to the suppliers – where General Aerogistics user can state the breakdown costs that suppliers are required to quote on, i.e the fields from the 'Requirements' in section 3.7.3.
3.9.5	The RFQ will be sent to all the e-mail addresses entered for each supplier. It is important that each e-mail recipient can see who else in their organisation has received the RFQ – most likely in the "CC" section of the e-mail. ▪ If no e-mail address is found for a particular supplier, the system should prompt the user to enter one. ▪ **If an e-mail isn't delivered (e.g. misspelt address, technical problem etc) alert sender.** ▪ User should be able to print the RFQ's in a printable and readable format if necessary.
3.9.6	Within each RFQ, the user should be able to view the list of drawings being sent to a supplier.
3.9.7	The email message should always include the default text of: **** This is an automatic e-mail – please DO NOT reply to this e-mail address as it is unattended and we regret your e-mail will not be answered **** All correspondence should be via the "Enquiries" functionality.
3.9.8	Navigation back to the "Auto-Match Drawings to Potential Suppliers" functionality should be possible if any amendments are necessary.
3.9.10	All details entered here should be stored (and displayed where appropriate) in all subsequent areas of the system
3.9.11	The user should be able to print off a RFQ for reference along with details of the suppliers it was sent to – (A pop-up window will display a preview of the RFQ and users can review or print RFQ regardless of whether it is in draft state or already been sent out to customer.)
3.9.12	When supplier receives a RFQ email, it should request the supplier acknowledge receipt of the RFQ and commit a date for response. Possibly do this via a link in the RFQ email which enables the supplier to automatically log into AeroTender and record date they will submit their quote by.(Once a date is entered and submitted, another supplier user from the same

	organization cannot submit a different date.)

3.10 Submit a Quote

	Description
3.10.1	The functionality detailed in 3.10 is only accessible by Suppliers and General Aerogistics and Administrator. (Where necessary, General Aerogistics should be able to log in and submit a quote on behalf of a supplier)
3.10.2	Each supplier should have an AeroTender account with username and password set-up by the Administrator. When a user logs in to submit a quote they should only see information relating to this quotation. No previous quotations should be accessible. Once a quote has been submitted a supplier can only view the quote's details and cannot make any amendments.
3.10.3	User should be able to download / view all their drawings and any other supporting documents User can download individual files or group multiple files. Make all downloads zip files.
3. 10.4	User should be able to quote on each drawing separately. The system should only allow suppliers to quote on drawings and not on any other supporting documentation.
3. 10.5	Each quote should contain the following information: ▪ Supplier Name ▪ Work Package Reference ▪ Drawing Number For each drawing number, the user is provided with: ▪ An option to 'Quote on this drawing' ("Yes" / "No" option – automatically default to Yes) ▪ 'Part Number' – automatically displayed ▪ 'Unit of Measure – an alphanumeric string (manually entered) (e.g. off, kg, m, sqm etc) ▪ 'Quantity' – numerical value (manually entered) ▪ 'Price Per Unit' – currency GBP (manually entered) **[Question] Two decimals are ok? Etc 234.67. -Yes this is correct** ▪ 'Lead-times' – text string (manually entered – a lead-time will always be a number of "days") ▪ 'Observations' – text string (manually entered)
3.10.6	For instances where a drawing contains more than one part the system should provide the user with the different Part Numbers and allow the user to submit multiple quotes per drawing i.e. one quote per part. For example, a user may want to make a quote for Part A and Part B of Drawing 1.

	[Question] Could you say more clear or more details about it? – You have already factored this into the Prototype. It basically means that when a drawing contains more than one part; allow the supplier to see each different part and submit a quotation for each part within the drawing.
3. 10.7	User should be able to enter a: • Supplier Quote Reference – an alphanumeric string (manually entered). This is needed in future if Aerogistics choose to place an order with the supplier and need to reference the quote (This is not a compulsory field, but optional for the supplier to complete.) **[Need Confirm] As discussed during our meeting with Jane and Selina in Beijing, the Supplier Quote Reference can't be input, but will be automatic generated by system. So we'll discard this description. –No, this is not correct. This number will be determined by the supplier from their own records and (if applicable) will be manually entered into the system.**
3.10.8	When entering costs two possible routes should be incorporated into the system: a. User enters a **Price per Unit** – one single price with no Breakdown costs specified. b. User enters a **Breakdown** of costs – the cost split into discrete pieces of work. The user should be able to: o Select Cost Name from a drop down menu (this menu should contain all the options under 'Requirements' in section 3.7.3). o Enter the Price associated with it (in £s). E.g. Milling at £10. The user should be able to enter multiple breakdown costs. E.g. Milling at £10, Treatment at £4 etc. Both of these options are done on a per part basis.
3. 10.9	The user should be able to submit different quotes for different quantity amounts. For example, the system should allow the user to enter a quote for Part A at quantities of 10 and 50.
3. 10.10	The system should ensure that the supplier quotes on **all** their drawings, unless they have selected "No" in the "Quote on this drawing" field.
3. 10.11	The user should be able to submit their quotes and these details should be stored and displayed in the "Compare All Quotes" functionality.
3. 10.12	Once a quote is sent back to AeroTender (the "Submit" button has been clicked) the screen should inform the user that their quotation has been successfully submitted. If submission is unsuccessful, alert sender to try again. – AEROGISTICS to provide message to be displayed. – **If successful, the alert message should be "Your Quotation has been successfully submitted!"; otherwise, if unsuccessful, the alert message should be "Your Quotation has not been successfully submitted! Please Try Again Later!".**

3. 10.13	If necessary, a supplier should have the option to make a quotation query from this area (see section 3.13 – Queries for this functionality details)
3. 10.14	If a quote is large and has many details to be entered, allow user to save their progress for completion at a later time. If a quote is not yet submitted, allow user to amend their quotation details. Once a quote is submitted the supplier can no longer amend.

3.11 Compare All Quotes

For each part/breakdown MUST assign to at least a supplier –What do you mean by this?

	Description
3.11.1	The functionality detailed in 3.11 is only accessible by General Aerogistics and Administrator
3.11.2	Users should be able to view all the quotes received from suppliers for a given Work Package or RFQ. User should be able to search for / filter quotes by: ▪ Work Package Reference ▪ Customer RFQ Reference
3.11.3	When viewing / comparing quotes, user should be able to view on a per drawing basis (i.e. the user should be able to view all the quotes for Drawing A and then move on to view all quotes for Drawing B).
3.11.4	Users should be able to easily navigate between quotes for the different drawings (i.e. by entering the drawing number they require or by using scroll buttons to move between them)
3.11.5	All quotes received should be displayed in tabular form for easy comparisons. The following information should be included for reference purposes: ▪ Supplier Name ▪ Part Number ▪ Quantity ▪ Leadtimes ▪ Observation ▪ Unit of Measure (as entered by the supplier) ▪ Price Per Unit

	▪ Breakdown Costs (if the supplier has entered breakdown costs, the "Cost Type" and "Price Per Unit" should be displayed) ▪ A "Select" option next to each quote / breakdown cost (for the user to choose best quote prices)
3.11.6	The information should be automatically sorted in the sequence of: 1. Part Number 2. Quantity 3. Price Per Unit **[Need Confirm] Initially, the list is sorted by supplier quote date -Yes this is correct**
3.11.7	**The user should be able to manually sort the information by any of the information in 3.11.5**
3.11.8	For each work package / RFQ, the system should highlight the cheapest quotes for each Part Number at a given Quantity. For example, if the suppliers have quoted for Part A at quantities 1 and 10 the system should show which is the cheapest at quantity 1 and which is the cheapest at quantity 10.
3.11.9	If Breakdown Costs have been entered the system should highlight the cheapest quote for each individual breakdown cost.
3.11.10	When selecting quotes two possible routes should be incorporated into the system: a. Selection based on cheapest separate breakdown costs b. Selection based on cheapest individual part cost. *For example:* 1. User enters separate Breakdown Costs for: o Machining o Treatment o Materials o Labour Different suppliers maybe chosen based on best prices. (e.g. Velden chosen for Machining and Materials, Honda for Treatment and Mazda for Labour). OR 2. One total price for the whole part from a single supplier (e.g. "Joe Bloggs").
3.11.11	When selecting quotes the system should allow the user to save their progress for completion at a later time. It should be highlighted if a work package has un-reviewed quotations. **[Need Confirm] Does "un-reviewed quotations" refer to the supplier quotations which have not been viewed by Aerogistics? -Yes this is correct. And should we highlight those quotations? But when you review the "Quote**

	Analysis(Compare All Qoutes)" in Jane's design documents, you will see all the fields have been in many colours, how should we highlight the "un-reviewed quotations"? What we mean here is that it should be apparent to the user that there are quotes for this work package that remain un-reviewed.
3.11.12	The user should be able to return to any quote and edit selections made.
3.11.13	The system should highlight which suppliers have yet to quote on a drawing and display the following details: ▪ Supplier Name ▪ Part number for quote ▪ Quantity for quote
3.11.14	The user should be able to send e-mail reminders to the suppliers that have yet to quote. (No more than 3 reminders per supplier.) **[Need Confirm] The e-mail subject may read "Reminder to quote for XXXRFQ ". is the subject ok? -Yes this is correct**
3.11.15	Selected quotes will be compiled on a work package basis for the customer within the "Prepare Quote for Customer" functionality.
3.11.16	The user should be able to edit / modify a quotation if necessary (for example, if a supplier has made a mistake which needs amending or a price has been re-negotiated.) Each revision needs to be held for possible later review, i.e. archive originals for traceability. – (Only administrators can do this. Once a deadline has passed, only the administrator can modify prices and re-select suppliers.)

3.12 Prepare Quote for Customer

	Description
3.12.1	The functionality detailed in 3.12 is only accessible by General Aerogistics and Administrator
3.12.2	For each work package the system should display all quotes that were selected in the previous "Compare All Quotes" functionality on a per drawing basis
3.12.3	The following general information should be displayed for reference purposes: ▪ Customer ▪ Work Package Reference ▪ Customer RFQ Reference

	The user should be able to enter a 'Validity Date' – (manually enter or calendar selection) User should be able to enter a date until which quotation prices to the customer are valid. After this date prices are subject to change. The following work package details should be included for each drawing: ▪ Drawing Number ▪ Part Number ▪ Quantity ▪ Unit of Measure ▪ Price Per Unit ▪ Breakdown Cost Type ▪ Breakdown Cost Per Unit ▪ Add Percentage Mark-Up (enter manually – the default minimum value is 20%) ▪ Breakdown Cost Per Unit (After Mark-Up) (automatically calculate) ▪ Breakdown Total Price (After Mark-Up) (automatically calculate) ▪ Total Price (automatically calculate)
3.12.4	When preparing a quote, two possible routes should be incorporated into the system: <u>a. BREAKDOWN COSTS</u> ▪ If Breakdown Costs are specified – the system should automatically calculate "Price Per Unit" from the total value of all "Breakdown Costs" for a particular Part (E.g. Machining = £4, Treatment = £1.50, Materials = £4 and Labour = £3. Therefore, "Price Per Unit" = £12.50). ▪ The user should be able to enter a percentage mark-up for each Breakdown Cost Type. ▪ Once a percentage mark-up has been allocated the system should automatically calculate: o "Breakdown Price Per Unit (After Mark-up)" o "Breakdown Total Price (After Mark-up)" o "Price Per Unit (After Mark-up)" o "Total Price"

<table>
<tr><td></td><td>
b. NO BREAKDOWN COSTS

When a single "Price Per Unit" is specified, the system should display the "Price Per Unit" entered by the supplier.
"Breakdown Cost Type" and "Breakdown Price Per Unit" should be left blank.
The user should be able to enter a percentage mark-up for the Price Per Unit.
Once a percentage mark-up has been allocated the system should automatically calculate:

"Price Per Unit (After Mark-up)"
"Total Price (After Mark-up)"

<table>
<tr><td></td><td colspan="4">Fields</td></tr>
<tr><td></td><td>Breakdown Price Per Unit (After Mark-up)</td><td>Breakdown Total Price (After Mark-up)</td><td>Price Per Unit (After Mark-up)</td><td>Total Price</td></tr>
<tr><td>a. Breakdown Costs</td><td>[Breakdown Price Per Unit * Percentage Mark-up] + Breakdown Price Per Unit</td><td>[Breakdown Price Per Unit (After Mark-Up)] * Quantity</td><td>Sum of all [Breakdown Price Per Unit (After Mark-up)]</td><td>Sum of all [Breakdown Total Price (After Mark-Up)]</td></tr>
<tr><td>b. No Breakdown Costs</td><td>n/a</td><td>n/a</td><td>[Price Per Unit * Percentage Markup] + Price Per Unit</td><td>[Price Per Unit (After Mark-up)] * Quantity</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>3.12.5</td><td>When the user selects their preferred prices in the "Compare all Quotes" functionality, the result maybe a mix of Breakdown Costs from different suppliers. The system should group the chosen Breakdown Costs to give a new Price Per Unit.
An example:
Part A (quantity of 1) comprises 4 Breakdown Costs. The user selects Velden (for Machining and Materials), Honda (for Treatment) and Mazda (for Labour) from the previous "Compare All Quotes" functionality. In the "Prepare Quote for Customer" functionality these quotes are grouped to form a full quotation for Part A with a quantity of 1.</td></tr>
<tr><td>3.12.6</td><td>Once the quote is complete the user should be able to:

Send the quote to the customer via e-mail – the user should be prompted to enter the customer's e-mail address and a personalised message that will accompany the quotation – the personalised message can be amended per customer and per quote. The compulsory e-mail content is detailed in "Customer Quote E-Mail" functionality.
Print the quote in an easy to read format.
</td></tr>
</table>

3.13 Customer Quote E-Mail

	Description
3.13.1	The system will generate an e-mail to the customer which should include the following information: ▪ Customer Name ▪ Work Package Reference ▪ Customer RFQ Reference ▪ Validity Date – the expiry date for the price. ▪ Personalised E-Mail message – this can be amended per customer and per quote ▪ Work Package Details – (prices for parts) ▪ If necessary, an attachment (if a customer requires the quote to be submitted within their own template format)
3.13.2	When formulating the e-mail two possible price structures should be incorporated: a. BREAKDOWN COSTS For instances where Breakdown costs are entered the following work package details should be displayed for each drawing: ▪ Drawing Number ▪ Part Number ▪ Quantity ▪ Breakdown Cost Type ▪ Breakdown Price Per Unit (After Mark-Up) (in this e-mail, the field should be renamed to "Breakdown Price Per Unit") ▪ Breakdown Total Price (After Mark-Up) (in this e-mail, the field should be renamed to " Breakdown Total Price") ▪ Price Per Unit (After Mark-Up) (in this e-mail, the field should be renamed to "Price Per Unit") ▪ Total Price b. NO BREAKDOWN COSTS For instances where no Breakdown costs were entered the following details should be displayed for each drawing: ▪ Drawing Number ▪ Part Number

	▪ Quantity ▪ Price Per Unit (After Mark-Up) (in this e-mail the field should be renamed to "Price Per Unit") ▪ Total Price The user should have the option to hide certain fields (e.g. Breakdown Cost Type and Breakdown Prices) so that they are not displayed in the customer e-mail as they don't necessarily want to always show the customer the breakdown costs.
3. 13.3	The Aerogistics Logo should be present on the e-mail.
3. 13.4	User should be able to view e-mail before it is sent to the customer.
3. 13.5	If an e-mail isn't delivered (e.g. misspelt address) then alert the sender. Is it possible to just track when e-mail addresses bounce (e.g. misspelt) and then send an e-mail alerting a nominated admin user? **[Need Confirm] No, it is impossible to track it in a asp.net application. Ok**

3.14 Search Work Packages / Generic Searches

	Description
3.14.1	The functionality detailed in 3.14 is only accessible by General Aerogistics and Administrator
3.14.2	The main search the user should be able to perform is to search for details of any Work Package
3.14.3	Users should be able to search for work packages and RFQ's using the following criteria: ▪ 'Work Package Reference' – alphanumerical string ▪ 'Customer RFQ Reference' – alphanumerical string ▪ 'Individual RFQ Reference' – alphanumerical string ▪ 'Customer Name' – text string ▪ 'Supplier Name' – text string ▪ 'Drawing Number' – alphanumerical string ▪ 'Status' (Won / Live / Lost / Dead / Draft) – default to "Live" option ▪ 'Part Number' – alphanumerical string ▪ 'Sent Out By' - text string ▪ 'Quantities' – numeric value ▪ Allow user to enter a "To" – "From" date range – based on "Date Received"

	Can search for a combination of options.
3.14.4	Users should be able to search for the following information: ▪ General Aerogistics profiles (Statistics on system users, possibly based on "Received By" / "Sent Out By" information) ▪ Supplier profiles (Statistics on supplier users, i.e. Number of Quotes submitted etc)
3.14.5	Allow the user to view / print results of searches in an easy-to-read report-style format.

3.15 View a Work Package

	Description
3.15.1	The functionality detailed in 3.15 is only accessible by General Aerogistics and Administrator
3.15.2	In regards to the main search in 3.10.2, when a user has selected a particular Work Package, the following details should be displayed: ▪ Work Package Reference ▪ Customer RFQ Reference ▪ Customer ▪ Date Received ▪ Received By ▪ Drawing Numbers ▪ Status (Won / Live / Lost / Dead / Draft) – user should be able to enter / select the status of a work package ▪ Reason if "Lost" (Price / Delivery / Price & Delivery / Approval / Late Quotation / King & Fowler / Other) – user should be able to select a primary reason why the work package was Lost **[Need Confirm] Lost reason may be multi-select? -Yes this is correct** ▪ Reason if "Lost" Explanation – user should be able to enter further details of why the work package was lost
3.15.3	Users should be able to view all drawings associated with the Work Package. They should be able to easily navigate through a collection of drawings.
3.15.4	Users should be able to view all the quotations received for the particular Work Package.

	The same details that were entered in the "Compare all Quotes" functionality should be displayed for review.
3.15.5	Users should be able to view all the quotations that were **chosen** for the work package. The same details that were displayed in the "Prepare Quote for Customer" functionality will be displayed for review.
3.15.6	Users should be able to: ▪ Re-issue / resend a whole Work Package ▪ Re-issue / resend a specific RFQ from a Work Package ▪ Re-issue / resend a particular line item (e.g. a user should be able to re-issue only the Machining for part A quantity 1 or re-issue whole of part A). **[Need Confirm] User is not allowed to change the drawings and supporting documents detail, just to Re-issue it? - Yes this is correct**
3.15.7	If necessary, users should be able to lower their quotation cost by editing the "Percentage Mark-Ups" within an existing quotation and then re-submit the amended quotation to the customer for review.
3.15.8	Users should have the option to re-issue / resend to: ▪ All the suppliers (selected previously) ▪ New suppliers ▪ A combination of new and old suppliers
3.15.9	For each work package, a user should be able to view/print off any associated RFQ and be able to see what suppliers it was sent too, for reference purposes. The individual RFQ reference number maybe used here – REMOVED THIS REF NUMBER)
3.15.10	After re-issuing/resending, the work package reference should be added the revision number. For example, the original work package reference is WP1. after re-issued, its reference should be WP1_1.

3.16 Reports

	Description
3.16.1	The functionality detailed in 3.16 is only accessible by General Aerogistics and Administrator
3.16.2	The user should be able to create reports containing any of details held within the system. The user should be able to create customisable reports, by selecting which information they want displayed, in addition to

	entering range values (e.g. between two dates), where applicable.
3.16.3	Standard reports which should be created are: ▪ Quote Status of Work Packages – i.e. all work packages with a status of: o Live o Lost o Won o Dead ▪ Total Quotation Value per Customer – within date ranges. E.g. the value of all quotations sent to a customer within a particular time period. ▪ Total Quotation Value per Supplier – within date ranges ▪ A report which compares if the date a quotation sent to the customer is on or before the actual customer deadline date. ▪ A report to compare supplier commit dates to the actual date they quote. The format of reports should be html with the option to print and download into / save as Excel so the data can be used for further analysis. Each report should show Aerogistics logo with data displayed in columns.

3.17 Queries

	Description
3.17.1	The functionality detailed in 3.17 is only accessible by Suppliers and General Aerogistics and Administrator
3.17.2	Suppliers should have the capability to enter and submit a query into the system. General Aerogistics should be alerted when new queries have been received in order to review them.
3.17.3	Each query should include the following details: ▪ Work Package Reference – alphanumeric string ▪ Customer RFQ Reference – alphanumeric string - REMOVE ▪ Supplier Name – text string ▪ First Name (of enquirer) – text string ▪ Surname (of enquirer) – text string

	▪ E-Mail – alphanumeric string ▪ Telephone Number – numeric value ▪ Query Details – text string **[Need Confirm] Need query date? –Yes, please add Query Date**
3.17.4	General Aerogistics should be able to view the following query details: ▪ Work Package Reference ▪ Customer RFQ Reference - REMOVE ▪ Supplier Name ▪ Full Name of Enquirer ▪ Query Number ▪ E-Mail ▪ Telephone Number ▪ Query Details ▪ Date and Time of Query
3.17.5	General Aerogistics should be able to view all queries received. Each query could have more than 1 response.
3.17.6	General Aerogistics should be able to respond to supplier queries, but also forward a query onto a customer (– Cannot forward onto customer as AeroTender cannot receive a response back from the customer. Have agreed that if a query needs to be forwarded to the customer, the content will extracted and forwarded via a separate email.)
3.17.7	All enquiries and related responses should be recorded and archived on a per supplier basis for response traceability.
3.17.8	If a supplier has a quotation query (as described in 3.10.13) they should be able to access this functionality from the "Submit A Quote" functionality. The "Work Package Reference" and "RFQ Reference" - REMOVED fields should be pre-populated with the current values.

3.18 Administrator – Amend / Delete / Archive Work Packages

	Description
3.18.1	The functionality detailed in 3.18 is only accessible by the Administrator
3.18.2	Administrator should be able to amend / modify any details of an existing work package (if any errors need correcting or any

	changes need to be made.) **[Need Confirm] A work package can be deleted before its RFQ sent out, if its RFQs have been sent out, this work package can not be deleted. Is this logic right? -Yes this is correct**
3.18.3	Administrator should be able to delete an existing work package if necessary – **(Only Draft work packages can be deleted.)**
3.18.4	Administrator should be able to archive work packages (including drawings and quotations received) to be stored independently of the system but viewable on demand.
3.18.5	Administrator should be able to set up supplier accounts and provide suppliers with usernames and passwords
3.18.6	Administrator should be able to add any additions to drop-down menus in 3.4 and 3.7. Administrator should also be able to delete and update any options from drop-down menus.

Appendix E

Case Study Four Project Document

1.0 Background Info.

1.1 Business Problem to Be Solved

Foodport is an online portal which is being developed specifically for the North West food and drinks community. It comprises four areas:

- Community
- Information
- Procurement
- Business Grid

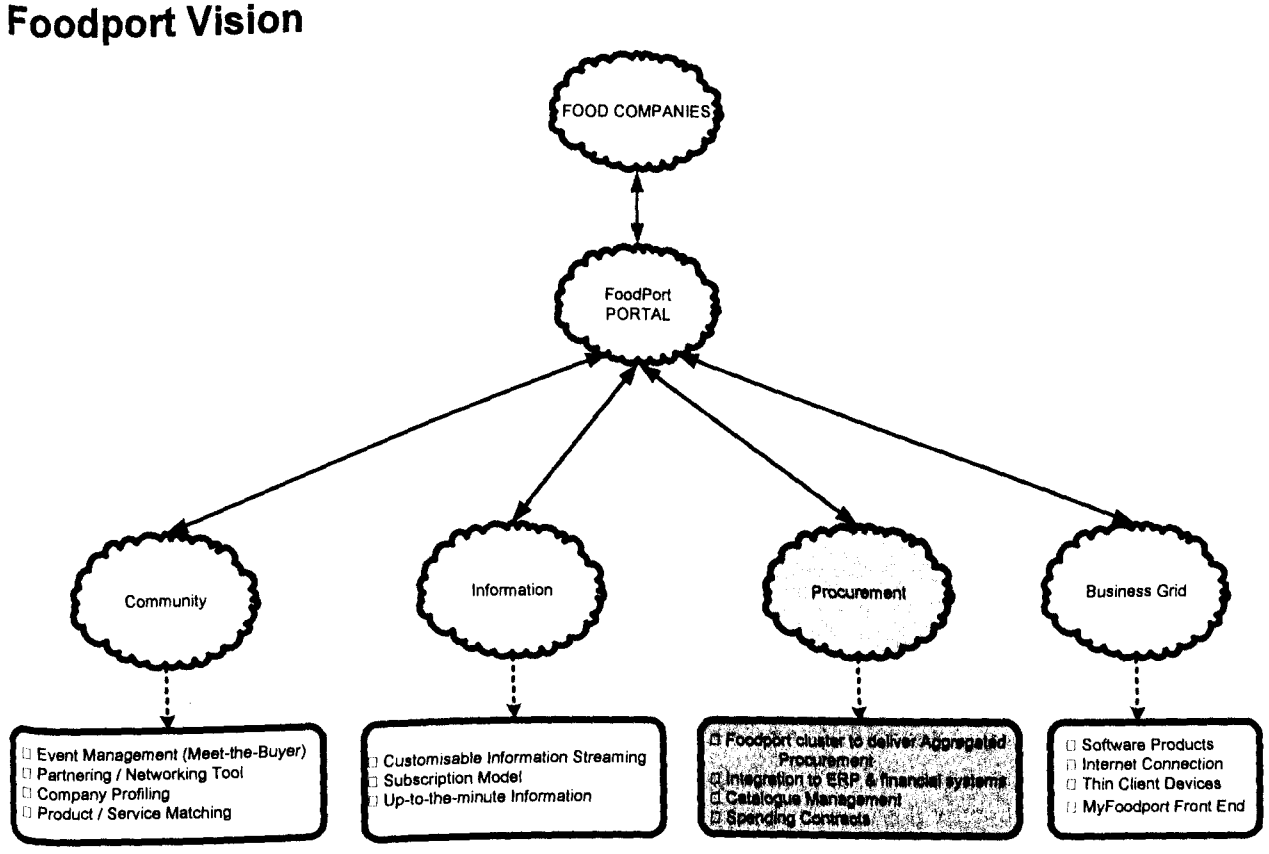


Figure 1 – Foodport Concept

This document is concerned specifically with the Procurement area within Foodport which aims to facilitate collaboration between food companies who normally do not buy through collaborative channels.

The purpose of the FoodPort Procurement portal is to provide aggregated procurement opportunities for a cluster of North West food companies so that they can purchase a number of common commodities at lower prices. The difference between SME's and larger global organisations in terms of purchasing is that SME's do not have the same level of buying power as the larger organisations and as a result they have their prices pushed higher over time. In comparison larger global businesses use their buying leverage to reduce prices over time.

The target of the NorthWest cluster is to mimic the global business by aggregating spend from a number of SME's to give them an increased buying leverage and so benefit from lower prices. The aim is to use the combined spend of the cluster to drive prices down by negotiating better deals with one exclusive supplier in each product area and allow food companies to purchase the lower priced items easily through the system.

1.2 High Level System Definition

The vision of FoodPort Procurement is:

From Buyers (food companies) side:

- Provide food companies with access to lower priced commodities common to their business which they can order online quickly and easily
- Provide access to the contracts established with one exclusive supplier for each commodity negotiated
- Provide food companies with access to catalogues / price matrixes to view items and associated prices available
- Allow food companies to select items to purchase, create PO's (Purchase Order's) and submit them to the supplier
- Allow food companies to access and then complete DN's (Delivery Notes) from the suppler, and access invoices
- Allow food companies to send RFQ's (Request for Quotes) to suppliers for prices of associated product items
- Allow food companies to make payments

From the Suppliers side:

- Allow suppliers to receive RFQ's for specific product items
- Allow suppliers to receive PO's
- Allow suppliers to send DN's / Invoices

1.3 Project Vision and Benefits summary

The project vision is to provide an online procurement system for both food company buyers and suppliers, which electronically handles all the functions of contract and catalogue management and the purchase-to-pay process such as uploading/reviewing contracts, searching catalogues, sending and receiving RFQ's, sending PO's, DN's and invoices.

The solution will provide a 'fully functional live' web service, with the following

benefits:

- Contract management – contracts will exist directly between each Buyer and Supplier and only be visible to those two parties and the System Administrator.
- Catalogue Management – system will contain catalogues of items specific to each category
- Efficient information exchange with no reliance on particular individuals for information
- No duplicated information and data entry (in paper copies and spreadsheets)
- Decreased administration costs and paperwork
- Centralised online system – leading to improved control of PO's and RFQ's

In order to encourage uptake of FoodPort Procurement by people initially interested in the main FoodPort portal (for example due to the community side or the news information), there should be a 'teaser' page giving some information about Procurement and the possible benefits with an option to request registration as a buyer. When new users are being added to an existing Procurement organisation, the administrator should have the option to also create them as FoodPort users.

The FoodPort Procurement system should be developed to the requirements specified in this document.

The system will be developed in several phases – the first phase will be to provide the essential requirements necessary to conduct the initial pilot. The second phase will then build on that to include additional functionality. There may then be further phases as user feedback is received.

1.4 Document Purpose

Functional requirements and non-functional requirements are laid out in this document. Functional requirements are defined as the functionality to support business processes. Non-functional requirements are non-tangible aspects of the system such as response times and stresses, as well as number of concurrent users.

1.5 Assumptions

- The software can be completed by AIMES and their development team within the time scale required.
- PwC and Vendigital will provide the product categories / catalogues and contract details for items available to purchase
- Food North West and a sample of pilot companies will be responsible for signing off these requirements and testing the software to accept/sign off as fit for purpose
- An acceptable training plan and schedule will be agreed with Food North West.
- The process flow depicted in '2.4 High Level Procurement Process Flow' is how the system is envisaged. It is assumed that this is the complete workflow; however AIMES is willing to discuss any additional functionality that is believed to benefit / complement the system.

1.6 Dependencies

- The Portal is dependent on agreement and signoff of the requirements from Food North West
- It is also dependant on Food North West (or other) managing the contracts/catalogues and facilitating engaging the cluster.
- The Procurement system is dependent on the FoodPort site being operational and it's user database and registration system.

2.1 Non Functional Requirements

2.1.1 Usability

Requirement No.	Description
2.1.1.1	Fast response times / reliability are required. On average, a 3 second delay between screen changes should be achieved.
2.1.1.2	The use of the 'browser back button' must not produce 'Page Cannot Be Displayed' issues. Should a user click their browser back button, the solution must not lose any unsaved data or display an unexpected Internet Explorer error.
2.1.1.3	The system should be easy to use and intuitive as it is not expected that training will be provided.
2.1.1.4	The system must allow quick searching (Three second response time to searches)

2.1.2 Volumetric

Requirement No.	Description
2.1.2.1	The system should suffer no performance lag when it contains 5000 users and their data (3 seconds should be the maximum time taken for the system to respond to a user regardless of the number of records held in the database. This is based on using a 512Kbps internet connection).
2.1.2.2	The system should suffer no significant performance degradation when 250 concurrent users are on the system.

2.1.3 Look and Feel

Requirement No.	Description
2.1.3.1	A consistent look and feel to be accomplished by employing a clear and easy to use web template across all aspects of the proposed solution, encompassing the whole of the FoodPort portal.
2.1.3.3	The solution must be compatible with all major web browsers. The site design and functionality must remain identical regardless of the browser used to view the solution. Such browsers include: • Internet Explorer • Mozilla based browsers such as Netscape Navigator, Opera and Firefox.
2.1.3.4	Corporate presence to be maintained throughout the system by use of a logo in the design of the web template so that it appears on every screen. The style of the web template will be agreed by Food NorthWest.

2.1.3.5	Each screen should contain/display a unique name/identifier AND display the version number. Each time a new release is made the screens should reflect/display any changes to the version number.

2.1.4 Data Integrity Requirements

Requirement No.	Description
2.1.4.1	For access rights, see Organisation Setup section of Functional Requirements.
2.1.4.2	Users must only be allowed to view and manipulate their own data.
2.1.4.3	Significant areas of system data must be controlled to allow a history of changes to be recorded and accessed – for example, if a Buyer submits Credit Information, then makes changes and re-submits, the system should retain a record of both 'versions' of the Credit Information that were submitted.
2.1.4.4	It should be possible to safely de-activate all Standing Data (such as Organisations, Users, Products etc) without having to fully delete that data from the system. In a future phase, some sort of archiving capability will be required.

2.1.5 Security Requirements

Requirement No.	Description
2.1.5.1	All users will have the ability to change their passwords to aid memorisation.
2.1.5.2	The solution must allow for automated retrieval of lost usernames and passwords.
2.1.5.3	Access to areas of the site will be prevented to users who have not logged in. For example, a user who has bookmarked an area of the site will be required to log in before being able to access that page.
2.1.5.4	An Administrator should have the ability to change a user's password on request.
2.1.5.5	The entire site from FoodPort onwards must be coded with security in mind where applicable - AIMES welcomes recommendations in regard to this. In particular, the Procurement data is especially sensitive so it must not be possible for this data to be accessed by any unauthorised users – either people not authorised to access the FoodPort or Procurement sites, or people authorised but only with limited access (ie: a Buyer User role should not be able to gain access to data that is not relevant to their organisation and role).

2.1.6 Technical Requirements

Requirement No.	Description
2.1.6.1	The solution will need to integrate with the main "foodport.com" portal and may need to share elements of the database, such as usernames and login passwords. However, this must be done with security in mind and the architecture should

	be designed so that software releases to Procurement don't impact the rest of the portal, and vice-versa.
2.1.6.2	*The solution should be produced using the .NET Framework and use an Oracle 10g database.*
2.1.6.3	The application and database should be deployed using a single mechanism and all software updates must update both the application and database simultaneously.

2.2 Functional Requirements

2.2.0 User Registration & Login

Requirement No.	Description
2.2.0.1	The system will allow for the following three expected routes of user registration into FoodPort Procurement : 1. An existing FoodPort user wants to register for Procurement, or wishes to see more information about Procurement and as a result decides to register for Procurement. 2. A new user already knows they want to register for Procurement as well as FoodPort. 3. An organisation already has Procurement set up, and that organisation's Administrator or the Procurement System Administrator wishes to add additional users. a. These users will have FoodPort login created as part of this process. By default, these users will not have access to the other areas of FoodPort, but the Administrator will have the option to grant this access, either at this time or after the user has been created. b. If the email address used during the Procurement user creation already exists in FoodPort, then the administrator will be asked whether they wish to cancel the Procurement registration, or add to that existing user account. In all these routes, the user could be representing a Buyer or a Supplier.
2.2.0.2	An Information 'teaser' page about Procurement will always be available from the FoodPort portal site – whether someone is registered for FoodPort (and/or Procurement) or not. The option to register for Procurement will only be available once the user has registered for FoodPort including any validation during that process.
2.2.0.3	Where a Procurement user has not been granted access to other FoodPort areas, during login they will be taken directly to the Procurement system. Where a user does have access to other FoodPort areas, there will be a Procurement login option directly available from the first page they reach after logging in to FoodPort (with no additional password etc).
2.2.0.4	Procurement users will have additional information relevant for Procurement: • Some additional data against the user record such as Role • Organisation details • Buyers will have the option to enter delivery addresses at this point if they wish (or these can be added/updated later) • Buyers will also have the option to enter credit information (or again, they can enter/update this later).

2.2.0.5	It's assumed that the first time a user for a particular organisation name is registering then that user is the Organisation Administrator role as that will then allow them to setup the information needed to register. It will be possible to change that later – ie: if another user is then added who will be the administrator moving forward.
2.2.0.6	Once the user and organisation details have been entered, a notification will be sent to the System Administrator who will do some limited manual verification such as ensuring the organisation doesn't already exist with a different name (ie: ABC Ltd and ABC Limited etc), and making sure the data looks genuine. The entered information will then be passed to the FoodPort Category Manager (PwC/Vendigital initially) to start the sourcing and contracts process. If the organisation already exists, the Administrator should have the option to either redirect the new user registration to the existing organisation, or to cancel the new registration request (in which case the system should notify the Organisation Administrator so they can decide how to proceed – ie: to create that user account).
2.2.0.7	When capturing credit information for the Buyers, the system will display terms & conditions or disclaimer type information indicating that this credit information is captured purely to enable the suppliers to reach contractual agreements with the buyer. The FoodPort entity does not have any role in credit checking other than facilitating this information transfer.
2.2.0.8	When a user logs into Procurement, the first page they see will depend on their role: • System Administrator – Organisation List page showing all Organisations • Buyer User – Purchase Order List page showing Draft • Buyer Manager – Purchase Order List page showing Pending Confirmation (Pending Approval once that is implemented) • Buyer Organisation Administrator – Organisation list page showing just their Organisation • Supplier User – Purchase Order List page showing Pending Confirmation • Supplier Manager – Invoice List page showing Pending Confirmation • Supplier Organisation Administrator – Organisation list page showing just their Organisation • Any other user (ie: new roles added) – Purchase Order List page showing all PO's that user has access to For a future development phase it may be worth considering a more sophisticated Procurement Home Page concept – for example, showing a Supplier Manager a page with the various items requiring action such as PO's, Invoices, DN's etc. Or the page could be dynamic depending on what actions are required – for example show the Supplier Organisation Administrator buyer approvals if there are any pending etc.

2.2.1 Organisation and User Setup

2.2.1.1 Main setup

Requirement No.	Description

2.2.1.1.1	*This functionality will only be accessible to System Administrators and Organisation Administrators (apart from Users ability to change their own password and some user account details)*
2.2.1.1.2	There will be four standard roles that can be assigned to users of the system: • User – their main role is to place orders (They have limited privileges in the system) – by default they will only be able to see data items that were created by them. Optionally, they can be given permission to see other user's data items for their organisation • Manager – their main role is to approve orders and invoices as well as same permissions as User role (They have limited privileges in the system) – they will be able to see all data items for their organisation. Approvals are likely to be implemented in a future phase so this role is probably not relevant until that point. • Organisation Administrator – their main role is to maintain organisation details and add new users to their organisation, they will have full privileges to perform any action in the system except creating new organisations (although initially they can enter registration request) – they will be able to see all data items for their organisation. They can take control of other users within their organisation. • System Administrator – their main role is to add new organisations into the system, and verify new registration requests - no other user should have this ability. They have full system privileges and be able to see all data for all organisations. They can take control of any other users in the system. The system will contain a set of permissions for all key actions e.g. create PO, edit PO, delete PO. For each role permissions can be turned on/off as required. Roles can be added/edited by System Administrators for system wide roles or by Organisation Administrators for specific organisation roles (in which case, the new role must be approved by System Administrator before it becomes active, with an option to make that role only applicable for that organisation). When an Organisation Administrator is adding or editing a role, they cannot grant permission to create/edit/delete a user or create/edit an organisation.
2.2.1.1.3	Administrators (Organisation and System) will be able to manage (view, add, edit) organisation details. These details are: • Organisation Type (Buyer / Supplier) • Company Name • General Contact Number – optional • Fax Number - optional • VAT Number • Allow RFQ (Yes/No) * • Invoice Address** - Address - Town/City - County – should be a drop down menu of all possible County options in UK (To be provided) - Country – should be a drop down menu of countries (default to UK)

	- Postcode • Unlimited Delivery Addresses** - Address - Town/City - County - should be a drop down menu of all possible County options in UK (To be provided) - Country – should be a drop down menu of countries (default to UK) - Postcode All this information will be editable. The user should be able to view, add, edit and delete delivery addresses. Organisation administrators will only be able to access the organisation they are responsible for. System administrator will have access to all organisations. * *Only for supplier organisations* ** *Only for buyer organisations*
2.2.1.1.4	Users will be assigned to organisations and can be created/removed by both types of administrator users. User details can be modified by administrators and the user themselves. User accounts created in the Procurement system will create a FoodPort user login also if one doesn't already exist. If FoodPort user login already exists, the administrator should be able to link the Procurement account to that existing FoodPort login. By default, this FoodPort login will only have access to the Procurement system, but the Administrator can change this so that user has access to other FoodPort areas. Additional data will be captured for Procurement: • Organisation (auto populated based on the organisation being managed and can't be changed) • System role (Assigned by administrator, can't be changed by user) • Default delivery address (selected from organisation delivery address list) – can be changed by user • Can only access own data? (PO's etc - still only for their organization though) – default Yes. Assigned by administrator, can't be changed by user.
2.2.1.1.5	Administrators (System and Organisation) will have the ability to take control of another users account and will be able to see all information of that user and carry out the same actions as that user. System Administrators will be able to access any user in the system and an Organisation Administrator will be able to access other users within their organisation. The system will clearly indicate that the current login is acting on behalf of another user, and note this against any actions carried out for audit purposes.
2.2.1.1.6	As part of the user setup, notifications for particular system events (e.g. a Purchase Order submitted) can be turned on or off. Any notifications turned on will be sent to the user's specified email address. The following notifications will be available to buyers: • Supplier Approval or Decline • Purchase order for approval / approval - urgent (sent 7 days after PO submitted) • Purchase order approved / submitted / amended / cancelled / on-hold / declined

	• *Delivery note for confirmation / confirmation overdue (sent 7 days after DN received)* • *Invoice ready for payment / approved* • Credit note issued • Payment due / overdue - urgent (sent after payment is overdue, specific to each contract) • RFQ result Suppliers: • New food company for approval • Purchase order received / cancelled / amended / for confirmation • RFQ request received Note this may not be the final full list of notifications the system contains.
2.2.1.1.7	All users will have the ability to change their password.
2.2.1.1.8	Each buyer will be able to view a list of all suppliers within the system. They will be able to see which suppliers they have been approved to purchase from, which suppliers they are pending approval with and which suppliers they have been declined by. Buyers will be able to de-select suppliers who they do not wish to work with – (their catalogue will be hidden.)

2.2.1.2 Credit Information

Requirement No.	**Description**
2.2.1.2.1	This functionality will only be accessible to System Administrators (read only) and Buyer Organisation Administrators
2.2.1.2.2	Once an organisation is setup as a "Buyer" – a credit information form must be completed in order for buyer to be able to view catalogues. The following credit information is required: • Company Name – automatically populate from Organisation Setup • Registered Company Addresses for Statements and Invoices • Telephone Number – automatically populate from Organisation Setup • Fax Number – automatically populate from Organisation Setup • VAT Number – automatically populate from Organisation Setup • Company Reg. Number • Year Established • Number of Employees • Email Address for Account Queries • Contact Name for Account Queries • Director(s) Name(s) • Type of Business (e.g. Corporation / Partnership / Individual / Limited)

	• Type of Premises • Is company part of any group? Y/N • Other information (text box) • More details to follow from PwC
2.2.1.2.3	Credit information must be completed, submitted and approved by the relevant supplier(s) before buyer can view/access catalogue items, prices or contracts. If the buyer needs to change this information (for example over time some details may change) then the system will retain a 'history' so that the various versions of the information are kept in line with the applications to suppliers that were made at that time.
2.2.1.2.4	Once credit information is completed, the buyer will see a list of possible suppliers and be able to select the ones they wish to deal with. The credit information will then be made available to all those suppliers the buyer has selected, for approval by each Supplier.
2.2.1.2.5	If a buyer has been rejected by a supplier, they will be sent notification with the reason entered by the supplier. If they are not happy with the reason, any further negotiation must be done outside of the FoodPort system (ie: manually by phone/meeting etc). The supplier will have the ability to then approve the buyer if an agreement is reached.
2.2.1.2.6	If the buyer has updated their credit information, then they will have the ability to resend their request based on that new credit information. If the buyer has changed credit information, they will not be able to view/access catalogue items, prices or contracts until they have submitted and been re-approved by the relevant supplier(s).
2.2.1.2.7	If a buyer is accepted by a supplier then the system will notify the buyer and also the FoodPort Category Manager (PwC/Vendigital initially) so that contract negotiation can be conducted.

2.2.1.3 Buyer Approvals

Requirement No.	**Description**
2.2.1.3.1	This functionality will only be accessible to System Administrators (read only) and Supplier Organisation Administrators
2.2.1.3.2	Suppliers are notified that a buyer organisation has submitted new or updated credit information for their approval.
2.2.1.3.3	Supplier must approve new buyers based on credit information submitted. Once approved, the buyers can access items and make purchases.
2.2.1.3.4	If the supplier declines the buyer they can enter a reason why they have been declined and this can be made available to the buyer. The buyer will then be unable to view that supplier's items. The supplier will still have the option to approve in the future (for example, if an agreement is reached outside of the FoodPort Procurement system).

2.2.2 Contract Management – all these points need to be confirmed/checked with PwC

No.	
2.2.2.1	The ability to create or edit contracts will only be accessible to System Administrators (for all contracts) and Organisation Administrators (for the contracts applicable to them) – check with PwC. Other users will be able to view contracts applicable to them.
2.2.2.2	Once a contract has been received from Vendigital, it should be uploaded into the system for buying organisations to view. The system should provide facilities to store key data about the contract as per next point, and to store the contract itself as file(s) such as PDF, MS Word etc.
2.2.2.3	Contract information to be stored includes: • Commercial Requirements o Selected Supplier o Contract Start Date o Review Points o Expiry Date o Standard Leadtimes o Standard Payment Terms o Catalogue Type o More details to follow from PwC • Catalogue Details – all the product items from the contract will be added to the relevant category
2.2.2.4	The expectation is that each Buyer will have their own contract with each Supplier so the system must allow this. Check with PwC: However, the system should also allow for the possibility that some Suppliers may have the same contract that applies to multiple Buyers as this may be the structure in some cases.
2.2.2.5	Check with PwC: There may be multiple contracts per Buyer/Supplier so the system must be capable of handling this – for example, for different catalogue categories (Packaging, Freight etc), or due to different lot agreements, or simply due to contracts being reviewed over time (in which case a history of contracts will be stored and be available for viewing).
2.2.2.6	Each Product in the catalogue will be associated with a single contract at any point in time. Check with PwC – should we allow same contract code to be used that just has it's terms updated over time – that way avoids having to update the catalogue with new contract details. Or do we need the ability to register 'next contract' in advance so it automatically picks that one based on the date? etc

2.2.3 Catalogue Management

2.2.3.1 Main Setup

Requirement No.	Description

2.2.3.1.1	The System Administrator (for all catalogues/products) and Supplier Administrators (for their own catalogues/products) will have access to manage (add/edit/delete etc) the catalogues. Other users will be able to view. The system needs to allow an upload facility for data migration of catalogues - this feature should only be available to System Administrator – at least initially until data formatting is stable. Note: it's assumed that any changes/additions made by suppliers to their catalogues conform to the contract associated with that product item, and that buyers agree to this when they make purchases. The system should have terms&conditions at initial user registration that encompass this type of disclaimer.
2.2.3.1.2	The system must support both general catalogue items (which are available to all buyers approved for that supplier) and buyer-specific catalogue items (which are available to one or more specified buyers). Buyer-specific items may be by agreement during the contract creation, or due to RFQ's during the contract lifetime.
2.2.3.1.3	The catalogue should be organized by a hierarchical category structure. It should be possible to define this structure within the system. When viewing the catalogue, this structure should be shown in a tree structure that can be expanded and collapsed at all levels.
2.2.3.1.4	Users (either while managing the catalogues or when viewing them) should be able to navigate around the catalogue by browsing using the category structure, or by searching using key words. If the user has browsed to somewhere within the category hierarchy then the search should operate within that sub-structure – in other words, to perform a full catalogue search, the user should select the 'top' level of the catalogue structure.
2.2.3.1.5	The catalogue search should recognize words or parts of words in all the following fields: • Product Code • Product Name • Supplier Name
2.2.3.1.6	Check with PwC/Food NW as Lee doesn't recommend: Users should be able to select numerous products from different catalogues to be added to the PO. The system should automatically create a separate PO for each supplier of the items selected.
2.2.3.1.7	Product items will contain the following information as standard: • Supplier • Supplier Product Code • Product Name • Product Description • Unit of Measure • Standard Lot Size • Product Image (administrators will have ability to upload/remove images) • Product Specifications (file attachments .doc, .jpg, .pdf etc – administrators will have ability to upload/remove) • Vat • Net Price

	• ~~Gross Price~~ • *Notes* • Contract – mandatory => Note: this strongly depends on how the contracts work. If contracts are specific to each Supplier/Buyer pairing then the contract reference cannot simply be held against each product in the catalogue, there will need to be another level of data relating each Buyer that has a contract with that Supplier and what the contract reference is against that pairing. On the other hand, if contracts are at an umbrella level from the supplier and relate to all buyers as long as they sign up to that contract, then having contract reference against product item like this may be ok. The main catalogue view will show key items such as "Supplier Product Code", "Product Name", "Supplier" and "Net Price". The user should be able to select to view any additional information on a specific product, such as Product Image and Product Specifications.
2.2.3.1.8	It's expected that the standard information will be sufficient for the Packaging category. Other categories may require additional or different items but these are expected to be dealt with after Phase 1.

2.2.3.2 RFQ Process

Requirement No.	Description
2.2.3.2.1	Buyers should be able to submit an RFQ for additional items not currently listed in the system. This RFQ will be directed at a specific supplier the buyer already has a relationship with in the system.
2.2.3.2.2	Suppliers should be able to indicate whether they are willing to accept RFQ's or not. If the supplier indicates they are not willing then the system should not allow an RFQ to be sent and should notify the Buyer that this is the case. In these cases, any additions to the catalogue would have to be done by the buyer contacting the supplier directly or via the FoodPort Category Manager.
2.2.3.2.3	The RFQ should contain the following information: • Supplier • Product category • Product name • Product description • Product specifications (file attachments) - optional • Standard lot size - optional • Unit of measure - optional • Estimated annual requirement
2.2.3.2.4	Once the buyer has completed the RFQ details it will be submitted to the supplier, who will receive a notification of the RFQ.

2.2.3.2.5	The supplier should be able to access a list of "Pending RFQs". The supplier should be able to open each RFQ to read the specific RFQ details. The supplier can either choose to accept the RFQ or decline the RFQ.
2.2.3.2.6	If the supplier accepts the RFQ they must enter a unit price and set the VAT for the item and should be able to enter additional details such as notes, if required, or to update details like standard lot size. Once the RFQ item has been selected it will be added to the buyers list of "Custom Products" under the selected category at the price specified. All RFQ details should be stored with the new product item. The buyer will then receive a notification that the RFQ has been accepted and is available for order from the catalogue.
2.2.3.2.7	If the supplier rejects the RFQ they must enter a rejection reason. The RFQ will then be returned to the buyer and they will receive a notification of the rejection. The buyer may then change and resubmit the RFQ to the supplier or can delete the RFQ from the system.
2.2.3.2.8	When a RFQ has been submitted to the supplier for approval, it is deemed "Open". Once an RFQ has been approved by a supplier, it is deemed "Active".

2.2.4 Purchasing

2.2.4.1 Creating a Purchase Order (PO) FROM THE CATALOGUE

Requirement No.	Description
2.2.4.1.1	This functionality should be accessible to buyer organizations
2.2.4.1.2	It will only be possible to generate one PO, based on products from one Supplier, at a time. Check with PwC for their opinion on this.
2.2.4.1.3	User should be able to add their own PO number if relevant. The system must retain its own internal PO reference.
2.2.4.1.4	Once items have been added to the PO, it is in a 'Draft' state until it is submitted to the supplier
2.2.4.1.5	User should be able to add / delete items from the PO while it is in a 'Draft' state
2.2.4.1.6	User should be able to search for other items to add to the existing 'Draft' PO from the same supplier
2.2.4.1.7	For each item added to the PO, the following item information should be displayed: • Product Code • Product Name • Unit Cost • Unit of Measure • Quantity to be order – entered by the user • Net Total – for each item (Unit Cost * Quantity)
2.2.4.1.8	The PO should display: • Supplier Name • Name of user who placed the order The PO should display the following values:

	• *Total Net – (Total of all items net values)* • *Total VAT – (Total Net / VAT rate)* • Total Gross – (Total Net + Total VAT)
2.2.4.1.9	PO should have a delivery date field defaulted to the suppliers standard leadtime. The date cannot be set earlier than the standard leadtime. There should also be a "created date", populated when the PO is submitted from Draft.
2.2.4.1.10	PO will allow user to select a delivery address from the list of delivery addresses associated with the user, but will default to a set delivery address for that user. Alternatively they can enter their own delivery address which will then be added to the organisation list.
2.2.4.1.11	PO will have a general 'Notes' section where user can add any relevant comments associated with the whole PO
2.2.4.1.12	A PO can be in any of the following 'states': • Draft – when a PO is first created it is in a "Draft" state • *Pending buyer approval – when a "Draft" PO is submitted, if there are any approval rules in place, e.g. if a PO is above £1000 it may need to be approved by a manger. Note this is likely to be implemented in Phase 1b.* • Pending confirmation (from supplier) – when a PO has been submitted to a supplier, this state is applicable if a supplier wishes to confirm a PO before they supply • Pending Delivery – when a supplier has sent items, and buyers are waiting to receive them • On-hold – a supplier can put a PO 'on-hold' when its Pending Delivery • Completed – once a PO has been paid • Deleted / Cancelled – only a buyer can delete or cancel a PO See Matrix 1 for workflow of PO states and other documents. For each of the states above, the system should display how many PO's are within each state. E.g. Draft (3).
2.2.4.1.13	Once the PO has been submitted from the Draft state it will also contain additional fields by each product item showing the quantities for "Accepted", "Damaged" and "Invoiced".
2.2.4.1.14	The PO should be printable by either buyers or suppliers and contain all the relevant PO details.
2.2.4.1.15	The PO document should have tracking information associated with it. All actions performed on the PO, e.g. PO submitted, PO amended etc should be stored with the user who performed the action and the time / date it was carried out. All documents associated with the PO should also be tracked e.g. Delivery Notes, Invoices and Payment Documents. Users should be able to view all documents linked to the PO and be able to access these documents directly.

2.2.4.2 Creating a Purchase Order (PO) TEMPLATE – probably Phase 1b

Requirement No.	Description
2.2.4.2.1	This functionality should be accessible to buyer organisations
2.2.4.2.2	In order to create a PO template for future use, a user must select items from the catalogue and then use the "Create

	Template" functionality to allocate to the template.
2.2.4.2.3	The template will contain: • Template Name • PO items (with the same information as normal PO's) • Delivery address – default • Set quantities that can be changed • Supplier Name • Additional Information The template will not have delivery dates or PO numbers automatically allocated to it. These can be manually added/selected by the user.

2.2.4.3 Creating a Purchase Order (PO) FROM A TEMPLATE – probably Phase 1b

Requirement No.	Description
2.2.4.3.1	This functionality should be accessible to buyer organisations
2.2.4.3.2	A template can be selected from a list of templates which will be specific to each organisation. Once selected the template details will populate the standard PO document. The user will then be able to add in a delivery date, a custom PO Number and change quantities if required. The PO will then be saved into the "Draft" state.

2.2.4.4 Creating a Purchase Order (PO) FROM PREVIOUS ORDERS – probably Phase 1b

Requirement No.	Description
2.2.4.4.1	This functionality should be accessible to buyer organisations
2.2.4.4.2	Users can go into previous orders and re-submit the order as a new PO which will be in a new "Draft" state. User can allocate new quantities, delivery date and address and PO number but do not have to search the catalogue for these items.

2.2.4.5 Creating a Purchase Order (PO) AUTOMATED SCHEDULED ORDERING – probably Phase 1b

Requirement No.	Description
2.2.4.5.1	This functionality should be accessible to buyer organisations
2.2.4.5.2	The system will allow a Purchase Order in "Draft" state to be automatically scheduled.
2.2.4.5.3	The PO will then have additional options: • Schedule Sequence

	○ Weekly (select day of the week) ○ Fortnightly (select day of the week) ○ Monthly (select day of the month) ○ Other (input a number of different dates at irregular intervals. Once a date has been selected then the user will be able to add more dates) • Finish Date (the date the sequence will finish, if left blank the sequence will continue indefinitely)
2.2.4.5.4	The automated scheduled orders will all use the same custom PO number for all scheduled orders.
2.2.4.5.5	The system will provide a history of scheduled PO's and tracking of what PO's are scheduled.
2.2.4.5.6	The system will allow scheduled PO's to be updated or stopped.

2.2.4.6 PO Approval – probably Phase 1b

Requirement No.	Description
2.2.4.6.1	The facility for PO approval must be accessible to food companies who require PO's to be approved by another member of the organisation (a person who has been granted approval status) before they are submitted to the supplier.
2.2.4.6.2	Once a 'Draft' PO has been submitted and if any approval rules apply to this organisation, the PO will move to the 'Pending buyer approval' state. The person with the approval rights must then log into the system and either approve or reject the submitted PO. If the PO is approved, it is sent to the supplier and awaits their confirmation. If the PO is rejected it is not submitted and moved to the 'Cancelled' state with a reason entered.
2.2.4.6.3	When an approval is made is should be noted in a 'tracking log' for the document, recording the person who approved the PO and the time / date of approval.

2.2.4.7 PO Confirmation

Requirement No.	Description
2.2.4.7.1	The facility for PO Confirmation must be accessible to suppliers who wish to confirm each PO before they agree to supply.
2.2.4.7.2	Once a 'Draft' PO has been submitted (and, once approvals are implemented, if any approval rules have been passed in the 'Pending Approval' state) the PO will move to the 'PO Confirmation' state. Suppliers can then log into the system and either confirm or reject the submitted PO. If the PO is confirmed, it moves to the 'Pending Delivery' state and awaits the Delivery Note being completed. If the PO is rejected it should be moved to 'Cancelled' state instead of being confirmed, and the Buyer will be notified.
2.2.4.7.3	When a confirmation/rejection is made is should be noted in a 'tracking log' for the document, recording the person who confirmed the PO and the time / date of confirmation.

2.2.4.8 Amend Order

Requirement No.	Description
2.2.4.8.1	Buyers should be able to amend an order in 'Pending Buyer Approval', 'Pending Supplier Confirmation' and 'Pending Delivery' states.
2.2.4.8.2	The buyer should be able to change the quantity of items on the order, remove items and add additional items to the order. Once an amendment has been made the order should be resubmitted and go back to the 'Pending Buyer Approval' stage (if approvals exist). The buyer must enter the reason for the amendment in the notes field.

2.2.4.9 Order On-hold

Requirement No.	Description
2.2.4.9.1	This functionality should be accessible to supplier organisations from the 'Pending Delivery' state.
2.2.4.9.2	Suppliers can select to put a PO 'on-hold' and only suppliers can move the PO from an 'on-hold' state back to the Pending Delivery state.

2.2.5 Delivery Processing

2.2.5.1 Create Delivery Note (DN)

Requirement No.	Description
2.2.5.1.1	This functionality will be accessible to supplier organizations
2.2.5.1.2	For PO's that have been confirmed by the supplier and are in 'Pending Delivery' state a Delivery Note (DN) should be created in the system which is then sent to the buyer for confirmation. The buyer should receive a notification when they have a DN to confirm.
2.2.5.1.3	A Delivery Note can be in any of the following 'states': • Pending Confirmation • Cancelled • Confirmed See Matrix 1 for workflow of DN states.
2.2.5.1.4	A delivery note will contain the following information: • DN Number

	• *Delivery Address* • *Date Submitted (date it was created)* • Date Confirmed (completed by the buyer) • Invoice Number (entered by the supplier) • PO Number • Delivery Date (default to today's date) • Supplier Name • Notes • Product Items • Quantity Delivered • Redelivery indication
2.2.5.1.5	The supplier can enter their own unique Invoice number when the DN is created.
2.2.5.1.6	When the DN is created, if it is not a Redelivery DN, an invoice will be automatically generated for the total amount of the DN, using the suppliers Invoice Number (if provided). See also 2.2.5.2.2 and 2.2.5.2.3

2.2.5.2 Confirm DN

Requirement No.	**Description**
2.2.5.2.1	The buyer will view delivery notes in the 'Pending Confirmation' state. The following details will be completed on the DN: • Date Confirmed (defaults to today's date) • The quantity of items "Accepted" (defaults to the quantity delivered for each item) • The quantity of items "Damaged/Missing" (defaults to 0) • Enter "Notes" section. Free text for any comments about items or delivery. The DN cannot be confirmed unless the total of accepted and damaged/missing for each line item is equal to the quantity delivered.
2.2.5.2.2	Note: this point used to say 'When the DN is confirmed, an invoice will be automatically generated for all accepted items on the DN, using the suppliers Invoice Number (if provided) - the DN will now be in confirmed state.'. need to check this- should the invoice be generated based on the DN (or maybe even PO?) – that seems to be the current business process? Otherwise, if invoices are always generated based on accepted items in DN's, when would you ever need a credit note?
2.2.5.2.3	If any items on the DN are set with a quantity "damaged/missing" then the Buyer will be given the option to either request redelivery of the Damaged/Missing items or request a credit note. If requesting redelivery, the PO will return to "Pending Delivery" state, and will update the quantities for Accepted, Damaged/Missing and Invoiced items. The supplier can then resubmit additional DN for the damaged items – in that case, the new DN will be marked as

	'Redelivery' and won't generate a new invoice (since these items are already covered under the original invoice).
2.2.5.2.4	Once all items on the PO have been Accepted and Invoiced, the PO will also move to "Completed" state.
2.2.5.2.5	The DN should be printable by either buyers or suppliers and contain all the relevant DN details.

2.2.6 Invoicing

2.2.6.1 Auto Generate / Create Invoice

Requirement No.	Description
2.2.6.1.1	Once a supplier has created a Delivery Note (note: used to say 'buyer has confirmed a Delivery Note' – see 2.2.5.2.2), an invoice for that PO will also be generated and listed in the "Invoice" section of the system. This invoice will be accessible to both the buyer and suppoer. (used to say 'buyer once they have confirmed the DN.')
2.2.6.1.2	The system should display how many invoices there are to be paid.
2.2.6.1.3	An invoice can be in any of the following 'states': • Pending Confirmation • Pending Approval • Rejected • Unpaid • Paid See Matrix 1 for workflow of invoice states.
2.2.6.1.4	Once an invoice is ready, a user should be able to view it in the "Invoice section" of the menu. A list of invoices should be displayed to the user.
2.2.6.1.5	A buyer should be able to select an invoice and view its details
2.2.6.1.6	For each invoice, the following data should be displayed: • Date Submitted • Invoice Number • PO Number • DN Number • Supplier Name • Due Date (calculated for each supplier based on the contract terms e.g. 30 days) • Invoice Total (NET Total)
2.2.6.1.7	When a buyer views each invoice, it should contain the following details: • All details from summary, plus: • Document State • Amount to be paid • Payment Due Date

	• Supplier
	• Buyer
	• Delivery Date
	• Delivery Address
	• Buyer Address
	• Supplier Address
	• Supplier VAT Number
	• Item Details
	  o Product Code
	  o Product Name
	  o Price (Unit)
	  o Unit of Measure
	  o Number Accepted
	  o Net Total (for each line item)
	  o Total Net
	  o Total VAT
	  o Total Gross

2.2.6.1.8	Buyers should be able to add comments to a 'Notes' section. Suppliers should be able to view these notes.
2.2.6.1.9	Buyers will have the option to Pay the invoice
2.2.6.1.10	The invoice should be printable by either buyers or suppliers and contain all the relevant invoice details.

2.2.6.2 Confirm Invoice

Requirement No.	Description
2.2.6.2.1	This is an optional step for suppliers to confirm an invoice before it is sent to the buyer.
2.2.6.2.2	An Organisation Administrator should be able to switch on / off invoice confirmations if necessary.

2.2.6.3 Invoice Approval – probably Phase 1b

Requirement No.	Description
2.2.6.3.1	This functionality is applicable to buying organizations
2.2.6.3.2	The facility for invoice approval must be accessible to food companies who require invoices to be approved by another member of the organisation (a person who has been granted approval status) before they are submitted to be paid
2.2.6.3.3	Once an invoice has been submitted and if any approval rules apply to this organisation, the invoice will be sent to the 'Invoice approval' state. The person with the approval rights must then log into the system and approve the submitted

	invoice.
2.2.6.3.4	If the invoice is approved, it is moved to the 'Invoice - Unpaid' state.
2.2.6.3.3	If the invoice is not approved, it will move to the 'Invoice Rejected' state. The buyer will then communicate offline with the supplier to resolve the issue. The invoice can then be resubmitted from 'Invoice Rejected' state to 'Invoice Approval' state.

2.2.6.4 Create Credit Note

Requirement No.	Description
2.2.6.4.1	A credit note will be created by a supplier in the event of invoice values not meeting PO values. For example if a buyer doesn't receive all the items on their order (due to damage/lost/incorrect etc) the supplier should issue them with an electronic credit note of the outstanding value which they can allocate to future purchases.
2.2.6.4.2	Once a buyer has entered the quantities received into the DN note, the system should automatically determine the value of goods received compared to the value of goods on the PO in order to allocate the difference to the credit note.
2.2.6.4.3	A credit note can be in one of two states: • Approved for Payment – (can be allocated to an invoice) • Used – (has already been used against an invoice but details are retained in the system for information purposes) See Matrix 1 for workflow of Credit Note states.
2.2.6.4.4	When a user is within 'Draft Payment', a list of credit notes applicable to the supplier should be listed. The user can select which credit notes (one or more) can be allocated to the invoices. The credit note amount will be deducted from the invoice value.

2.2.7 Payment Processing – Phase 1

Requirement No.	Description
2.2.7.1	This functionality should be accessible to buyer organizations
2.2.7.2	A Payment Document can be in any of the following 'states': • Draft • Submitted
2.2.7.3	If user selects to pay an invoice, a 'draft payment' should be made accessible. User can enter: • Payment Reference • Payment Date (automatically populated with current date)
2.2.7.4	System will automatically populate the following data:

	• *Buyer Name and Address* • *Supplier Name and Address* • Supplier VAT Number
2.2.7.5	All additional invoices for the selected supplier that are in the Unpaid state should be viewable. The system should show the following details for each invoice: • Invoice Number • Payment Due Date • Net Amount • VAT • Gross Value
2.2.7.6	If a supplier has sent any outstanding credit notes to the buyer, these will also be listed in the 'Draft Payment' which the buyer can then use on the payment document. The value of any credit notes will be subtracted from the value of invoices on the payment document.
2.2.7.7	The Payment document will also contain a "Total to be paid" value which will be calculated automatically based on the total value of all invoices to be paid minus the credit notes to be used.
2.2.7.8	The buyer will select the payment method for the payment from a drop down list. This will show "BACS", "CHAPS" or "CHEQUE".
2.2.7.9	The buyer can submit the payment, which will then be made viewable to the supplier in the 'submitted' state.
2.2.7.10	The payment document can be printed by the buyer or supplier.
2.2.7.11	For Phase 1, the system will allow a Payment Document to be produced which can then serve as a reminder outside of the system for the Buyer to process the actual payment to the Supplier. The system will allow this Payment Document to be produced in a printable human readable format such as PDF, and also in a data format such as CSV, XML – this may allow some organizations to pass this data into external systems such as financial packages.

2.2.7.12 Payment Processing – future phases

Requirement No.	Description
2.2.7.12.1	It is envisioned that in a future phase of development, the system will also be capable of integrating with popular methods of payment.

2.2.8 Reporting

2.2.8.1 General Reporting Requirements

Requirement No.	Description
2.2.8.1.1	This functionality should be accessible to buyer and supplier organizations and to system administrators.

2.2.8.1.2	Users should be able to create and view reports on key parts of the system, there will also be specific reports for system administrators. Reports will be set up as default templates, which users can then customize and save to their own user account.
2.2.8.1.3	All reports will have a set of possible fields that can be selected/ deselected by the user.
2.2.8.1.4	Each field can have individual filter restrictions applied to it. Common fields to apply filters will include: • Date fields which should have a date range • Numeric fields which should have a range (to and from) • All other fields should have drop-down selections of possible filter values Filters should be set to include or exclude the filter values. Each field should have the ability to sort "ascending" and "descending" and it should be possible to set a sort order for multiple fields.
2.2.8.1.5	All reports should be generated in the following formats: • HTML • CSV • Excel • XML • PDF
2.2.8.1.6	In general, screens in the system that allow the user to view lists (for example PO list depending on status they have clicked on), should have the option to Output that list as a report.

2.2.8.2 Buyer Reports

Requirement No.	**Description**
2.2.8.2.1	Purchase Orders Pending Approval • Supplier Name • PO Date • PO Number • Submitter • Approver • Delivery Date • Net Value • VAT • Gross Value
2.2.8.2.2	Purchase Orders Pending Delivery • Supplier Name

	• PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value
2.2.8.2.3	Purchase Orders Completed • Supplier Name • PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value
2.2.8.2.4	Delivery Notes Pending Confirmation • Supplier Name • PO Number • DN Number • Delivery Date • DN Date • Days Overdue
2.2.8.2.5	Invoices Pending Approval • Supplier Name • Approver • PO Number • DN Number • Invoice Number • PO Date • Delivery Date • Net Value • VAT • Gross Value
2.2.8.2.6	Invoice Unpaid • Supplier Name • PO Number • DN Number

	• Invoice Number • PO Date • Delivery Date • Invoice Date • Due Date • Net Value • VAT • Gross Value
2.2.8.2.7	Invoice Paid • Supplier Name • PO Number • DN Number • Invoice Number • Payment Reference • PO Date • Delivery Date • Payment Date • Net Value • VAT • Gross Value
2.2.8.2.8	Payments Issued (each invoice/credit note on the payment document will have separate entries) • Supplier Name • Supplier Address • Supplier Vat Number • Credit Note Number • Invoice Number • Payment Date • Payment Reference • Net Value • VAT • Gross Value

2.2.8.3 Supplier Reports

Requirement	Description

2.2.8.3.1	*Purchase Orders Pending Confirmation* • Buyer Name • PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value
2.2.8.3.2	Purchase Orders Pending Delivery • Buyer Name • PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value
2.2.8.3.3	Purchase Orders On-Hold • Buyer Name • PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value • Notes
2.2.8.3.4	Purchase Orders Completed • Buyer Name • PO Date • PO Number • Delivery Date • Net Value • VAT • Gross Value
2.2.8.3.5	Delivery Notes Pending Confirmation • Buyer Name

	• PO Number • DN Number • DN Date • Days Overdue
2.2.8.3.6	Delivery Notes Completed • Buyer Name • PO Number • DN Number • DN Date
2.2.8.3.7	Invoices Pending Confirmation • Buyer Name • PO Number • DN Number • Invoice Number • PO Date • Delivery Date • Net Value • VAT • Gross Value
2.2.8.3.8	Invoice Unpaid • Buyer Name • PO Number • Invoice Number • DN Number • PO Date • Delivery Date • Invoice Date • Due Date • Net Value • VAT • Gross Value
2.2.8.3.9	Invoice Paid • Buyer Name • PO Number • DN Number • Invoice Number

	• *PO Date* • *Delivery Date* • Invoice Date • Due Date • Net Value • VAT • Gross Value
2.2.8.3.10	Payments Issued (each invoice/CRN on the payment document will have separate entries) • Buyer Name • Credit Note Number • Invoice Number • Payment Date • Payment Reference • Net Value • VAT • Gross Value

2.2.8.4 Administrator Reports

Requirement No.	Description
2.2.8.4.1	Supplier Delivery Performance • Supplier Name • Buyer Name • PO Number • DN Number • Delivery Date • DN Date • Days Overdue
2.2.8.4.2	Supplier Quality Performance • Buyer Name • Supplier Name • PO Number • DN Number • Delivery Date

	• DN Date • Damaged Items • Not Accepted Items • Days Overdue
2.2.8.4.3	Buyer Payment Performance • Buyer Name • Supplier Name • Invoice Number • Invoice Due Date • Invoice Days Overdue • Payment Date • Payment Reference • Net Value • VAT • Gross Value
2.2.8.4.4	Payments Issued (each invoice/CRN on the payment document will have separate entries) • Buyer Name • Supplier Name • Supplier Address • Supplier Vat Number • Credit Note Number • Invoice Number • Payment Date • Payment Reference • Net Value • VAT • Gross Value
2.2.8.4.5	Invoices Unpaid • Buyer Name • Supplier Name • PO Number • Invoice Number • PO Date • Delivery Date • Invoice Date • Due Date

	• *Days Overdue* • Net Value • VAT • Gross Value
2.2.8.4.6	Buyers List (available to Supplier and System Administrators) • Buyer Name • (Organisation details – to be confirmed) • Date registered • Date Credit Information last submitted
2.2.8.4.7	Supplier List (available to Buyers and System Administrators) • Supplier Name • (Organisation details – to be confirmed) • Date registered • Date Credit Information last approved (if System Administrator running report this should show list of Buyers that Supplier has approved with date next to each)
2.2.8.4.8	Transaction Volumes (available to System Administrator only) • Details to be confirmed, but some sort of KPI report to enable FoodPort administrators to verify contract adherence (ie: have the buyers been buying the volumes expected in the contracts), general system uptake (so are there organizations signed up who aren't really using the system much) etc.

2.3 Workflow of documents within the system

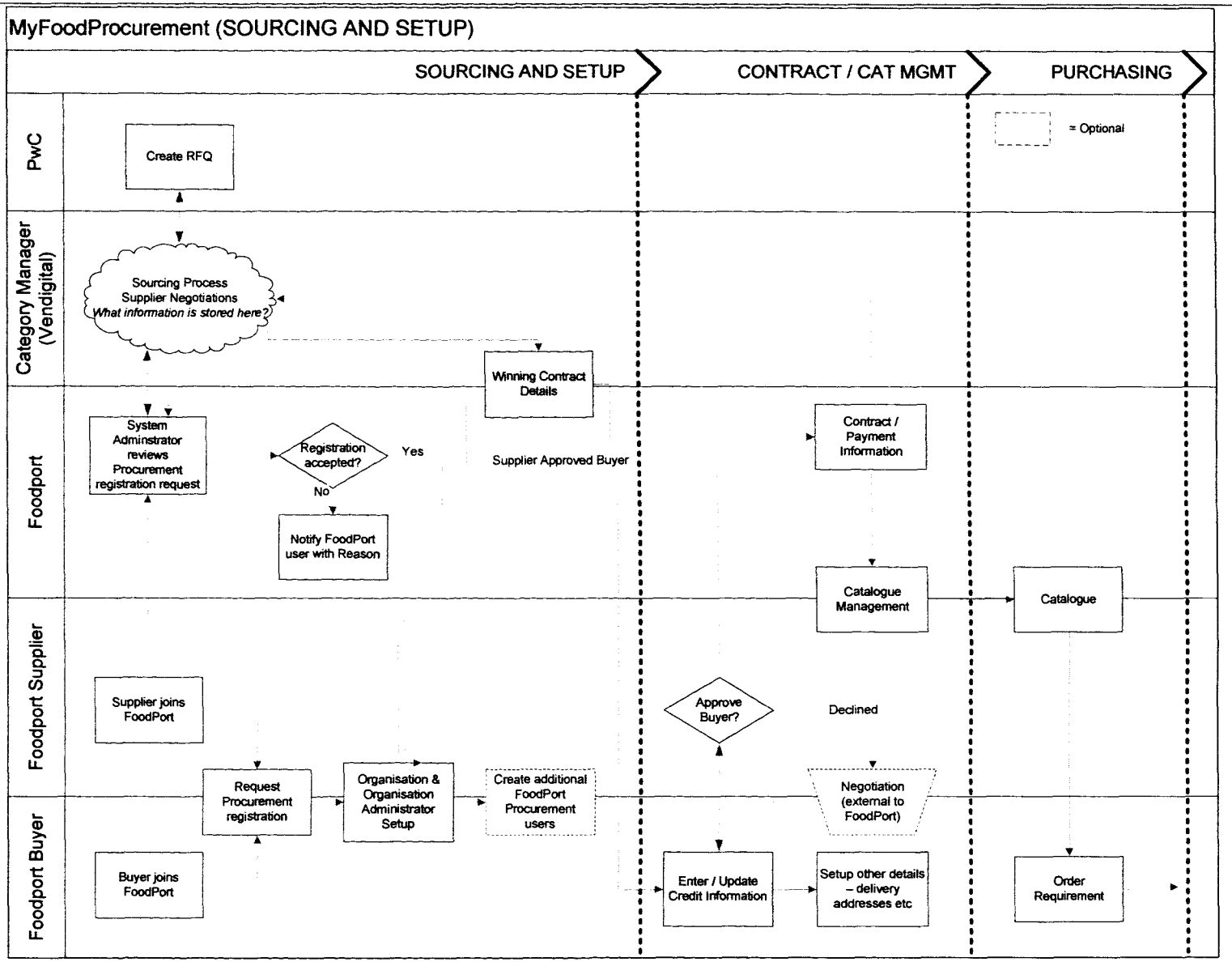
Definitions:
PO - Purchase Order
DN - Delivery Note
INV - Invoice
CRN - Credit Note

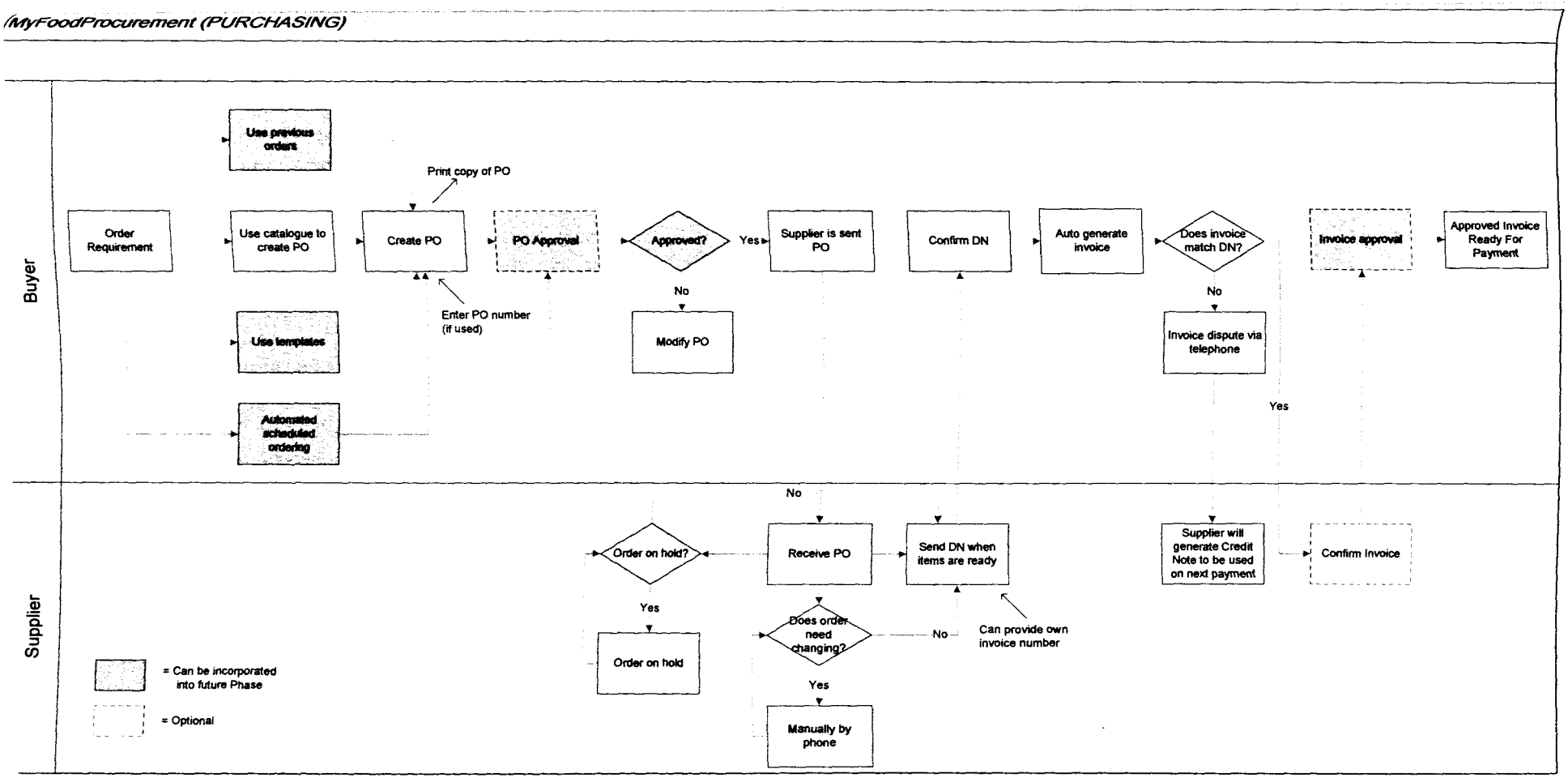
Document Type	State	Buyer	Resulting State/Notes	Supplier	Resulting State/Notes
PO	Draft	Submit	PO - Pending Approval / Pending Confirmation / Pending Delivery		
		Edit	None		
		Delete	Removed From System		
PO	Pending Approval	Approve	PO - Pending Confirmation / Pending Delivery		
		Reject	PO - Cancelled		
		Edit	PO - Draft		
PO	Pending Confirmation			Confirm	PO - Pending Delivery
				Reject	PO - Cancelled
		Edit	PO - Draft		
PO	Pending Delivery	Edit		Create DN	DN - Pending Confirmation
				Place On-Hold	PO - On-Hold
PO	On-Hold	Reinstate	PO - Pending Delivery		
PO	Completed	Use Previous PO	Copy of PO (in Draft state)		
PO	Cancelled				
DN	Pending Confirmation	Confirm	DN - Confirmed, related PO - Completed and creation of invoice in one of the following states: INV - Pending Confirmation/ INV - Pending Approval/ INV - Unpaid	Cancel	DN - Cancelled
DN	Confirmed				
DN	Cancelled				
INV	Pending			Confirm	INV - Pending Approval /

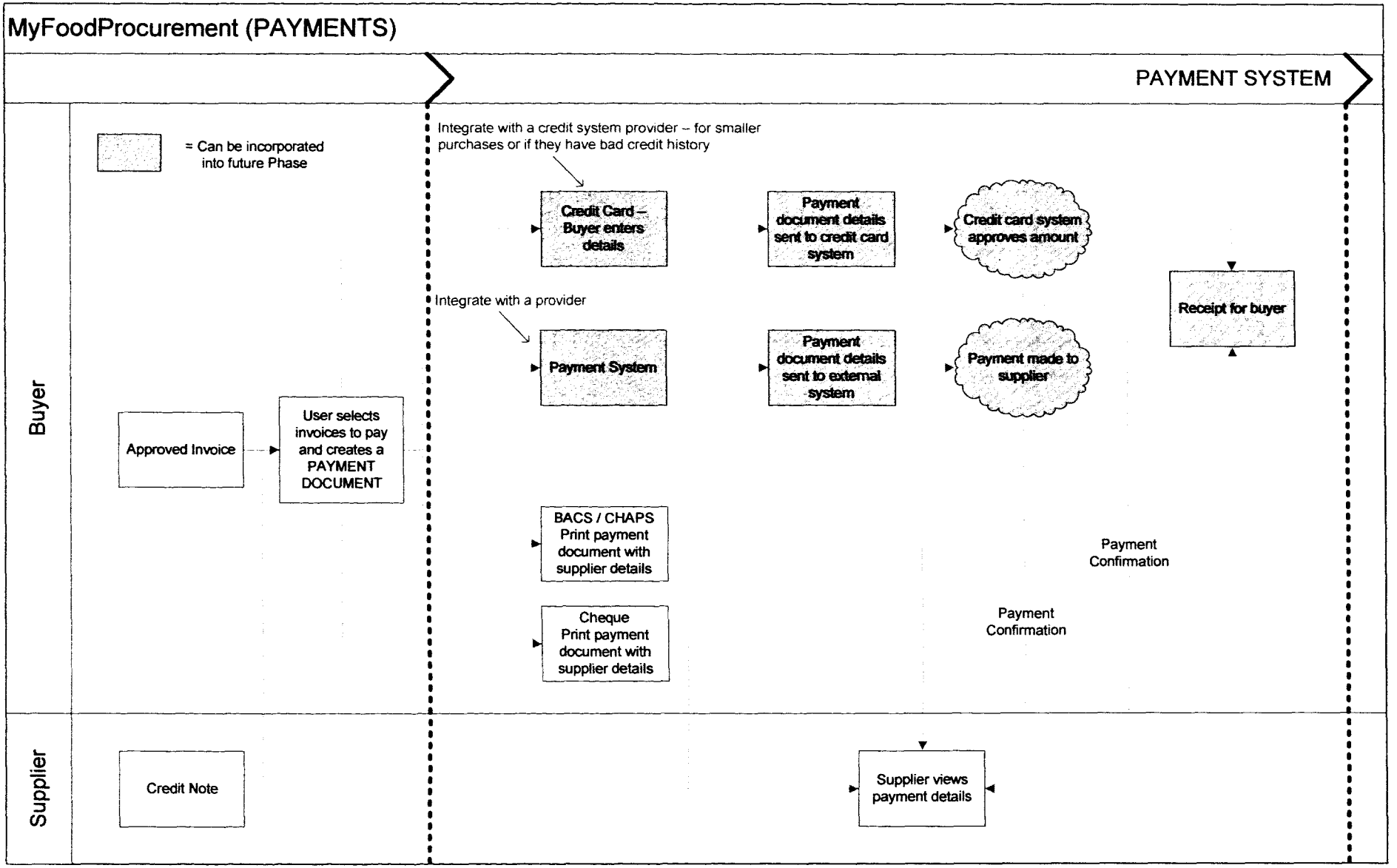
	Confirmation				*INV - Unpaid*
INV	*Pending Approval*	*Approve* *Reject*	*INV - Unpaid* *INV - Rejected*		
INV	On-Hold	Reinstate	INV - Unpaid	Place On-Hold	INV - On-Hold
INV	Rejected			Reinstate	INV - Pending Approval / INV - Unpaid
INV	Unpaid	Pay Invoice	INV - Paid - added to PAYMENT - Draft	Create CRN	CRN - Approved For Payment
INV	Paid			Create CRN	CRN - Approved For Payment
CRN	Approved For Payment	Use CRN	CRN - Used, CRN added to PAYMENT - Draft		
CRN	Used				
PAYMENT	Draft	Submit Edit	PAYMENT - Submitted PAYMENT - Draft		
PAYMENT	Submitted				

Matrix 1 – Workflow of Document States

2.4 High Level Procurement Process Flow




MyFoodProcurement (PURCHASING)
Buyer
Supplier
Use previous orders
Print copy of PO
Order Requirement
Use catalogue to create PO
Create PO
PO Approval
Approved?
Yes
Supplier is sent PO
Confirm DN
Auto generate invoice
Does invoice match DN?
Invoice approval
Approved Invoice Ready For Payment
Enter PO number (if used)
No
Modify PO
No
Invoice dispute via telephone
Use templates
Automated scheduled ordering
Yes
No
Order on hold?
Receive PO
Send DN when items are ready
Supplier will generate Credit Note to be used on next payment
Confirm Invoice
Yes
Order on hold
Does order need changing?
No
Can provide own invoice number
Yes
Manually by phone
= Can be incorporated into future Phase
= Optional


MyFoodProcurement (PAYMENTS)
PAYMENT SYSTEM
Buyer
Supplier
= Can be incorporated into future Phase
Integrate with a credit system provider – for smaller purchases or if they have bad credit history
Credit Card – Buyer enters details
Payment document details sent to credit card system
Credit card system approves amount
Receipt for buyer
Integrate with a provider
Payment System
Payment document details sent to external system
Payment made to supplier
Approved Invoice
User selects invoices to pay and creates a PAYMENT DOCUMENT
BACS / CHAPS Print payment document with supplier details
Payment Confirmation
Cheque Print payment document with supplier details
Payment Confirmation
Credit Note
Supplier views payment details

The following requirements are likely to be carried out after the core development identified for Phase 1a above:

2.5.1 Contract Review Functions

- Functions will need to be provided to assist in contract reviews
  - 2.5.1.1 Reports showing what RFQ's have been generated and which ones were fulfilled, what volumes were purchased etc.
  - 2.5.1.2 Ability to manage contracts over time periods (need to check with PwC how best to handle this).
  - 2.5.1.3 Possibly, functions to assist updating the catalogue with new contract info (search and replace type functions for example). Depends on answer to above question.

2.5.2 Catalogue Enhancements

- 2.5.2.1 Possibly add more sophisticated search options such as advanced search with and/or options.
- 2.5.2.2 Possibly allow different 'views' of the catalogue – ie: allowing one user to have main tree structure to be categories (packaging, freight etc) and show multiple suppliers within each product grouping, while another user has the main tree structure divided by supplier, with the categories then being sub-structures within. Need to check with PwC what the most likely scenarios are going to be.
- 3.2.3 Additional product fields/structures for new categories.

2.5.3 Purchasing Enhancements

- 2.5.3.1 Possibly allow users to select numerous products from different suppliers at one go, in which case the system would automatically generate a PO per supplier. Possibly a 'shopping basket' type function could be implemented. Also check with PwC for their opinion on this. See 2.2.4.1.2
- 2.5.3.2 Allow PO templates to be created and PO's to be generated based on those templates – see 2.2.4.2 & 2.2.4.3
- 2.5.3.3 Allow PO to be generated based on a previous PO – see 2.2.4.4
- 2.5.3.4 Allow PO to be setup on an automated schedule – see 2.2.4.5

2.5.4 Approvals

- 2.5.4.1 The system/organisation administrator should be able to create a number of approval rules which require PO's and Invoices to be approved based on a number of criteria. See 2.2.4.1.12, 2.2.4.6 & 2.2.6.3
  - e.g. total PO value. If PO is above £1000 it must be approved by a manger, if below it doesn't need to be approved. Notifications should be sent to the approver, who must then login to the system and approve the document.