

Using Social Media to Inform Supplier Selection in New Product Introduction

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ABSTRACT

Supplier networks today are seeing a complete redirection in their purpose from a decade ago. Supplier networks focused originally on transaction-oriented exchanges for sending purchase orders electronically. However, based on the current increased need to understand business risks, supplier networks are demonstrating a clear shift in emphasis from establishing “transaction-based focus” relationships towards the evolution of network platforms. The Aberdeen Group (2011) demonstrates that 76 per cent of supplier networks increasingly are being used to identify new suppliers and market opportunities. Moreover, with social-networking features similar to Twitter, LinkedIn and Facebook (which are very recent phenomena), supplier networks have become more important in their role of spending management based on the ability to help organisations identify new suppliers while sharing information with other buyer organizations. Therefore, analysing data from supplier networks today has become a necessary strategy for optimizing transaction-focused procurement, in addition to improving supplier relationships.

With this in mind, the Social Media Domain Analysis (SoMeDoA) framework has been developed to facilitate the decision-making process for selecting flexible suppliers within the e-procurement-based marketplace and apply it to a real set of data gathered from two social-networking sites (Twitter and LinkedIn). The research contributes a rigorous method that analyses effectively domain concepts and relations between notions from social networks and builds the domain ontology.

The effectiveness of the framework, in analysing domain and relations, is evaluated by its application to varying datasets gathered from social networks, including the pharmaceutical domain. This model extrapolates findings from stages in the research and marries elements from various papers and frameworks therein, in order to produce a guideline model for organisations seeking a suitable supplier with whom to work. The results of the evaluation are encouraging, and provide concrete outcomes in an area that is little researched.

This thesis is dedicated to my beloved parents and brother for their unconditional love, endless support and constant encouragement. Thank you for your limitless faith in my abilities.

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درد ما را در جهان درمان مبادا بی شما
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مولانا

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CHAPTER 1 INTRODUCTION

1.1 Motivation

Effective inter-organisational collaborations are vital means of gaining competitive advantage in today's global business. Over the course of only a few years, the web has become a portal for mass communication, a global sales channel, a platform for collaboration and a core feature of business strategy. The 'virtual organisations' that shed assets and use technology to bind a dispersed network of suppliers, manufacturers and distributors in one central market space have become a reality.

Electronic commerce is a revolution that many industry and academic observers believe will transform the conduct and structure of business (Pavlou and Fygenson, 2006; Turban *et al.*, 2004; Kauffman and Walden, 2001; Hagel and Armstrong, 1997; Kalakota and Whinston, 1997). The beginning of this revolution was influenced initially by person-to-person or peer-to-peer communication (Smart, 2010). From the late 1990s onwards, the business community embraced increasingly the internet as a medium for trading, transacting and collaborating (Kalakota and Robinson, 2001). The rapid, and often competitive, flow of change within web-based e-commerce presented an opportunity for practicing firms to become more efficient, reach more customers globally, lower operational costs and re-engineer the business processes (Kalakota and Whinston, 1997). The development of web-based e-commerce has impacted not only on governments, but also on the private and public sectors, which are seeking to achieve greater efficiency through technology deployment. Many new technologies have replaced electronic data interchange (EDI), an inter-organisational system of exchanging data through networks (Senn, 1992). Usually, EDI was established between communities within an industry or manufacturer to enable communication exchanges with its suppliers (Smart, 2010). Kurokawa and Leblanc (2001) and Ramamurthy and Nilakanta (1994) found that the size of the initial investment presented a significant barrier to EDI adoption. Therefore, the expensive nature of EDI, as a Web communication platform, made these networks redundant from global and virtual perspectives and led firms to explore wider opportunities for the exchange of information.

This exposition explores the newly commercialized electronic procurement marketplace (EPM) and its hypertext-based, multimedia-supporting "spin-off," the World Wide Web (WWW). EPMs are raising hopes of finally changing the face of costly, time-consuming and inefficient procurement processes by enabling major improvements in terms of lower administrative overheads, better service quality, timely location and receipt of products, and increased flexibility (Gebauer, Beam and Segev, 1998). Chaffey (2009) describes the development of the profile of industrial firms since 1970 by illustrating the progression from vertical to virtual integration, facilitated by technology (see Figure 1.1).

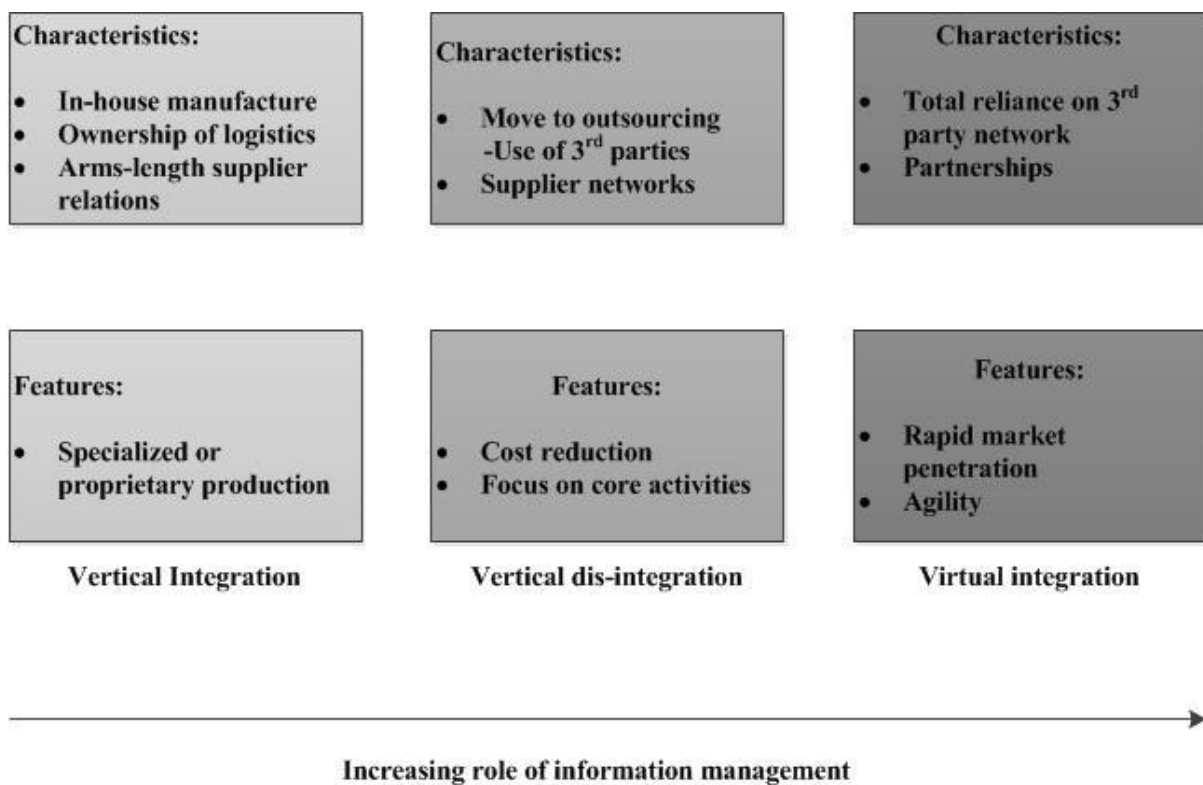


Figure 1.1: From vertical to virtual integration (based on Chaffey, 2009)

In Figure 1.1, the first level describes the organizational structure and how it has changed. For example, in the early part of the twentieth century, most large industrial firms were integrated vertically, owning most of the production equipment. The second level of the diagram presents the features of the industrial model, which is often characterised by the current need for agility and rapid market penetration. Cisco is an example of an organisation that is moving further towards virtual integration. This company has replaced the traditional functions of the firms, which were under direct ownership, with a network-based system of third-party suppliers, manufacturers and distributors (Kraemer and Dedrick, 2002). Firms

choose suppliers for strategic and operational reasons, such as reducing the cost of materials, components or services; innovation; access to new technology and R&D; higher quality; and taking costs off the balance sheet (Van Weele, 2009; Monczka, Handfield and Giunipero, 2008). The development of suppliers underwent a significant transformation; from mere providers of goods and services to a more integrated relationship with the buying firm. According to Womack and Jones (1998), manufacturers, such as the Japanese motor industry, prefer to work under long-term, rolling contracts with specific vehicle manufacturers as this is conducive to closer working relationships and lower lead times for supply. Indeed, selecting suppliers who are flexible in relation to rapid and on-going changes in the networked environment is one issue faced by organizations and EPMs. The reason for this was the fast pace of technological development and advancement, resulting in new product innovations in and improvements to the manufacturing processes. Organizational changes may affect the supplier side and the network in terms of adapting them on their systems. Consequently, and inevitably, these challenges would cause ambiguity and inconsistency within the relationship and environment, resulting in an adverse effect on organisational performance. For firms to be able to benefit from suppliers in new product developments, it is important to select the most appropriate supplier. This can be difficult. In the process of selecting suppliers for the manufacturing of components, the buying firm can evaluate the supplier according to a number of criteria. The number of criteria varies, but a recent review by Ho et al. (2010) has shown that the selection of the most appropriate supplier has typically focused on quality, delivery and cost, while less has been written about supplier selection from strategic collaboration perspective such as supplier selection in new product or service development.

Initially, the introduction of web technology, under the title of EPM, offered an opportunity to experiment with alternative methods of selecting suppliers by considering the factors of flexibility and robustness in order to increase corporate EPM and online sales, and decrease the risk of failure in the competition. Ambiguity and lack of inconsistency in the firms' and suppliers' relationships eliminate the power of flexibility for achieving effective EPM. Indeed, considering the continuous changes being made to the web, establishing the nature and role of selecting suppliers, how they are chosen and managed, and their contribution to the goals of the buying firm are less obvious in EPM literature.

1.2 Aim and Objectives

The aim of this research is to provide a *methodological approach for the development of decision making in the process of selecting suppliers*, with the aim of achieving higher matching quality as an outcome. The objectives of this research are as follows:

Objective 1 - Investigate existing flexibility factors and EPMs with the aim of learning about their strengths, weaknesses and best practices for utilising them in selecting a supplier process.

Objective 2 - Investigate the structure of the existing EPMs with the aim of identifying the associated gaps in their development processes, which are believed to eliminate flexibility factors.

Objective 3 - Identify the requirements for a flexible supplier selection approach in EPM development methodology in order to improve the state-of-the-art (taking into account the findings of Objective 1 and Objective 2).

Objective 4 - Develop a methodological approach/framework (SoMeDoA) that considers and covers the findings of Objective 3, which provides semantic clarity and coherence.

Objective 5 - Evaluate and demonstrate the practical adequacy of the proposed framework on datasets of domains of analysis.

1.3 Research Methodology

Design research is chosen as the research method for executing this study. The objective of design research is to produce a relevant IT-based solution to a significant business problem with a focus on the utility of the artefact (Hevner *et al.*, 2004). This approach applies a set of analytical techniques from the problem space to understand, explain and improve the designed artefact. Design research is considered both a product and a process: the process incorporates a set of design and behavioural science activities - build, evaluate, justify and theorise (March and Smith, 1995); while the products can be classified according to the following four-point product classification (March and Smith, 1995):

- Constructs are sets of concepts used to define the problems and solutions.
- Models are used to describe a real-world situation of the design problem and its solution space.

- Methods are used to provide guidance on how to solve problems using the constructs and models. They are thought of as methodological tools (March & Smith, 1995).
- Instantiations are the implementations of constructs, models and methods allowing actual evaluation, in terms of feasibility and effectiveness, of the design research artefact.

Design research must be applied as a search process for an effective solution, utilising and sustaining laws in the problem space. In order to demonstrate the effectiveness of the solution, rigorous design research evaluation methods from the knowledge space must be executed to evaluate the quality of the artefact (Hevner *et al.*, 2004). Design research seeks to achieve an appropriate solution to the design problem in an iterative knowledge refinement manner; whereby each iteration executes build and evaluate cycle, contributing new learning and knowledge that feeds back into subsequent iterations.

A design research process is employed as a problem-solving method; whereas valid IS research is achieved through an iterative build and evaluate design cycle of a purposefully designed artefact. The main design research phases applied are as follows:

Problem Awareness involves conducting extensive review and analysis of the related literature; specifically, employing a systematic literature review (SLR) to provide taxonomy of the EPM and flexibility concepts from which to develop a framework. Furthermore, a suitable domain can be identified that is appropriate for developing an flexible e-procurement market place FEPM framework. The SLR evaluation results will demonstrate that the pharmaceutical domain has been subject to little analysis over the past decade. Therefore, a set of semi-structured interviews in a pharmaceutical organisation will be conducted to discover the reason for this lack of analysis and issues specific to the pharmaceutical domain. One important problem facing the pharmaceutical organisation is the selection of suppliers in times of change.

Suggestion involves introducing a tentative idea of how the problem might be solved by the design of an appropriate framework. This step originates in Iteration 1 with the development of an appropriate concept extraction framework. Further suggestions arise in later iterations; for example, when social media network analysis is used to analyse how wider network opinion could help the pharmaceutical organisations select their suppliers. As new knowledge

is gained during development and evaluation of the developed framework, new suggestions from the build and evaluate cycles are used to initiate subsequent iterations.

Development is carried out by building a research artefact – a flexible EPM. The framework consists of flexibility factors with the purpose of better understanding the dynamic elements of EPMs and their importance over time with e-commerce and EPM evolution over the study period. Flexible EPM aims to incorporate and support the changes that have taken place in recent years. Flexibility categories are used as a means of supporting EPM design and use.

Evaluation is performed through an evaluation strategy that measures the validity and effectiveness of the research based on the performance improvements possible when using the developed framework over the existing domain. Design research evaluation criteria are adopted to examine the efficiency and generality of the framework. Applying the framework to a realistic EPM scenario taken from the pharmaceutical domain resulted in extending the developed framework that serves as an instantiation of flexible EPM. This framework is used to validate an experimental evaluation over the different set of social media network in Iteration 3.

Conclusion is where the research output is summarised, the results of the evaluation are identified and future improvement is highlighted. Limitations of the solution and areas for future work are also provided in the conclusion of the research.

Applying March & Smith's (1995) design research product classification to illustrate research contributions leads to identifying the main design artefact as the development of a matching process of selecting a flexible supplier. In order to deliver the final method, the research significance lies in building consequent set of constructs, models, methods and instantiations. These activities are executed in an iterative incremental design research manner consisting of the following three iterations:

Iteration 1 – the core framework developed in Chapter 2 is extended in this iteration by synthesising and analysing the existing knowledge base (SLR) and business need (expert interviews). Primarily, this iteration will provide a framework containing flexibility factors as the main design dimensions that need to be examined when designing and implementing flexible EPM. Moreover, the SLR analysis in this iteration will demonstrate the paucity of research tackling flexibility from an EPM perspective. Nonetheless, initial interviews with a pharmaceutical organization show that it is facing the problem of selecting flexible suppliers

with respect to the rapid changes taking place in e-marketplaces. Therefore, the importance of conducting empirical research throughout the next iterations is clear, whilst utilising and building on the initial framework.

Iteration 2 - Extending the framework to incorporate the process that pharmaceutical organisations are going through when they want to select flexible suppliers. This iteration contributes a secondary design research structured interpretation model of supplier selection by conducting studies on pharmaceutical industries to identify and understand the actual supplier selection process.

Iteration 3 - Evaluate and extend the framework by applying and evaluating the SoMeDoA method. The generality of this method will be demonstrated by comparing evaluation measures for two different data sets.

1.4 Thesis Overview

In order to achieve the objectives of the work, the thesis is structured as follows:

Chapter 2 - Drawing extensively from the literature, this chapter presents a review of relevant research articles, and provides a general background to EPM and flexibility factors. This literature review is organised into four main sections: the first presents a brief overview of EPM; the second provides a review of their flexibility and typology; the third provides a chronological overview of the web evolution to the development of FEPM; and the final section demonstrates how the two facets (EPM and flexibility) are used in conjunction in the literature so far. The aim of this literature review is to gain an understanding of the state-of-the-art in the above domains and further learn about the ways in which flexibility factors may facilitate matching processes in EPM-based organisations.

Chapter 3 - This chapter proposes using design research as the research methodology for effectively conducting a valid Information Systems study. It then discusses how this methodology is applied in order to plan and execute the research design problem, by developing a method for selecting flexible suppliers. Research iterations are identified and research outputs are categorised according to the design research product classification. The chapter discusses issues relating to supplier selection and presents a taxonomy of evaluation approaches in order to derive an appropriate evaluation framework for assessing the

effectiveness of the developed methodological framework. Finally, a summary of the chapter is provided.

Chapter 4 - This chapter presents the first design research iteration, tackling the concepts, empirical findings and the gaps in literature, and interviewing experts with the purpose of understanding the viability and likely evolution of EPM with respect to current and future flexibility requirements. This iteration design follows well-founded prescriptions gathered from the IS literature (Hevner *et al.*, 2004) for understanding the existing knowledge base (literature review) and business need (expert interviews). This review assists in identifying the domain of study (pharmaceutical industries) and gaps in the selected domain (primarily, for achieving greater flexibility in selecting suppliers), and a suggestion to undertake further investigation to identify and understand the actual supplier selection process within the pharmaceutical industry.

Chapter 5 – This chapter refines and extends the outcomes of the first iteration of the research by inductively identifying in-depth the process of supplier selection in pharmaceutical industries, while applying them to the conceptual framework outlined in Chapter 2. This chapter also discusses the potential solution associated with decision making for selecting suppliers and provides a set of guidelines for overcoming the problems of inflexibility.

Chapter 6 - The third research iteration is executed in this chapter to improve and evaluate the generality of the framework. It develops a SoMeDoA method for extracting and analysing domain specific data that aims to feed into the supplier selection process produced in the previous iteration. Evaluation of the SoMeDoA method is done by analysing and examining two real-life cases of pharmaceutical organisation activities on Twitter of the underlying domain. The aim of this iteration is to validate, improve and extend the supplier selection framework to include a wider view of organisations and people by analysing data from social networks.

Chapter 7 - This chapter concludes the research thesis and presents the contributions and key findings. An evaluation of the design research process is performed against satisfying the research aim and objectives, and highlighting the research limitations. Limitations that were learned from applying design research to solve the proposed problem are also explained. Finally, relevant conclusions will be drawn on the degree to which the proposed approach

meets its objectives, while future improvements based on the research limitations are presented.

For ease of reference, the structure of this thesis is mapped to its aims and objectives and is summarized in Figure

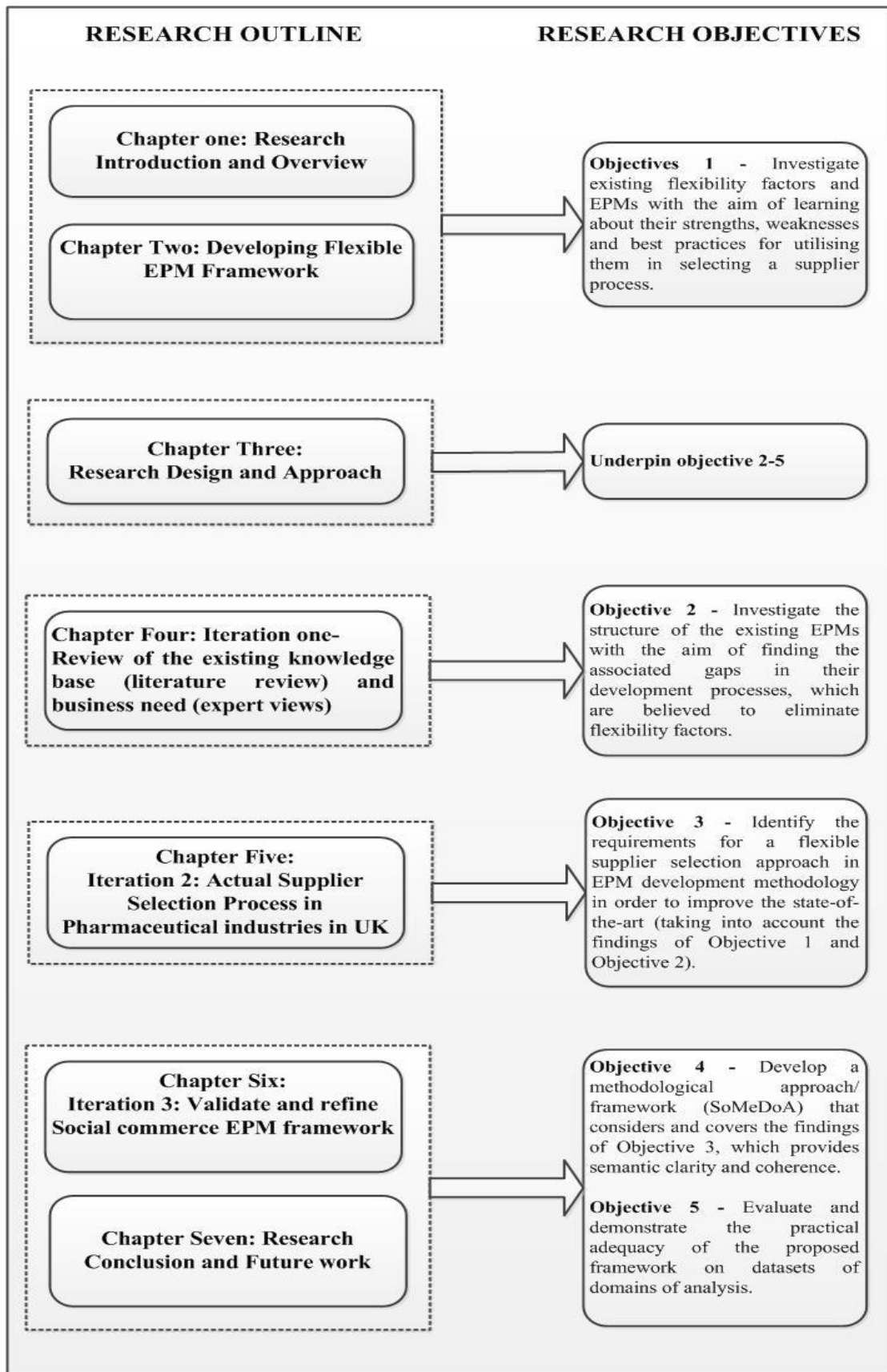


Figure 1.2: Research Outline and Objectives

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

In this chapter, the research focus of this thesis is positioned through a review of the literature pertinent to the field. It identifies the relevant themes that have informed the research agenda and outlines the investigative opportunities that have arisen through the identification of gaps in the current knowledge. This chapter reviews critically two intersecting fields of study that are necessary for this research: e-procurement marketplace (EPM) and flexibility. The aim of this literature review is to: (1) provide an understanding of state-of-the-art EPM and flexibility concepts (i.e. what constitutes EPM and flexibility); (2) web evolution analysis, with respect to EPM flexibility, is conducted in order to better understand the relationships between flexibility and EPM; (3) the modelling principles of flexible EPM (i.e. what guidelines organisations need to draw upon when modelling their flexible EPM, what are the characteristics of flexible EPM, and what features are included. Furthermore, this literature review assists in the conceptual framework of flexible EPM and facilitates the selection of an appropriate research methodology.

This chapter is structured as follows. Section 2.2 provides a general review of EPM. Section 2.3 introduces the need for understanding the flexibility factors required to manage EPM more synergistically. Web evolution with respect to EPM flexibility is presented in section 2.4 to provide the reader with a holistic overview of the research. Section 2.5 synthesises the different types of flexibility factors from the literature. Finally, section 2.6 provides a summary of the chapter.

2.2 E-Procurement Marketplace

In recent years, industrial e-markets (sometimes referred to *e-procurement marketplace (EPM)* or *business to business (B2B) e-marketplaces*) have become an instrument of attaining increased “efficiency in almost every sphere of economic activity” (Anandalingam, Day and Raghavan, 2005). EPMs are web-based platforms that facilitate commerce and trading among Internet-linked businesses (Zhu, Kraemer and Xu, 2003). Johnson (2010: 157) defines B2B e-marketplaces as “inter-organisational trading systems that seek to smooth out supply chain inefficiencies by facilitating buyer-supplier information exchange, products, services, prices

and transactions in an integrated and synchronous internet-based environment". Attaran et al. (2007) estimate that 90 per cent of all transactions occur between organisations that trade globally through EPMs.

Until the late 1980s, the majority of buyer-seller relationships were conducted in an arms-length manner, and were typically adversarial in the sense that both the customer and supplier tried to achieve a profitable deal at the expense of their opponents (Chang *et al.*, 2003). Importantly, this situation has evolved over the last ten years to one in which the customer-supplier relationship is actively managed. This closer relationship between stakeholders has developed at a time when the web has supported growth and decline in marketplaces. In particular, this has been clear in the case of one of the vital e-commerce areas; B2B electronic marketplaces (Ash and Burn, 2003). Essentially, B2B e-marketplaces, also known as EPMs, electronic supply chains, trading hubs or trading communities, are web-based procurement networks whereby one or more companies attempt to source their suppliers at the lowest possible cost (Ong, 2000). EPM provides electronically value-added communication, brokerage and integration services to customers as buyers and suppliers through handling of procurement processes using information and communication technologies, particularly with the help of the Internet (Chaffey, 2006).

By making this process web-based, EPM providers are changing the procedures in ways that go far beyond mere computerization and automation (Ageshin, 2001). Companies are able to source products and services at the lowest cost, while ensuring that those inputs match technical and other (tender) specifications (Ong, 2000). With the potential of EPMs to improve effectiveness and efficiency, a considerable number of marketplaces were launched during the dot.com boom period of the late 1990s. Their significance has not diminished since the dot.com crash and the subsequent emergence of many minor EPMs between 2001 and 2003 (Standing, Standing and Love, 2010), such as Efdex, Fyffes and Just2Clicks.

Although the majority of EPMs launched in the past decade have failed, hundreds have survived and, in some cases, thrived (Li and Li, 2005). Indeed, many successful EPMs continue to grow in terms of transactions, such as Alibaba, Global Healthcare exchange and cc-hubwoo. Alibaba.com manages an industry-specific EPM that has become the world's largest e-marketplace (Li and Li, 2005). Global Healthcare Exchange (GHX) is another; the world's largest EPM in the healthcare sector (Son and Benbasat, 2007). Cc-hubwoo is the leading global provider for source-to-pay electronic solutions and supplier network

management. The company manages the largest B2B e-procurement community in the world, with more than 60 buying corporations and over 12,000 connected suppliers in 44 countries worldwide (Standing, Standing and Love, 2010). Cc-hubwoo’s trading hub processes 2 million purchase orders, representing \$5 billion annually in customer spend value. Flexibility is required in order to grow customer numbers, transactions and industry-domain support.

A motivating factor for EPM deployment is its relative low cost and the resulting enhanced transaction cost efficiency, thereby improving the performance of purchasing rights, which are: the right price; delivered at the right time; the right quality; the right quantity; and from the right source (Wang, 2008; Smart and Harrison, 2003; Jap, 2000; Bakos, 1991). Figure 2.1 illustrates an embryonic conceptual framework of an EPM that enables customers and suppliers to submit their requirements and fulfil the demand in the shortest time and at the lowest cost.

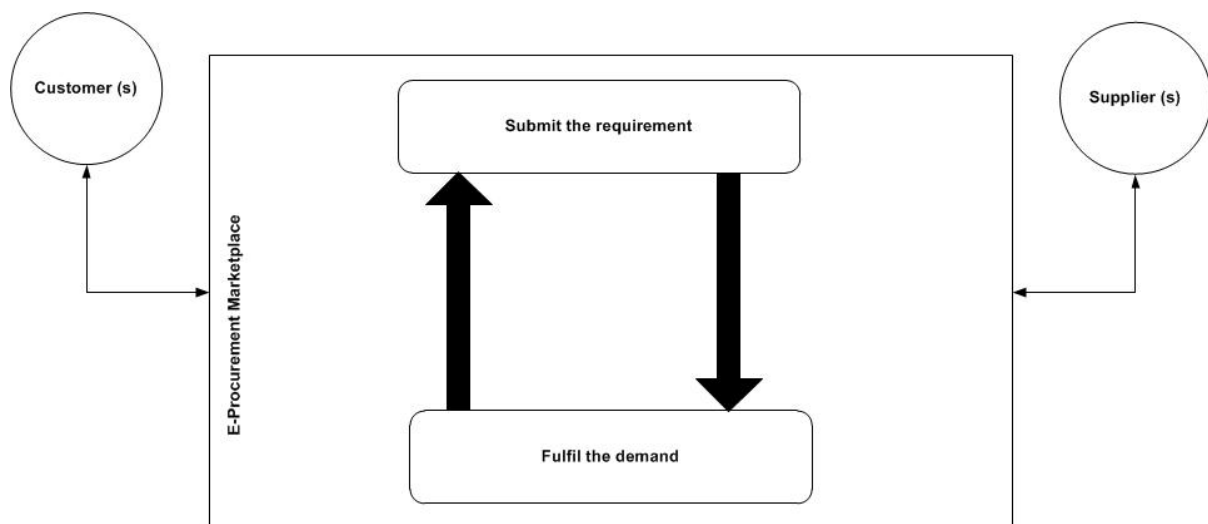


Figure 2.1: EPM

With increasing corporate procurement and selling completed on-line every day, the number of EPMs worldwide soared during the years preceding and following the millennium (Li and Li, 2005). One of the reasons for this increase is that further technological development and advancement is occurring at a faster pace, resulting in new product innovations and improvements in manufacturing processes. Surprisingly though, rapid and ongoing change is surpassed by the rate of failure. Customers are demanding more variety, and better quality and service, including reliability and faster delivery (Duclos, Vokurka and Lummus, 2003). A reduction in the number of EPMs has yielded some advantages for both customers and suppliers. For example, if there are more suppliers active within an electronic market, more

purchasing alternatives become available for customers. Opportunities to determine market price sensitivity and reduced search costs are provided by Internet technologies (Smart and Harrison, 2003; Jap, 2000). For suppliers, the more buyers there are in an e-marketplace, the more customers will select their products. There will be improved opportunities to sell excessive inventory and gather available market intelligence; all of which will result in an improved likelihood of increasing sales (Wang, 2008; Daniel *et al.*, 2004; Stockdale and Standing, 2002; Dai and Kauffman, 2001; Bakos, 1991).

Conversely, the reduction of and focus on fewer EPMs can result in small changes in procurement processes (either with internal systems or external customers and suppliers). This can have a major impact on the entire chain. In order to mitigate these effects, a flexible system is expected to provide timely delivery when conditions changes, including those to short-term demand (Fitzgerald, 1990). Unsurprisingly, a major concern of procurement managers is to address such changes more effectively; for example, how to manage the whole marketplace in light of changes (Fitzgerald, 1990). Indeed, by examining the literature, it is clear that many authors over the last decade have focused on changes to EPM, while few have considered how flexibility can be achieved. Eid *et al.* (Eid, Trueman and Ahmed, 2002) categorised flexibility into: marketing strategy; website; IT; technical support; global; internal; and external.

Researchers use the term “flexibility” to define different types of changes. The flexibility types offered so far address flexibility partially, with the primary focus being on infrastructure and system. Furthermore, the issues of relationships and trade-offs between flexibility types and the strategic pathway for managing flexibility on the EPM have not been adequately addressed.

In business, we observe a complex environment, increased competition, global challenges and market shifts combined with rapid technological developments (e.g., (Behrsin, Mason and Sharpe, 1994)), and the increasing importance of the world wide web and e-commerce. Vokurka and O’Leary-Kelly (2000) categorised these organisational challenges in EPM as: organisational; environmental; strategic; and technical. However, achieving flexibility is the main challenge for organizations. There has been little work conducted on how to manage the flexibility of EPM and further research is needed into how it can be used more synergistically in organisations. The requirement for flexibility across the EPM must be better understood and its dimensions uncovered in order to better define flexible, market-based e-procurement.

2.3 Flexibility

The term “flexible” is defined in the Oxford English Dictionary as “ready and able to change so as to adapt to different circumstances”. Upton (Upton, 1995) describes flexibility as the ability to adapt to changing conditions in order to ensure continuity of the organisation and respond rapidly to changes, both internal and external. Evans (Evans, 2002) discusses different terms that have been used instead of flexibility, such as “agility”, “elasticity”, “robustness” and “versatility”. It is important to note that there is no universally-agreed definition of flexibility (Oosterhout *et al.*, 2007). Fitzgerald (Fitzgerald and Siddiqui, 2002) considered flexibility as a characteristic essential for organisations to deal with the threats and opportunities that emerge through the increased dynamics and complexity of environments. In the manufacturing industry, flexibility is defined in terms of range, mobility and uniformity; i.e. the various states a system can adopt the ability to move from making one product to another and the ability to perform comparably well when making any product within a specified range (Upton, 1997; Upton, 1995; Slack, 1993).

Flexibility has been studied from an overall organisational, manufacturing and IS perspective. Indeed, by examining the literature, it becomes clear that many authors outline a number of taxonomies that address different types of flexibility, such as functional aspects: i.e. flexibility in operations; marketing; logistics (Garavelli, 2003; Kim, 1993); hierarchical aspects, such as flexibility at shop, plant or company level (Garavelli, 2003; Koste and Malhotra, 1999; Gupta, 1993; Slack, 1993); measurement aspects focused on global flexibility measures *vs.* context-specific ones (e.g., (Garavelli, 2003; De Groote, 1994; Sarker, Krishnamurthy and Kuthethur, 1994; Gupta, 1993; Chung and Chen, 1990)); strategic aspects centred on the strategic relevance of flexibility (Garavelli, 2003; Gerwin, 1993; Chambers, 1992; Nakane and Hall, 1991); and time-horizon aspects, for example long-term *vs.* short-term flexibility (Garavelli, 2003; Zelenovic, 1982).

Flexibility has been an important topic of interest to researchers in the area of operations management and extensively in the context of flexibility in manufacturing systems (Gerwin, 1993; Slack, 1993; Sethi and Sethi, 1990). The early frameworks of manufacturing flexibility are typically dependent on the internal operations and external environment (Gerwin, 1993; Slack, 1993; Sethi and Sethi, 1990). Slack (1993) describes five components of flexibility in the marketplace: new product; product mix; quality; volume and delivery. In 1987, he further stated that different types of flexibility are more important in some environments than in

others. In 1988, he designed hierarchal framework of flexibility to demonstrate that different competitive strategies will require different forms of manufacturing flexibility in order to improve competitive performance. In 2005, he modified the version of a previously presented hierarchy of flexibility. However, Slack's new framework suggests that availability, productivity and dependability are incorporated into a flexibility hierarchy that links companies' competitiveness with resource-level decisions concerning operational flexibility.

Gerwin (1993) describes the following seven types of flexibility: production equipment; product design; work organisation; planning and control procedures; and materials management and information technology in the marketplace domain. He worked on aspects of environmental uncertainty and designed the conceptual framework from strategy to environmental uncertainty and flexibility. He stated a company may reduce environmental uncertainty through, for example, long-term contracts with customers and suppliers, designing for manufacturability, taking preventive maintenance, and having total control over quality. Vokurka and O'Leary-Kelly (2000) expanded on different dimensions developed by Browne et al. (1984) and Sethi and Sethi (1990) on manufacturing flexibility to include fifteen elements (machine; material handling; operations; automation; labour; process; routing; product; new design; delivery; volume; expansion; programme; production; and market). The six main components of supply-chain flexibility, indicated by Duclos et al. (2003), are operations systems flexibility, market flexibility, supply flexibility, logistics flexibility, organisational flexibility and information system flexibility. He also proposed a framework for supply-chain flexibility based on these dimensions. Moreover, Parthasarthy and Sethi's (1993) strategic flexibility framework includes the industry's technological environment and its organisational structure. In 1995, Nilsson used the term "external flexibility" to refer to issues concerning rigidity in the relationship between the company and the outside environment. Nilsson describes two types: output flexibilities, which are found in the relationship between the company and its customers; and input flexibilities, which are found in the relationship between the company and its suppliers ((Nilsson and Nordahl, 1995a)). The framework begins with a description of the input transform output (ITO) model. This describes the flow of goods from suppliers, the transformation process and the impact on the customers. However, this model does have limitations; for example, its singular focus on one dimension of manufacturing - labour flexibility.

In fact, it can be seen in the literature that most of the frameworks address interrelationships in a limited form. Table 2.1 summarises the important frameworks and the types of flexibilities they have addressed from 1987 to 2002. Early approaches to manufacturing flexibility had a bottom-up structure, evolving from the basic flexibility types with respect to components such as volume flexibility (Fitzgerald *et al.*, 2009; Parthasarthy and Sethi, 1993; Slack, 1993; Sethi and Sethi, 1990; Browne *et al.*, 1984). More recently, research on manufacturing flexibility has considered top-down hierarchal structures and viewed flexibility in terms of manufacturing strategy or from a market perspective (Fitzgerald *et al.*, 2009; Barad and Even Sapir, 2003). Table 2.1 summarises a variety of reasons to consider flexibility as an important context.

Authors (year)	Flexibility type	Relevant contributions
Swamidass, P.M. (Swamidass and Newell, 1987)	Environmental factors	Industrial relationships, financial performance
Fiegenbaum, A. (Fiegenbaum and Karnani, 1991)	Organisational factors	Operations
Parthasarthy, R. (Parthasarthy and Sethi, 1993)	Strategy and organisational factors	Market, industry operations
Ettlie, J.E. (Ettlie and Penner-Hahn, 1994)	Strategy	New design, market, operation
Lee et.al (Lee and Hershberger, 1990)	Environmental	Human factors
Das & Elango (Das and Elango, 1995)	Strategic	Strategy
Upton, D.M. (Upton, 1995)	Organisational and strategy sactors	Operations, new design, resource
Nilsson, C.H. (Nilsson and Nordahl, 1995b)	Strategy, environment	Resources, market, buyer/supplier relations
Duncan (Duncan, 1995)	Technical	IT infrastructure
Safizadeh, M.H. (Safizadeh <i>et al.</i> , 1996)	Technology factors	Product, new technology
Suarez, F.F. (Suarez, Cusumano and Fine, 1996)	Organisational and technology factors	New product, buyer/supplier relationships , operations
Broadbent & Weill (Broadbent and Weill, 1997)	Technical, environmental	IT infrastructure, human factors
Upton, D.M. (Upton, 1997)	Organisational and technology factors	Operations, new product
Broadbent et.al (Broadbent and Weill, 1997)	Technical	IT infrastructure

Ward, P.T. (Ward and Duray, 2000)	Environmental and strategy factors	Market, resource, buyer/supplier requirements
Byrd & Tuner (Byrd and Turner, 2000)	Environmental	Human factors
Evans (Evans, 2002)	Technical	IT infrastructure

Table 2.1: Summary of flexibility literature (adapted from Behrsin et al. (1994))

Examination of past studies presents four general areas (technological, organisational, environmental and strategic) that comprise the dominant forces influencing flexibility in the manufacturing industry. Although these frameworks address the important relationship between manufacturing flexibility and one or two other flexibilities, they do not address the other equally important relationships involving manufacturing flexibility and technical, organizational, environmental and strategy (referred to in this study as TOES concerns). Frequent calls are made from users/suppliers for those aspects to be made more flexible, particularly in the face of turbulent environments. We deem that it is easier to visualize type of changes by associating them with flexibility aspects. Figure 2.2 illustrates the flexibility dimensions derived from the literature.

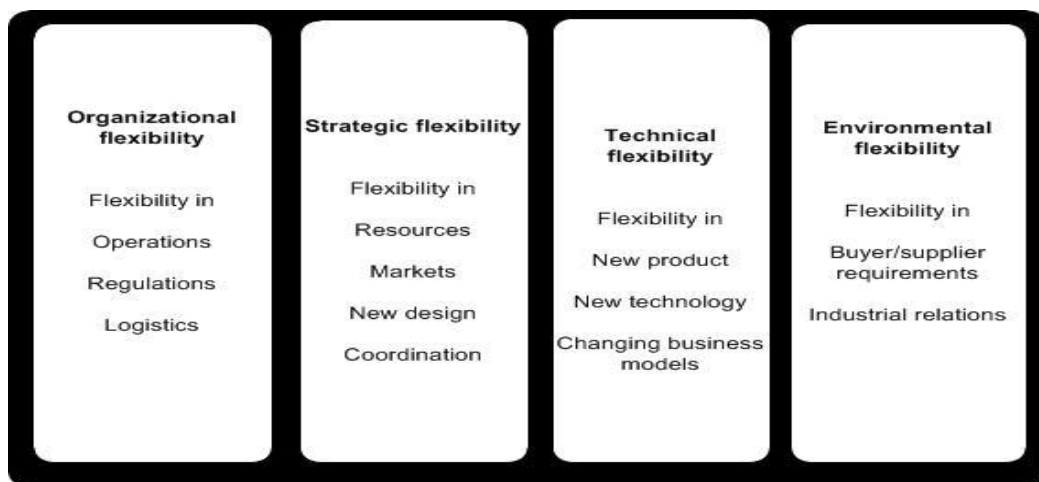


Figure 2.2: TOES concerns

More generally, flexibility represents the capability of a firm to respond to unanticipated environmental changes in its production process and in the marketplace. Manufacturing flexibility, which is one of the major competitive weapons for manufacturers in today's increasingly turbulent market (Beamon, 1999; Oke, 2005), has been well reported. However, as more participants become involved in the supply chain environment, including various suppliers, manufacturers, distributors, and customers, the relationships among them are

becoming increasingly complicated. As a result, there are more sources of uncertainty to be dealt with, such as supplier lead time, market demand, product quality, and information flow. Despite these changes, there is a lack of research on the nature of supply chain flexibility (SCF). In particular, the relationship between flexibility strategies and environmental uncertainties has yet to be fully acknowledged.

“Flexibility” has been investigated from the perspectives of economics (Lavington, 1921; Jones and Ostroy, 1984; Devereux and Engel, 2003) and organizational (Burns and Stalker, 1961; Boynton and Victor, 1991; Golden and Powell, 2000) for some time. In the area of operations management, flexibility was initially proposed to help managers deal with unexpected changes in manufacturing systems, such as equipment breakdowns, variable task times, queuing delays, and reworks (Sethi and Sethi, 1990). In this regard, flexibility signifies the ability to reconfigure a manufacturer’s resources to improve both productivity and quality. As a result of the increasingly globalized marketplace, inter-firm competition now extends to supply-chain competition. As this demands the cooperation of upstream suppliers and downstream distributors, the concept of flexibility needs to be expanded from manufacturing to include supply chain scenarios. A number of studies have addressed the need to reduce the risk in supply chains that contain environmental uncertainties, such as Wernerfelt and Karnani (1987), Caputo (1996), Sanchez and Heene (1997), van der Vorst et al. (1998), Pagell and Krause (1999), Childerhouse and Towill (2004), Bhatnagar and Sohal (2005), Sawhney (2006), Avittathur and Swamidass (2007) and Stevenson and Spring (2007). Sethi and Sethi (1990) noted that sophisticated computer and information technology and a flexible organizational structure underlie each of flexibility factors, both at the component and at the system levels. It is because of this technology that flexibility in manufacturing has become possible without a considerable sacrifice in efficiency. Hatum and Pettigrew (2007) introduced a combined approach that gathered three theories of organizational flexibility, innovativeness and institutional theory. They highlighted the fact that in order to study the determinants of organizational flexibility, it is necessary to explain the process of transformation of the firms in longitudinal data collection and range of qualitative and quantitative methods.

Fitzgerald et al. (2009) analyzed flexibility from manufacturing and information systems domains. They examined flexibility from information system, organizational behavior and manufacturing sides. They concluded with the fact that in the information systems context of flexibility is loosely defined.

Whether formulating strategy or developing IS architecture, flexibility is regarded as extremely important (Fitzgerald *et al.*, 2009; Gupta and Somers, 1996; Gerwin, 1993; Aaker and Mascarenhas, 1984). From the literature on manufacturing flexibility, a number of elements can be identified that might usefully be applied to EPM. First, flexibility appears to be a critical element of manufacturing success. Second, flexibility can be applied at a number of internally or externally levels; for example, to cover both internal organisational (marketplace) levels (organisational, strategic) and external levels (environmental). Furthermore, in order to build a system for on-line businesses, a number of hardware and software applications need to be synchronized, as stated by Vizard (2001). For this reason, Ozer (2002) reported that on-line firms acquire flexible technologies that enable them to add new applications to their systems (technical). We are aiming to cover both internal and external levels of the organisation (marketplace).

2.4 From Web Evolution to the Development of Flexible EPM

In order to better understand the relationship between flexibility and EPM, the evolution of the Web, with respect to EPM flexibility, has been analysed. The Web has undergone several periods of evolution in its short lifetime. For the purpose of this study, we refer to the period before 1990 as the “pre-Web era”, the early 1990s as the “reactive Web era”, the mid-1990s as the “interactive Web era”, and the period around the start of the 21st century as the “integrative Web era”. This terminology was taken from Chu (Chu *et al.*, 2007) and is presented in Figure 2.3.

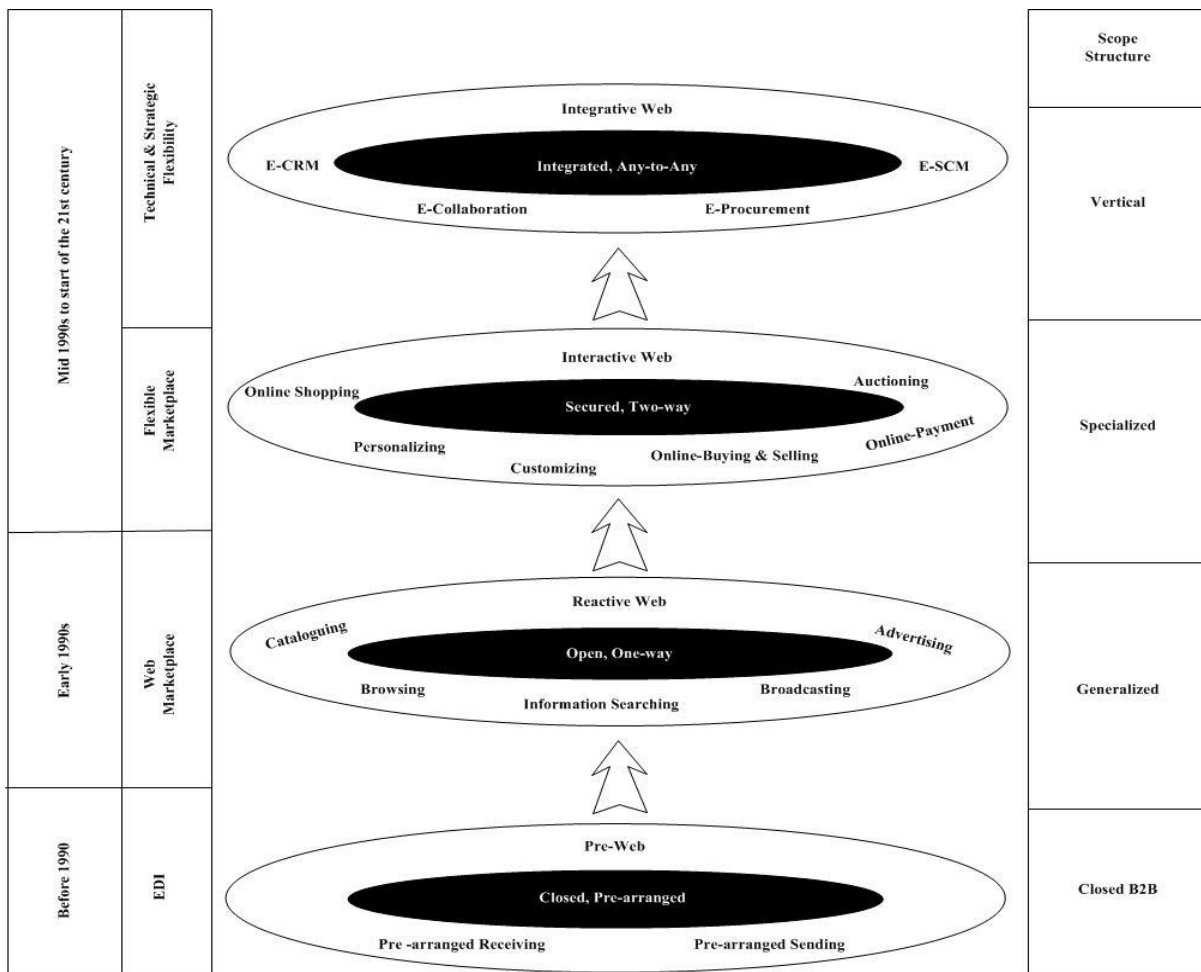


Figure 2.3: E-commerce web evaluation (adapted from Chu et al. (Chu *et al.*, 2007))

Before the advent of the World Wide Web, commercial activities were closed: the mechanisms of buying and selling were often rigid. In order to facilitate any digital engagement with business activities, communication channels had to be negotiated (Chu *et al.*, 2007). With the implementation of enterprise resource planning (ERP) or manufacturing resource planning (MRP) systems in the 1980s, electronic data interchange (EDI) connections with suppliers were established (Puschmann and Alt, 2005).

At this point, technology did not provide the open interfaces necessary for flexible business connectivity. It was a time of closed, one-to-one relationship, but the need to develop and take advantage of the Internet was observed. In the early 1990s, with the commercialisation of Internet and open computer technology, connectivity became affordable to businesses of all sizes; thereby enabling smaller suppliers to enter the network at this reactive phase. However, connected common messaging formats for encoding business activities were not developed and open communication could not be established (Chu *et al.*, 2007).

Relationships with business partners were designed in indirect procurement (Puschmann and Alt, 2005), which focused on products and services for maintenance, repair and operations (MRO) and products and services that are neither part of the end product nor resold directly (Zenz, 1994). As e-business activities expand across businesses and industries, e-business processes and on-line management of business processes have evolved into a separate genre of website. The Internet allows the sharing of information, and open access to product and pricing data. With the integration of electronic markets and the potential of EPMs to improve their effectiveness and efficiency, a considerable number of marketplaces were launched during the dot.com boom of the late 1990s (Li and Li, 2005; Poirier and Bauer, 2000). Despite the emergence of new communication opportunities, a request for information was typically still a one-way street and businesses could react only to requests (Chu *et al.*, 2007). Furthermore, a lack of secure transmission of confidential information limits the expansion of EPM activities.

In the mid-1990s, the interactive Web grew in terms of size and capability. Many firms implemented web-based applications and Internet-derived economic change continues to occur. With developing EPM websites, interactive two-way negotiation of buy–sell transactions arises. Moreover, personalisation and customisation became the main capabilities in online shopping as a result of interactive processes using new languages (Stockdale and Standing, 2004). E-shopping, personalised buying, e-selling and new business functions, such as ranking, matching authentication and contracting, are a result of new EPM activities. Flexible marketplaces evolved from these new Web features.

In the late 1990s and early 2000s, active management became imperative and interoperability began to emerge in some websites. This stage involves the creation of an Internet platform based on XML, which is used to coordinate procurement and distribution flows with suppliers and customers via the network (Muffatto and Payaro, 2004). In essence, it was the creation of a virtual network in which consortia of similar companies collaborated to increase the efficiency of particular processes. The other major requirements that were satisfied during this time of evolution were data sharing, on-line decision support systems, accessibility of databases (Chu *et al.*, 2007; Carlsson and Turban, 2002) and an integrative Web. Many tools are available to support more fully EPM processes. These have been developed by key EPM players, such as Ariba, CommerceOne, Oracle and SAP. The activities and processes were intertwined on-line to create a dual-purpose website as both an EPM and management

platform. Facilities provided by such websites enhanced collaboration, strategic alliance and business services; for example, SCB Co-op, Scotland. The strategic advantage in SCB Co-op is to provide a cost-effective, collaborative procurement website; thereby, reducing the need for substantial investments in technology and infrastructure management. Suppliers are more focused on selling their products (Tetteh and Burn, 2001). In contrast, buyers are offered access to a wide range of goods and services at low prices due to the low cost associated with marketing and distribution channel management for the vendors (Tetteh and Burn, 2001). Further examples of this type of website include Leading Agents in Australia (LAA), Best of Italy (BOI) and Sofcom.com.au.

The evolution of the Web has played a large part in the flexible nature of EPM over the review period. Web technologies have been adopted by EPM platforms to support businesses of varying size and with differing technological capability. The needs of an infrequent supplier of widgets require less technological integration than that of a key supplier. The variation in technological integration with newer Web technologies provides support for differing collaborations. EPMs have also provided a channel for technology adoption by the vast network of buyers and suppliers in the market; supporting and distributing technologies within (or interfacing into) their platforms.

2.5 A Synthesis of Flexibility Types into an EPM Framework

This section will synthesise the EPM and flexibility literature into a framework, in order to provide a context in which the systematic literature review can be undertaken. Table 2.2 outlines the need for flexibility, summarised from the literature on EPM.

The framework is conceptual in that it is amalgam of existing work that provides a basis for further analysis. Importantly, the framework and underpinning TOES concerns are grounded in the evolution of e-commerce and EPM evolution across the volatile study period. Examination of flexibility may begin with a specific domain of concern, such as an EPM, and consider how a more flexible design could be achieved; for example, the delayed delivery of goods as a result of changes to the limitations of technical platforms. The literature provided a considerable number of factors that could be judged as influencing EPM flexibility. The factors are synthesised in the framework and can be further explored according to levels of frequency of occurrence and influence. At the highest level, certain factors are determined by the organisational aspects in which the marketplace and companies operate. At the next level,

certain factors are determined by strategic aspects in which the marketplace operates. A further two aspects are included: technical and environmental.

Flexibility is required to	Reference
Response to changing market condition, regulations	(Das and Elango, 1995) (Parthasarthy and Sethi, 1993) (Upton, 1995) (Suarez, Cusumano and Fine, 1996)
Response to customers and suppliers requirements	(Byrd and Turner, 2000) (Ward and Duray, 2000) (Broadbent and Weill, 1997)
Response to changes in technology	(Evans, 2002) (Broadbent, Weill and Neo, 1999)
Changes in business strategy	(Michie and Sheehan, 2005)
Changes in business models and processes	(Gebauer and Scharl, 1999) (Sommer, 2003)
Changes in the level, location and type of resources (e.g. data, storage, applications, services, transactions, bandwidth)	(Englehardt and Simmons, 2002) (Lucas Jr and Olson, 1994)
Changing in industrial relations and coordination (agreements and outsourcing arrangements)	(Pagell and Krause, 1999) (Dangayach and Deshmukh, 2001) (Fitzgerald and Siddiqui, 2002) (Chang <i>et al.</i> , 2003)
Management of financial flow	(Gamba and Triantis, 2008; Abernethy and Lillis, 1995)
Development or adoption and deployment of products, services, systems, logistics, architecture, applications and data	(Upton, 1997) (Englehardt and Simmons, 2002) (Lucas Jr and Olson, 1994)

Table 2.2: Need for flexibility in the EPM domain

2.5.1 Flexibility and Technology

Technological flexibility refers to the ability to acquire and use flexibly hardware and software. As Vizard (2001) reported, in order to build a system for on-line business, a number of hardware and software applications need to be synchronised. Without this co-ordination, companies will be locked into using rigid systems that hamper their evolution, and will be prohibited from benefiting from system upgrades and patches. Nelson et al. (1997) define technology flexibility as consisting of structural and process flexibility. Structural flexibility “reflects the ability of the design of a technology to be adapted to changes in the business process and is pro-actively designed into the technology”. Process flexibility is “the ability of

people to make changes to the technology using management process that support business process changes” (Nelson and Ghods, 1998).

Within e-procurement on-line exchanges, flexible technology can bring efficiency by having the same technological platforms, and using compatible software to accommodate the different technologies used by buyers and sellers. Chen (2009) indicated that technological flexibility was one of the reasons for Citibank’s B2B site CitiCommerce failing to take off in Asia. An example of technological flexibility in EPM is flexible extranet sites. Technical flexibility in extranet sites is driven by customers who require an ability to store purchasing contract, pricing and purchasing histories, and for suppliers when coping with this growing and changing customer demand. Upton (1997, 1995) noted that other aspects may affect technological flexibility, including the age and scale of the product technology and production flexibility. In particular, Upton found that as the scale of technology increased, its flexibility decreased. Alternatively, if the age of technology increases (older equipment or software platforms), the level of product flexibility will likely decrease. However, older technology is able to increase production flexibility as it copes better with the process instabilities that result from production (1997, 1995). Vokurka (2000) argued that different dimensions of manufacturing flexibility do not impact equally on the different aspects of technology. Technological flexibility can help EPM become more competitive in rapidly changing environments. However, technology is not the only factor that needs to be addressed; other elements also require consideration. In support of this assertion, Ozer (2002) stated that technology gains importance when other system components function effectively.

2.5.2 Flexibility and Organisation

Organizational flexibility is defined as “the ease with which the organization’s structures and processes can be changed” (Huber and McDaniel, 1986) (p. 583). Volberda (1999) states that organisational flexibility can implement a variety of actual and potential procedures in order to increase the control capability of the management and improve the controllability of the organisation and environment.

Organisational flexibility in EPM recognises the reconfiguration and adjustment of operations. It will only be as successful as the flexibility of the workforce and organisational environment allows (Duclos, Vokurka and Lummus, 2003). Consequently, major challenges for organisations arise from environmental fluctuations that disturb their equilibrium (Palanisamy, 2005). One solution to this problem is to design operational characteristics and

appropriate behavioural aspects within organisations. A key question here is what organisational characteristics and behaviours are important in the realisation of manufacturing flexibility. Suarez et al. (1996) identify the beneficial effects of several managerial-based policies involving the use of lean management practices, supplier involvement and utilizing fixed wage scales on new design, volume and production flexibilities (Vokurka, and O'Leary-Kelly (2000), Suarez, Cusumano and Fine (1996)). The organisational aspects studies by Upton (1997, 1995) revealed that several relationships are involved in product and production flexibility. He examined the effect of production and product flexibility on managerial aspects and found that the workforce structure impacted negatively on product flexibility; whereas it had a positive effect on production flexibility (Upton, 1997; Upton, 1995). A possible reason for this is that less experienced operators may be more flexible in their ability to make certain types of changes quickly between products. Once internal operational flexibility is achieved, the practitioner needs to look more widely at the business environment. Organisational flexibility can help EPM to anticipate, respond or adapt to changes, such as structure, policies, processes, finances, and mergers and acquisitions (Fitzgerald *et al.*, 2009; Land, 1992; Longworth, 1985). Accordingly, careful design and management of EPM is required in order to increase organisational flexibility and performance.

2.5.3 Flexibility and Environment

This section indicates clearly the importance of any system or organisation being able to cope with changing circumstances – whether they are externally or environmentally generated – and, in particular, changes in market conditions. From an external perspective, the management capability to influence the environment (or interface to the environment) helps the firm become less vulnerable to environmental changes (Fitzgerald *et al.*, 2009; Volberda, 1999). Vokurka (2000) explained the ability or inability of management to predict new events in their organisational environments with a resulting unbalance between products and orders. Bourgeois (1980) classified environmental flexibility as attributes referring to the diversity in external factors facing an organisation or organisational legislations, and the degree of stability or instability in the marketplace in which a firm operates. Aaker et al. (1984) defined flexibility as the ability of a firm to cope with instability caused by the environment. As noted by Beckman (1990) (p. 127), “it is important that your company understand what types of variability it is dealing with, as they each may require different types of flexibility on the part of the organization”.

Environmental flexibility (reacting to unpredictable changes in the environment) relates closely to market flexibility; unsurprising, as the market operates within an environment. Wernerfelt (1987) and Sethi (1990) summarised some of the EPM's contextual factors with respect to environmental flexibility as industry (e.g., competitive environment, mergers), globalization of business and changing business.

2.5.4 Flexibility and Strategy

Strategic flexibility is “an expedient capability for managing capricious settings, such as those confronted in technology intensive arenas” (Evans, 1991) (p. 69). Strategic flexibility consists typically of managerial capabilities in relation to organisational goals or environmental volatility (Fitzgerald *et al.*, 2009; Aaker and Mascarenhas, 1984). This form of flexibility is largely qualitative in nature and can have a major impact on organisational activities (Fitzgerald *et al.*, 2009). More holistically, strategic flexibility can be considered as the relationship between the business environment, business strategy formulation and manufacturing strategy (Beach *et al.*, 2000). Strategic flexibility within an organisation could create a new product and market combination, using market power to deter entry and control competitors, or engage in political activities to counteract trade regulation (Fitzgerald *et al.*, 2009). From this perspective, it could also be critical when applying new technologies (including platform or process changes to EPMs being utilized) and renewing products or services (Fitzgerald *et al.*, 2009; Aaker and Mascarenhas, 1984).

Theoretical relationships between flexibility and strategy have also been of interest (Kumar and Maher, 2008; Beach *et al.*, 2000; Vokurka and O'Leary-Kelly, 2000; Gerwin, 1993). The earliest empirical study examining the link between strategy and manufacturing flexibility by Ettlé and Penner-Hahn (1994) investigated product concentration and focus within the manufacturing strategy, and two findings were reported. First, the researchers found that increased focus on the firm's manufacturing strategy resulted in lower production flexibility, as measured by the number of unique parts scheduled for production throughout the year. Second, they found no demonstrated effect of strategy on product flexibility (Vokurka and O'Leary-Kelly, 2000; Ettlé and Penner-Hahn, 1994). Daniel (2004) stated that a strategy adopted by an organisation impacted on its involvement with an EPM and what type of marketplace it chooses to participate with. From the above discussion, it can be acknowledged that strategic flexibility is able to impact critically on organisational

effectiveness. If flexibility is ignored, systems may be created that become a barrier to, or inhibitor of, change (Fitzgerald *et al.*, 2009).

2.5.5 Matching Flexibility

Matching flexibility represents the use and adoption of flexibility elements (TOES concerns) in the process of matching requests and responses (*bids* and *offers*) of the suppliers and customers, including their specification (see Figure 2.4). It is envisaged that each concern will be addressed practically in the design or selection of an appropriate marketplace or planning its usage.

Fisher *et al.* (1994) state that an accurate response to organisational changes, as well as on-line procurement, increases the matching capability. This impacts financially on the organisations (Fisher *et al.*, 1994). Childerhouse *et al.* (Childerhouse and Towill, 2000) have developed a route map for supply chains to match customer requirements. They state that, in order to avoid costly and ineffective mismatches from strategy to product characteristics, flexible matching should be considered an important perspective. Standing *et al.* (2010) provide a comprehensive review of more general e-marketplace literature from 1997-2008, highlighting the key themes of electronic market theory, systems perspectives, adoption, organisation implications and e-commerce issues. They state that further research is required on the e-marketplace selection process to guide firms in matching their requirements to types of e-marketplaces.

Although, typically, EPMs have a positive impact on organisations and the wider economy, Bao (2009, p.119) states that a “large number of innovations have failed in the marketplaces despite their benefits to the organisations and to economy”. Indications are that many organisations experience challenges when adopting innovation in e-marketplaces (Standing, Standing and Love, 2010; Johnsen, Howard and Miemczyk, 2009; Teo, Lin and Lai, 2009; Pavlou and Fygenson, 2006; Teo and Ranganathan, 2004). Loukis *et al.* (2011) investigate the main barriers to the adoption of B2B e-marketplaces by large enterprises, including the difficulties of integrating large and complex internal information systems with EPMs, the lack of common technological and procedural standards for the communication and exchange of information with all EPMs, inconsistent rules and regulations and a lack of trust in unknown suppliers. Johnson (2010) categorises the barriers of EPM adoption as risk perception, knowledge deficits, trust, firm size and organisational readiness. Based on the above barriers and extensive supporting research (White *et al.*, 2007; Hartley, Lane and

Hong, 2004; Stockdale and Standing, 2004), most of the challenges arise from a lack of reciprocal knowledge among organisations and EPM owners. Many believe that one way to improve knowledge between transaction partners (organisations and marketplace owners) would be through the use of social media websites (Swamynathan *et al.*, 2008). Conversely, many believe that in order to achieve the highest matching flexibility, the system first needs to be analysed internally (Goffin, Lemke and Szejczewski, 2006). Figure 2.4 presents the initial conceptual framework of flexible EPM, according to the need for flexibility summarised from the literature on EPM (Table 2.2) and the need to improve the relationship between transaction partners.

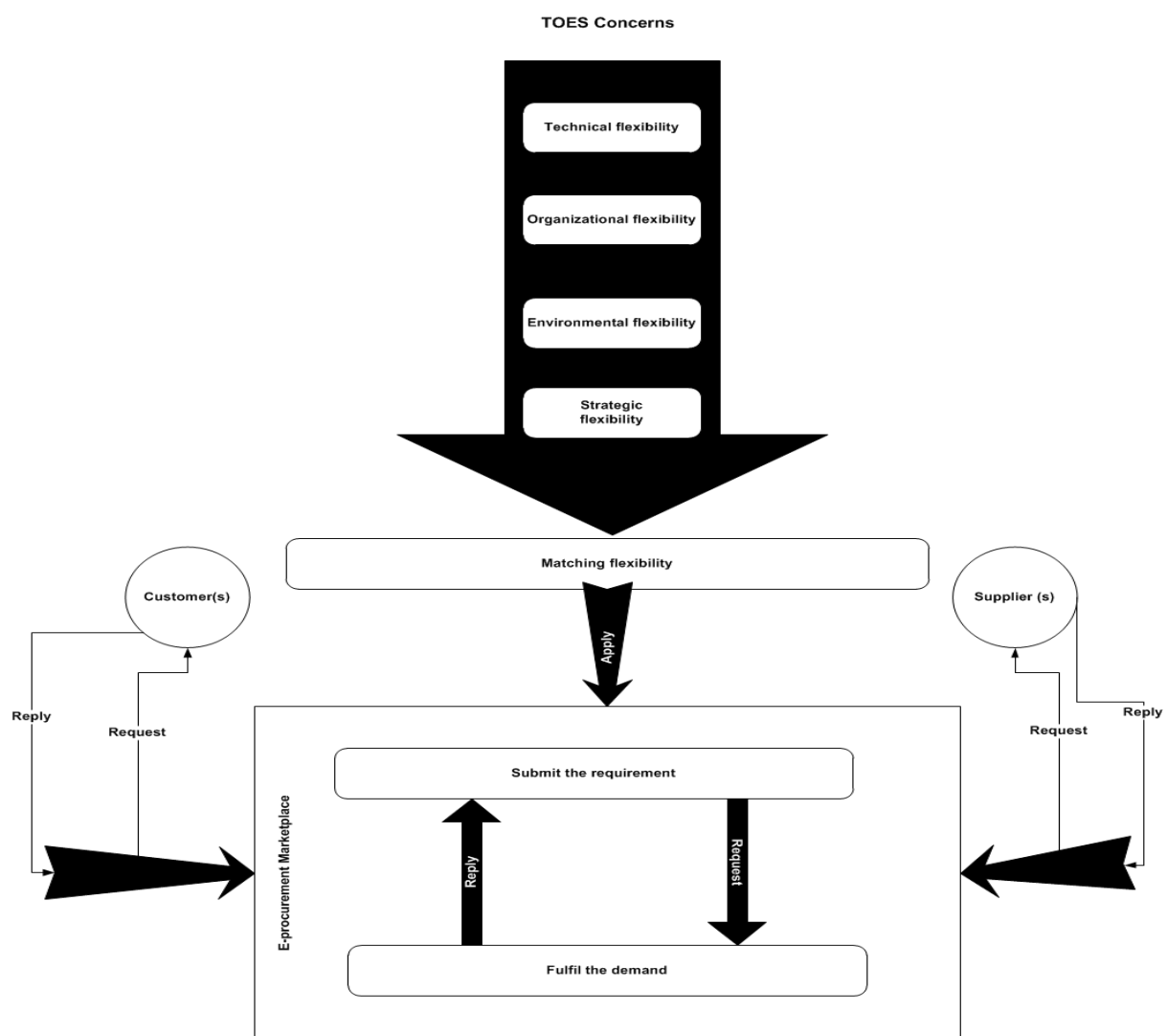


Figure 2.4: Matching flexibility of the EPM framework

2.6 Summary: Literature Findings and Research Direction

This chapter has studied and analysed separately and in combination the literature related to the following three facets: (1) EPM; (2) flexibility in EPM; and (3) matching flexibility. These are considered the backbone of the design methodology developed in this research. To utilise the flexibility factors in standardising the process and development, and minimizing the number of challenges, there is a need to re-engineer existing model and process development methodologies. Therefore, the first step in this journey was to study a longitudinal view in times of great volatility and to understand the viability of EPMs with respect to current and future flexibility. This study led the researcher to understand not only the lack in supporting literature, but also their development approaches. These approaches are not very critical and the literatures are developed in a semi ad-hoc manner. The necessary practical insights required the design of a more rigorous approach, which could cater for most flexibility development for the organisations in various domains.

CHAPTER 3 DESIGN RESEARCH METHODOLOGY

3.1 Introduction

In any discipline, the research community agrees upon the set of systematic activities considered suitable to the production and validation of knowledge. In a multidisciplinary paradigm, such as Information Systems (IS), there exist a number of research methods, which differ fundamentally. Among them, the phases employed include, techniques and philosophical aims, and the structure of those phases. This chapter investigates and presents Design Research as the chosen methodology with which to execute this research. It will detail the phases, techniques and philosophical background behind this method. Design Research employs a set of techniques to implement research in Information Systems. Normally, this entails analysing the use and potential of the designed artefact. The chapter also presents the justification for choosing Design Research as the framework to guide the research execution.

Section 3.2 of the chapter introduces the background to Design Research and provides reasons for its validity as a research method. In general, Design Research as a methodology for IS research is described in Section 3.3, giving a broad review of major Design Research frameworks in IS and detailing the main strategy in those frameworks. Section 3.4 presents Design Research evaluation criteria associated with artefacts and typical evaluation methods. Section 3.5 presents the design plan for this thesis and explains how the Design Research method is applied, while Section 3.6 introduces the research evaluation and provides a general background to flexible EPM framework evaluation. Finally, Section 3.7 summarises the chapter.

3.2 Design Research Background

IS design is defined as “the purposeful organization of resources to accomplish a goal” (Hevner *et al.*, 2004b) (p.78). It is important to discuss how design can be incorporated as a research method if the main aim is to change a current situation related to organizational or social systems into a more desirable one through the development of novel artefacts (Hevner *et al.*, 2004). Hevner *et al.* (2004) regard Design Research as an innovative means of solving a problem, while Edelson (2002) and Winter (2008) distinguish Design Research by the

generality of the proposed solution in that it can be applied to a wider class of situations; thereby leading to design science. Simon (1996) makes a valid differentiation between behavioural science and design science by unfolding the science of the artificial; Simon introduced the notion of an artefact, viewed as a link between the inner and outer environment in the search for a solution that fulfils the desired goal in seeking a satisfactory design, rather than an optimal one. Design is a learning process through which the underlying artefact development process is observed differently and learned.

Design Research, as presented by March & Smith (1995), signified the beginning of a new research era. This new era enabled research to achieve both relevance and effectiveness by combining research output (product) and research processing (activities) from behavioural and design science in a two-dimensional framework, as presented in Figure 3.1. The four research activities drawn from design science and natural science are: Build, Evaluate, Justify and Theorise. These four processes are applied in IS research to produce the following types of artefacts; constructs, models, methods and instantiations. These artefacts are employed to ensure the utility and efficiency of the produced IS. Design Research achieves an optimal solution to the design problem through iterative knowledge refinement.

	Build	Evaluate	Theorise	Justify
Construct				
Model				
Methods				
Instantiation				

Table 3.1: A Research Framework (March and Smith, 1995)

Categorising design artefacts using March and Smith’s (1995) research outputs classification can help to identify an appropriate procedure through which to build, evaluate, theorize and justify the research. The four research artefacts are described below.

- **Constructs:** Constructs are sets of concepts or vocabulary that form specialised knowledge within a domain; they are used to define problems and solutions (Hevner et al., 2004).

- **Models:** Models use constructs to describe a real-world situation of the design problem and its solution space (Hevner *et al.*, 2004); models can be used to express relationships between constructs (March and Smith, 1995).
- **Methods:** Methods are a set of steps that defines the solution space. They provide guidance on how to solve problems using the constructs and the models. Methods can be considered methodological tools that are created by design science and applied by natural science (March and Smith, 1995).
- **Instantiations:** Instantiations are the implementation of constructs, models or methods within a working system. They prove the feasibility and effectiveness of the models, methods and constructs, and allow for evaluation (March & Smith, 1995). Instantiation plays an important role in enabling researchers to learn about the working artefact in a real-world scenario. As Newell & Simon (1976) explain, the significance of instantiations provides a greater understanding of the problem domain and, consequently, offer better solutions.

According to Owen (1998) and Takeda, and Veerkamp & Yoshikawa (1990), knowledge can be generated and accumulated through a process iterated through knowledge-using and knowledge-building activities. Consequently, design is considered a process, and the steps involved in the design process are identified clearly by Vaishnavi & Kuechler (2004). Design can be employed as a research that generates knowledge. A number of research attempt to link theories and design to justify Design as a research approach leading to theories (Kelly and Lesh, 2000; Brown, 1992), while others place emphasis on identifying types of learning that can evolve from a researcher emerges in the design process, as demonstrated by Edelson (2002). A general Design Research methodology is proposed by Vaishnavi & Kuechler (2004), adapted from Takeda, Veerkamp & Yoshikawa (1990) that incorporates five phases of design and facilitates an iterative design cycle in which learning is a key attribute. Problem awareness is the initial step in Design Research, followed by a suggestion, producing a proposal and a tentative design. The third step is artefact development. Again, this may result in learning and improvement being fed back to the first step through circumscription. The fourth and most important step is the evaluation of an artefact, in which measures from the knowledge base can be applied to test the utility of the artefact in the problem domain. The fifth step is the conclusion, which involves highlighting the results of the Design Research by adding knowledge to the solution space or feeding back to consequent cycles. Nunamaker, Chen & Purdin (1990) agree that system development (artefact construction) is considered a

research methodology that can lead to an improved and more effective design. They agreed that, when system development is applied in conjunction with other research methodologies, a rigorous contribution to knowledge is made.

Utility and truth are two important aims of Design Research and behavioural science respectively, Design Research is proposed by March & Smith (1995) and Hevner et al. (2004) as a research framework, whereby IS research can occur by integrating two complementary disciplines. The first of these is behavioural science, where research is more focused on the processes of theorise and justify; and the second is design science research, where the research is more focused on the build and evaluates process.

3.3 Design as an IS Research Methodology

Design Research frameworks attempt to provide the IS community with a Design Research methodology (Hevner *et al.*, 2004; March and Smith, 1995; Nunamaker Jr and Chen, 1990). Within these, a common process is an iterative design cycle employed as a problem-solving process where valid IS research is achieved through the building and evaluation of purposefully-designed artefacts. Importantly, research in IS is no different from any other research; for example, where Blake (1978, p.31) defined research as "...systematic, intensive study directed toward fuller scientific knowledge of the subject studied". IS Research is considered a multi-inter-related disciplinary field, comprising social and natural sciences, management and engineering, and bound by an overlap of research methods, in which continued improvement is required to meet the complex dual nature of the IS field (Purao, 2002; Nunamaker Jr and Chen, 1990). In the discipline of IS, Design Research seeks to improve significantly aspects related to analysis, design, implementation, management and the use of information systems through the creation of useful artefacts (Hevner *et al.*, 2004).

Typical research in Information Technology (IT) is commonly categorised as either knowledge using action, where research aims to improve IT performance, or knowledge producing action, where research aims to understanding the nature of IT (March and Smith, 1995). In both cases, IS research takes place as a juncture connecting people, organisations and technology; therefore, IS definitely incorporates IT research.

Simon (1996) made a clear distinction between natural science and science of the artificial (design science); the first is concerned with naturally-occurring phenomena, whilst the

second relates to artificial human-made artefacts. In making this distinction, the IS community has come to realise and justify the need for design as a research discipline that combines the two (Winter, 2008; Hevner *et al.*, 2004; Edelson, 2002; March and Smith, 1995a; Nunamaker Jr and Chen, 1990).

Research rigour can be achieved by applying knowledge (theories) effectively from the knowledge base in order to develop and build an IS artefact. Moreover, relevance can be accomplished by assessing whether the artefact satisfies business needs. The justify-evaluate process is used to assess the artefact applicability in the appropriate environment (Hevner *et al.*, 2004).

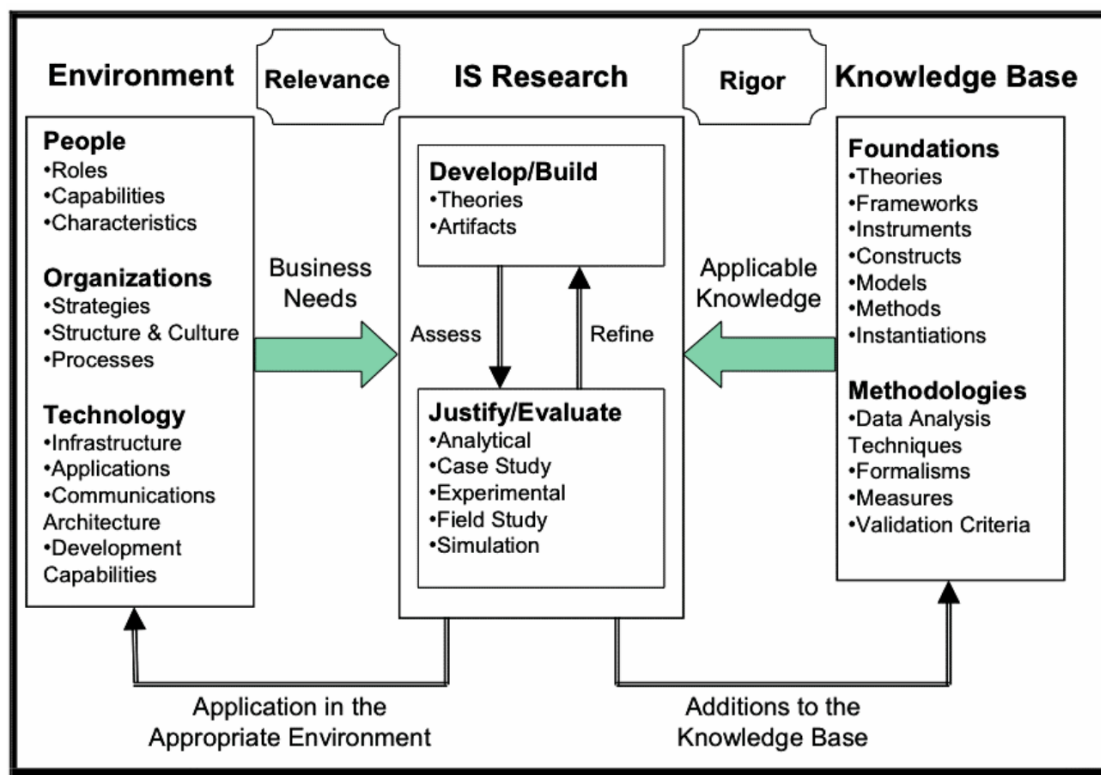


Figure 3.1: IS Research Framework (Hevner *et al.*, 2004)

Hevner *et al.* (2004) provide a concise IS research framework and present methodological guidelines for identifying, executing and evaluating IS research. Build and evaluate are considered iterative processes through which both method and product are assessed carefully by the researcher and used to assess and refine the developed product. This evaluate process typically applies measures from the knowledge base to assess the utility, efficacy and quality of the designed artefact. Hevner *et al.* (2004) propose a set of evaluation methods that can be used to evaluate the designed artefact discussed in the next section.

3.4 Design Research Evaluation

Evaluating a Design Research artefact is an important phase; it resides in the need to determine artefact performance and measure progress according to well-defined metrics (March and Smith, 1995). Artefacts are built to perform specific tasks and, thus, demonstrate their utility. Assessment of progress made in the problem space validates the research. Consequently, knowledge generated from the evaluation phase can be fed into later iterations; underlining the fact that evaluation plays a fundamental role in iterative research (design science). It is critical to develop appropriate evaluation metrics to assess artefact performance and prove the evaluation criteria (March and Smith, 1995). Evaluation criteria of the so-called quality attribute are identified based on artefact type, as proposed by March & Smith (1995), and are summarised in Table 3.1. Generally, evaluation is concerned with answering the important question: “How well does the artefact work?” (March and Smith, 1995) This can be answered by applying a suitable evaluation metric or measure from the knowledge base; thereby proving the appropriate evaluation criteria. For example, a search algorithm instantiation in the information extraction field can be evaluated using a mathematical metric, such as precision and recall (Hevner *et al.*, 2004). Therefore, these metrics can be used to prove the efficiency and effectiveness of the algorithm.

Artefact	Brief Description	Evaluation Criteria
Constructs	The conceptual vocabulary and symbols describing a problem within a domain	Completeness, simplicity, elegance, understanding ability and ease of use.
Model	A set of propositions or statements expressing relationships between the underlying designs constructs; they represent situations as problem and solution statements.	Fidelity with real-world phenomena, completeness, level of detail, robustness and internal consistency.
Method	A set of steps used to perform a task – how-to knowledge; method can be tied to particular models; they may not be articulated explicitly but represent tasks and results.	Operationality (ability of others to efficiently use the method), efficiency, generality and ease of use.

Instantiations	The operationalisation of constructs, models and methods; it is the realisation of the artefact in its environment to ensure its feasibility; e.g. (prototypes or the implemented artefacts).	Efficiency, effectiveness and impact on an environment and its users.
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Table 3.2: Summarised Evaluation Criteria with Artefact Types (Hevner *et al.*, 2004a; Vaishnavi and Kuechler, 2004; March and Smith, 1995)

Once the evaluation metrics and criteria are identified, an empirical work is applied (March & Smith, 1995) and an appropriate evaluation method selected. Hevner *et al.* (2004) emphasise that the selection of the evaluation method should be considered carefully and, when matched with the suitable artefact and evaluation metric evaluation, methodologies are typically drawn from the knowledge base. Indeed, the use of real-life cases is one of the main evaluation methods adopted in design-science research (Pries-Heje and Baskerville, 2008; Hevner *et al.*, 2004).

An inclusive set of evaluation methodologies are summarised in Table 3.2, adapted from Hevner *et al.* (2004). The classifications represent the most common evaluation methods from which a suitable method/s can be applied based on the type of artefact and the evaluation metrics used.

Design Research Evaluation Method Types and their Description	
Observation	Case Study: Study artefact in-depth in business environment.
	Field Study: Monitor use of artefact in multiple projects.
Analytical	Static Analysis: Examine structure of artefact for static qualities (e.g., complexity).
	Architecture Analysis: Study fit of artefact into technical IS architecture.
	Optimisation: Demonstrate inherent optimal properties of artefact or provide optimality bounds on artefact behaviour.
	Dynamic Analysis: Study artefact in use for dynamic qualities (e.g., performance).
Experimental	Controlled Experiment: Study artefact in controlled environment for qualities (e.g., usability).
	Simulation: Execute artefact with artificial data.
Testing	Functional (Black Box) Testing: Execute artefact interfaces to discover failures and identify defects.
	Structural (White Box) Testing: Perform coverage testing of some

	metric (e.g., execution paths) in the artefact implementation.
Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artefact's utility.
	Scenarios: Construct detailed scenarios around the artefact to demonstrate its utility.

Table 3.3: Design Evaluation Methods (Hevner *et al.*, 2004)

3.5 Applying Design Research

The research presented in this thesis begins with the development of a conceptual framework for the flexible supplier selection process in e-procurement marketplaces (EPMs). To meet the research aim, Design Research will be adapted from Vaishnavi and Kuechler (2004) as the overall research methodology alongside March and Smith's (1995) research product classification. Research products will be identified in the form of constructs, models, methods and instantiations. The Design Research methodology employed for developing the research artefacts is an iterative design cycle (build and evaluate). The main design artefact is a methodological flexible EPM framework; an iterative process involving the five design process steps of awareness, suggestion, development, evaluation and conclusion. These are elaborated in Figure 3.2.

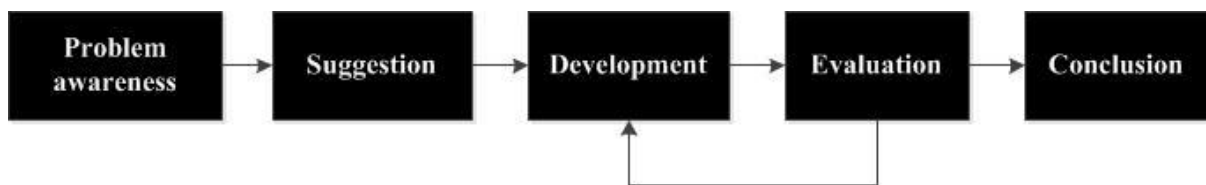


Figure 3.2: Adopted Design Research Methodology

Problem Awareness of the problem will be based on conducting extensive review and analysis of the related literature; specifically, employing a systematic literature review (SLR) to provide taxonomy of the EPM and flexibility concepts from which to develop a framework. SLR is conducted to address the need for a longitudinal view in recent periods of volatility and in order to understand the viability of EPM with respect to current and future flexibility. Furthermore, a suitable domain can be identified as being appropriate for developing a flexible EPM (FEPM) framework. The results of the SLR evaluation will show that pharmaceutical domain has received little analysis over the past decade. Therefore, a set of semi-structured interviews with a pharmaceutical organisation will be conducted in order

to discover the reason for this lack of analysis and issues specific to the pharmaceutical domain. One important problem facing the pharmaceutical organisation is the selection of suppliers during periods of change.

Suggestion involves introducing a tentative idea of how the problem might be solved through the design of an appropriate framework. This step originates in Iteration 1 with the development of an appropriate concept extraction framework. Further suggestions arise in later iterations; for example, when social media network analysis is used to analyse how wider network opinion could assist pharmaceutical organisations in selecting suppliers. As new knowledge is gained during the development and evaluation of the developed framework, new suggestions from the build and evaluate cycles are used to initiate subsequent iterations.

Development is carried out by building a research artefact; an FEPM. The framework consists of flexibility factors with the purpose of gaining a better understanding of the dynamic elements of EPMs; their importance for e-commerce over time and the evolution of EPM evolution over the study period. FEPM aims to incorporate and support the recent changes that have occurred. Flexibility categories are used as a means to support EPM design and use.

Evaluation is performed through an evaluation strategy that measures the validity and effectiveness of the research based on the potential performance improvements when using the developed framework over the existing domain. Design Research evaluation criteria are used to examine the efficiency and generality of the framework. Applying the framework to a realistic EPM scenario taken from the pharmaceutical domain resulted in extending the developed framework, which serves as an instantiation of FEPM. This framework is used to validate an experimental evaluation over a different set of social media network in Iteration 3.

Conclusion provides a summary of the research output and identifies the evaluation results and highlights areas for future improvement.

3.6 Research Iterations

Design Research is performed through iterative design cycles, which can be improvement iterations or improvement and incremental iterations (Hevner *et al.*, 2004). This research is implemented as incremental iterations, whereby each iteration is used to extend and refine the

design problem: 1) identify FEPM framework constructs and choose a domain that uses EPM actively in order to evaluate the rest of the study; 2) extend and refine the FEPM framework by developing a methodology for extracting supplier knowledge through social media network; and 3) evaluate and validate the framework through a real-life case with regards to EPMs.

Three design iterations are used to deliver the final artefact, as illustrated in Figure 3.3. In each iteration, the artefact refinement process comprises a mini Design Research cycle of build and evaluate, following Vashnavi & Kuhler’s (2004) design cycle steps.

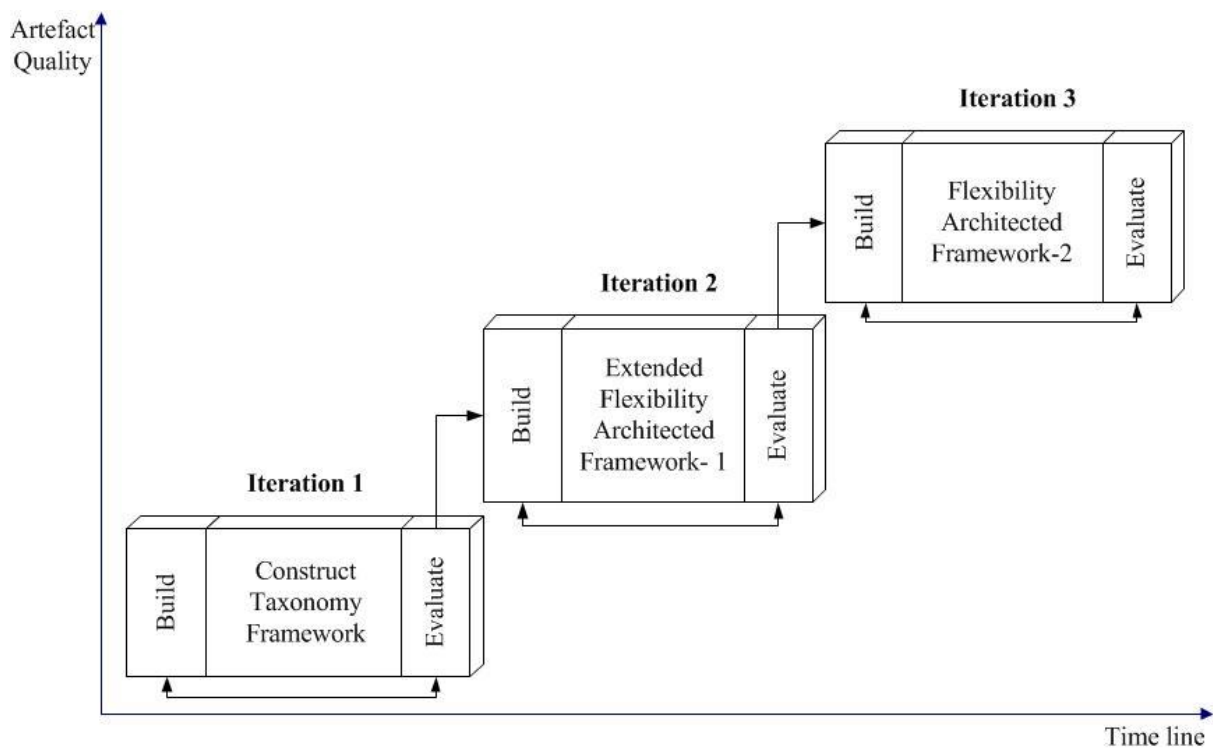


Figure 3.3: Research Iterations

Importantly, Design Research motivates knowledge generation as part of the design problem; new awareness is generated and suggestions are made during each build and evaluate cycle. Learning for each iteration is used to refine the explanatory hypothesis and feed back into subsequent iterations. The central Design Research artefact is the development of a methodological framework (FEPM), where framework is defined in the Oxford English Dictionary as “a basic structure underlying a system, concept, or text: the theoretical framework of political sociology”. Methodology is defined by Checkland (1999) as “a set of principles of method, which in any particular situation has to be reduced to a method

uniquely suited to that particular situation”. FEPM incorporates aspects of both a methodology and a framework.

3.6.1 Iteration 1

This iteration aims to synthesise and analyse concepts, empirical findings and the gaps in literature in order to understand the viability and likely evolution of EPM in relation to current and future flexibility requirements. While the construction process for Design Science artefacts is not widely understood (March and Smith, 1995), this iteration design follows well-founded prescriptions gathered from the IS literature (Hevner *et al.*, 2004) in order to comprehend the existing knowledge base (literature review) and business need (expert interviews).

In this iteration, we will use SLR to provide a longitudinal view in periods of volatility in order to understand the viability of EPMs with respect to current and future flexibility. The intention of SLR (Kitchenham *et al.*, 2009) will concentrate on identifying flexibility concepts (and taxonomy) for FEPMs. Since (1) it is difficult to obtain access to all the flexibility aspects within a single paper and (2) markets change continuously, it is important to extract papers that permit analysis of evolution. Kitchenham (2009) outlines several reasons for undertaking a systematic review, the most common of which is to synthesise the available research concerning a treatment or technology, identify topics for further investigation and formulate a background in which to position new research activities. This study will conduct the SLR using the aforementioned template, and will take into account the guidelines provided by Biolchini (Biolchini *et al.*, 2005) and Kitchenham (Kitchenham *et al.*, 2009). The volatility of EPM utilisation as the Web continues to develop warrants a systematic analysis of research over the early evolution of the Web.

In order to instigate and guide SLR activities, the research questions (RQ) will be defined in relation to EPM and flexibility. RQ1 aims to provide a recent history of EPMs. This is particularly important as it covers the Web era of marketplace innovation. RQ2-4 attempts to uncover elements, and provide details, of actual EPMs and provide support for the conceptual framework detailed previously (Figure 2.4). To address RQ1, a number of journal/conferences were identified that published papers on EPM each year. With respect to RQ2, the characteristics of EPM are examined for the period of study in order to validate the EPM architecture (from a requirement perspective). RQ3 relates to both EPM and flexibility,

and aims to identify the changing factors that limit EPM. Overcoming these limitations allows for further flexibility. With the final question, RQ4, we identified the changing flexible factors in order to further validate the components of the proposed architecture. The search strategy undertaken will identify alternative keywords and synonyms for terms used in the research questions (such as, EPM and flexibility). This will be performed in order to minimise the effect of differences in terminologies. The search process comprises a manual search of appropriate conference proceedings and journals. The journal/conference lists that are appropriate to this study will be selected from the review of highly-cited EPM and flexibility literature. Inclusion criteria will be applied to find the papers that are most relevant to support the research questions. Data inclusion criteria will determine which journals or conferences (found by the search terms) are used for data extraction. Each paper will be evaluated using the Database of Abstracts of Reviews of Effects (DARE) criteria (Centre for Reviews and Dissemination, 2007). DARE was produced by the University of York, Centre for Reviews and Dissemination (CDR). A set of quality assessment (QA) questions will help to test the validity of the SLR. The outcome of this analytical iteration is a taxonomy encompassing 22 unique (i.e. mutually exclusive) individual papers related to different aspects of the concept EPM and flexibility.

In order to explore the evolution of EPM with respect to flexibility factors, it is necessary to understand the temporal aspects of specific flexibility types within specific domains. Temporal aspects will be extracted and presented that emphasise popularity of flexibility in EPM in the research community at different points in time. The SLR evaluation results will demonstrate that the pharmaceutical domain has encountered little analysis over the past decade. Buyers and suppliers must work together towards standardisation, including agreeing on a universal product numbering system (More and McGrath, 2002). A previous study by Shirzad and Bell (2013) stated that there is a limited number of related works on flexibility in EPMs (Shirzad, 2013). This is surprising as it has been clear to the authors that flexible e-procurement is an important strategic goal for pharmaceuticals and their networks. Shirzad and Bell (2013) also highlighted that pharmaceutical e-marketplace adoption has been volatile over the past decade. Therefore, to discover more about the reason for the lack of analysis of and issues within pharmaceutical domain, a set of interviews will be conducted with e-procurement experts. By utilising the interview data, this iteration seeks to enrich the SLR by investigating: (1) the different approaches used in practice by different suppliers/customers; (2) the influential flexibility aspect for applying organisational changes

and the factors that affect configurations; and (3) the key value drivers within this context. An interview agenda will incrementally gain the new knowledge (see Appendix A-E for the interview agenda). Four semi-structured interviews with key practitioners (i.e. experts and managers) in the pharmaceutical industry will be conducted, as illustrated in Table 3.4. Interviews will be recorded and last approximately ninety minutes.

Involved Actors from the Pharmaceutical Industry
Head of Procurement
Director Vendor Manager
Head of Global Resourcing and Procurement Technology
Procurement Operation Manager

Table 3.4: Semi-structured interview participants

Interviews will be transcribed, verified and analysed. The interview data will be analysed thematically utilizing grounded theory method (GTM). GTM is the process of generating a theory from collected data (Glaser and Strauss, 1967). Thus, analysis will classify textual material (i.e. transcribed interviews) semantically and provide more relevant and manageable data (Weber, 1990). In other words, when analysing the collected data, a thematic coding process will be used. Strauss and Corbin (1998) highlight that the coding process will assist in building conceptualisation and that the comparison between elements ensuing from the coding course of actions helps to identify patterns and relationships between the constructs, as well as strengthen and support the final model. The coding process is given more form by Strauss and Corbin (1998) in their description of open, axial and selective coding: pen coding is the initial basic coding of the original data; axial coding is the drawing together of categories and sub-categories into a hierarchy; and selective coding is the process of integrating and refining categories in order to arrive at a theory. This whole process is summarised by Strauss and Corbin (1998, p21) as: “Theorising as work that entails not only conceiving or intuiting ideas (concepts) but also formulating them with a logical, systematic, and explanatory scheme”. NVivo9 will be used for the purposes of organising, categorising and searching textual, recorded data. NVivo9 was found to be comprehensive in its functionality, operationally stable, easy to use, error free, and had a large number of standard reports and export facilities. It has been proved ideal for manipulating and analysing the data gathered in this exercise.

Interview notes will initially be typed up in Microsoft Word. NVivo9 supports all of these formats so all notes and documentation will be imported into the system for analysis. The first activity in GTM is open coding. Each imported file will be reviewed and every significant sentence, phrase or word will be allocated a code (a Free Node in NVivo terms). These base codes will be then reviewed and a process of consolidation will merge codes that have, or appear to have, the same meaning. Axial coding will be then be used to review the remaining codes (Free Nodes), and those that are considered to be related will be grouped together under a new higher level code. The process of axial coding will undergo several iterations as ideas change and new relationships emerge. This is the “constant comparison”, which is a key feature of GTM as defined by Glaser and Strauss. It also equates to the circumscription feedback loop of the Design Research stages defined by Vaishnavi and Kuechler (2004). In practice, this means that the taxonomy undergoes a number of iterations where the changes are sometimes minor and sometimes involve a major hierarchical restructure. Axial coding highlights that one of the problems facing pharmaceutical organisations is the considerable pressure to cope with selecting suppliers, while trying to meet the requirements for processing systems, changes and, most importantly, focusing on implementing procurement in new platform.

Primarily, this iteration will provide a framework of flexibility factors as the main design dimensions that require examination when designing and implementing flexible EPM. Moreover, the SLR analysis in this iteration will demonstrate the paucity of research tackling flexibility from the EPM perspective. Nonetheless, initial interviews show that pharmaceutical organisations are facing the problem of selecting flexible suppliers in relation to the rapid changes in e-marketplaces. Therefore, the importance of carrying out empirical research throughout the next iterations is clear, while utilising and building on the initial framework.

3.6.2 Iteration 2

This iteration aims to conduct studies on pharmaceutical industries to identify and understand the actual supplier selection process. Pharmaceutical industries develop, produce and market drugs or pharmaceuticals licensed for use as medications. Pharmaceutical companies are allowed to deal in generic and/or brand medications and medical devices. They are subject to a variety of laws and regulations regarding the procuring, testing, marketing and ensuring the safety and efficacy. Exploring and understanding how procurement teams or managers think

about supplier selection process may provide a basis upon which to develop more common approaches. It will also apprise the suppliers, which can then improve flexibility and consistency. Our research question is: “what are the processes when selecting and integrating new suppliers?” (See Appendix F-G for the interview agenda) Therefore, the nature of this study is not to confirm and test an established theory; rather, it intends to identify inductively and in-depth the process of supplier selection in pharmaceutical industries.

Reparatory Grid (RG) is an evocative research method and an established psychological technique (Hunter and Beck 2000 ; Siau, Tan and Sheng (2010)) that is an appropriate fit for our research objective. The interviews incorporated the RG technique, a form of structured interviewing originating from Kelly’s (1955, 1963) Personal Construct Theory, which aids in breaking down complex personal views into manageable sub-components of meaning. The technique was derived originally from psychology and anthropology, and is particularly useful for exploring topics where the respondent knows the answer indirectly and tacit knowledge cannot be conveyed directly (Butt and Burr, 2004; Goffin, 2002). Experiences exist at a conscious and unconscious level (Joy, 1994); hence, eliciting the constructs by which customer experiences are judged appears to be one such topic where knowledge is partially tacit.

In two studies of manufacturer-supplier relationships, Lemke et al. (2003) and Szwejczewski et al. (2001) found that the RG technique resulted in a greater depth of construct elicitation than direct semi-structured questioning alone. The technique is also valuable in management research for avoiding the use of jargon and minimising social desirability bias (Lemke, Goffin and Szwejczewski, 2003; Goffin, 2002). Duberley et al. (2000) argue that the RG technique enables the identification of these constructs, which may be difficult for individuals to articulate since they are based on tacit knowledge. Thus, it provides access to the culturally-derived, sense-making processes deployed by individuals that influence their meaningful construction of action ((Kelly, 1955), p. 15). In other words, this method enables researchers to obtain a picture of the values and assumptions guiding workers' behaviour. In this case, the RG technique was used to identify the behaviours that individuals felt were important for effective task performance and which task behaviours they felt the company measured and rewarded.

Many researchers, both in IS and many other social science fields have applied RG to investigate a research participant’s opinion regarding the subject of discourse (Tan and

Hunter, 2002; Hunter, 1997; Moynihan, 1996; Reger and Huff, 1993; Phythian and King, 1992; Ginsberg, 1989; Stewart, Stewart and Fonda, 1981). Moynihan (1996), Goffin et al. (2006) and Siau (2010) agree that this method is superior to unstructured interview techniques, which tend to either overly constrain participant responses or produce excessive researcher biases.

Goffin et al. (2011) and Moynihan (1996) believe that qualitative and quantitative methods should be used in combination, rather than isolation, in RG. They agree that the interview transcripts and grids provide a valuable source of qualitative and quantitative information in order to demonstrate the validity of the RG findings. Moreover, it is salient to note that, in 1999, social scientists such as LeCompte and Schensul (1999, (p.18)) noted the value of both qualitative and quantitative methods. They said: “Another characteristic of good ethnography is its inclusion of both qualitative and quantitative data”. Therefore, this iteration will be concluded by qualitative and quantitative methods that can increase internal validity of this research.

In this research, I took the variant of RG applied by Moynihan (1996) and Siau (2010), as the nature of our studies is similar. The objective of Moynihan’s (1996) study is to identify the situational factors that managers of IS development projects consider when planning new projects for new customers. Moynihan (1996) adopted RG to identify idiographic personal construct systems and then analysed qualitatively (using content analysis) the individual RGs to identify the categories underlying individual constructs. The objective of Siau et al. (2010) study is to identify and understand the important characteristics of good team members in software development projects. They applied RG to identify important characteristics for good team members by qualitative (using open coding method of grounded theory) analysis followed by quantitative analysis by averaging the importance scores for each constructs class and category. Through quantitative analysis, they aimed to obtain a holistic view of the relative importance of each category, as perceived by the research participants. The RG process involves three major activities: element selection, construct elicitation and construct rating (Siau, Tan and Sheng, 2010). The following sub-section provides a brief introduction to the RG procedures involved in this study.

3.6.2.1 Element Selection

Hunter (1997) defines elements as the objects of attention within a specific domain. Depending on the research questions, elements may be people, such as systems analysts (Hunter, 1997), or activities, such as systems development projects (Siau, Tan and Sheng, 2010; Moynihan, 1996). According to prior studies, there are two ways of selecting elements. One is to provide participants with a list of elements to elicit the constructs based on the same set of elements. The other way is to ask the research participants to choose their own elements. In this situation, participants work on different sets of elements. As the aim of this iteration is to identify the supplier selection process, the second way of collection elements is deemed more appropriate.

After the element selection step, each research participant will face a pool of elements that should be representative of the area under investigation (Stewart, Stewart and Fonda, 1981) (in this case, the supplier selection process in the UK pharmaceutical industry). Hunter et al. (2000) noted that the pool of elements should provide sufficient variability in the subsequent construct elicitation (Hunter and Beck, 2000).

3.6.2.2 Construct Elicitation

Construct elicitation is an activity to identify constructs when the research participant interprets the elements (Siau, Tan and Sheng, 2010). There are several methods of eliciting the constructs (Reger and Huff, 1993; Stewart, Stewart and Fonda, 1981). The classical approach to generating constructs is known as the triadic sort method (Hunter and Beck, 2000). In this method, three elements (a triad) are selected randomly from the pool. For each triad, the research participant will be asked to identify how two elements are similar yet different from the third (Siau, Tan and Sheng, 2010; Hunter and Beck, 2000). This method is recommended by Kelly (1955) to promote the discussion of similarity and contrast. According to Kelly (1955), similarity and contrast represent a dichotomous construct that people use to interpret outside objects and events. In this step, participants will be asked to choose at random three elements as a triad. For each triad, the research participant will be asked to identify, in relation to supplier selection, how two of them will be similar yet different from the third one, and record his/her reasoning process. The construct elicitation will be repeated until the research participant could not elicit any additional constructs. Moreover, in order to obtain an accurate understanding of the constructs, laddering questions

(e.g. ‘How, in What Way?’) were asked, which in many cases resulted in eliciting new constructs (Jankowicz, 2005). Following this, the interview will proceed to the construct-rating step.

3.6.2.3 Construct Rating

In the construct-rating step, all the elicited elements and constructs will be listed on a piece of paper. The interviewee is asked then to rate all the processes on a scale of 1 to 5 against the elicited construct (Goffin, Lemke and Szwejczewski, 2006; Banister *et al.*, 1995). Figure 3.4 presents an RG generated by RepV software. Elements are given below the grid and poles of the constructs on either side of the grid. The scale used in this study is graded 1 to 5.

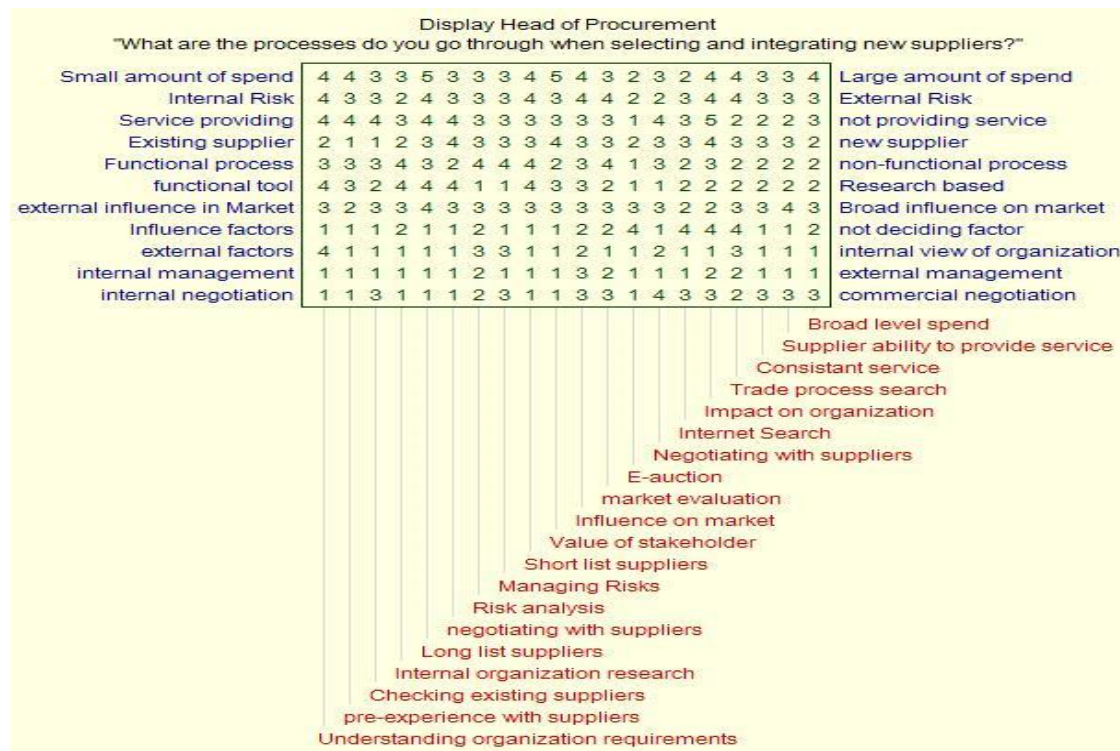


Figure 3.4: Example Repertory Grid (Interviewee: supplier selection process in Pharma company)

3.6.2.4 Analyse Repertory Grid

In accordance with interview protocol, the analysis followed closely Goffin et al. (2006):

Categorisation of elements and constructs (Qualitative analysis): In order to commence analysis, grids and interview transcripts will provide a rich pool of qualitative and quantitative data. Since elements differ across all interviews, it will be useful to break down

data from the RG into categories. Qualitative analysis will be conducted on the rich, in-depth and narrative data regarding the dichotomous elements and constructs. The verbal explanations of elements and constructs (transcripts) provided by each of the interviewees will be analysed. The coding process will be based on the interpretation of each interviewee's explanations of their elements and constructs. To conduct the qualitative analysis of the RGs generated from the data, the constructs generated were categorised in accordance with Stewart's (1981) approach to content analysis and Strauss and Corbin's (1998) methodology for open, axial and selective coding (which is further elaborated below). As mentioned previously (Iteration 1), the GTM developed by Strauss and Corbin (1998) was used to analyse the qualitative data collected and to develop a conceptualisation of FEPMs. The strength of this approach is in providing a means with which theory can be grounded in categories of data that have been developed through identification of distinctive relationships. Hence, the GTM is appropriate for developing a grounded theoretical conceptualisation of supplier selection process in this iteration. More specifically, the elements and constructs generated by participants were coded according to the open coding methodology outlined by Strauss and Corbin (1998). They also used the sorting procedure described by Moore and Benbasat (1991), whereby bipolar pairs describing similar constructs were grouped together and kept separate from those bipolar pairs describing different constructs.

Open coding entails identifying and categorising similar phenomena and labelling them. Axial coding provides a more in-depth and precise conceptualisation of the categories and sub-categories emerging from the collected data. Themes, or overarching categories from the data, were also identified. The final step, selective coding, is the process in which a core category is identified and "the process of integrating and refining the theory takes place" (Strauss & Corbin, 1998, p. 143). This step also entails integrating the concepts that emerge from the data analysis. They further acknowledged that the use of existing literature can be supplemental to the theory development stage.

Identification of key constructs (Quantitative analysis): At the final stage of analysis, in order to identify the key constructs categories (value dimensions), a quantitative measure of the importance of each value category has been performed using two parameters: Frequency and Variability, as proposed by (Goffin et al, 2006). The **frequency** is defined as the percentage of respondents who have mentioned constructs in a category. Frequency is used to identify a "common" construct (Lemke et al, 2003; Jankowicz, 2005; Goffin et al, 2006).

Variability is a mathematical measure of the spread of ratings for a construct (Goffin et al., 2006). A higher spread of elements' ratings for a construct shows that the interviewee perceives it as a more important dimension. Further details on these two parameters will be provided in Chapter 5.

This iteration provides a view of a particular business domain, which is not only useful in understanding the internal structures and functions, but also in realising how they are connected to their external environment and interact with it. This chapter demonstrates that designing a new process for supplier selection requires close examination of the supplier capabilities, as well as matching the business models and trends to services value elements. To Pharma's procurement team, in light of rapidly-changing consumer's demands, it is vital to have a strong method of analytical validation that is capable of providing an investigation of suppliers' collaborative activities in order to select the appropriate one.

In this iteration, delineating the collaboration issues Pharma have with various suppliers is crucial, because the structure of industries is shifting towards more modern, complex and open systems characterised by extensive collaborations with many suppliers. One way of analysing the supplier's activities is to investigate the social network.

3.6.3 Iteration 3

The supplier selection process framework from the second iteration extracted concepts from the analysis of interviews with procurement managers/team in two UK pharmaceutical organisations. This iteration applies a social network analysis in order to access a wider set of data and the views of suppliers and organisations. The aim of this iteration is to validate, improve and extend supplier selection frameworks to include a wider view of organisations and people by analysing data from social networks. Carter (2011) defines social network analysis as a powerful methodology for describing and analysing the interrelationships of units or nodes within a social network. He defines nodes as individuals or group of individuals (such as organisations or departments) (Carter, Ellram and Tate, 2011). As noted by Carter (2011), the analysis of such interrelationships among individuals within a social network can result potentially in highly revealing findings that would not be achieved using conventional survey and case study methodologies (Carter, Ellram and Tate, 2011). Thus, by utilising social network analysis, this research seeks to enrich the supplier selection model from Iteration 2 by investigating how social network data could facilitate the process of

selecting suppliers in organisations. This iteration develops a Social Media Domain Analysis (SoMeDoA) method for extracting and analysing domain-specific data that aims to feed into the supplier selection process. SoMeDoA involves core elements of social media data gathering and analysis (including GTM approaches). Twitter is selected because it focuses mainly on organisational activities from a spatial and temporal perspective.

The temporal model considers the visit activity of people in relation to specific times (including intervals) (Yoo and Hwang, 2008). Recently, the idea of harvesting temporal information from the Web has generated much interest (De Longueville, Smith and Luraschi, 2009). Li et al. (2005) proposed a probabilistic model to detect retrospective news events. They explained the generation of “four Ws” from each news article: who (persons), when (time), where (locations) and what (keywords). However, they considered time and location for discovering the reoccurring peaks in events. Mei et al. (2006) produced a model for spatio-temporal analysis for weblog data. In contrast to previous work, we apply the temporal model to describe organisational activities on Twitter with a more explorative motivation. The generated data files are then analysed using a mix of visualisation and analytical tools.

This iteration uses the learning (formed by evaluate, theorise and justify activities in Iteration 1) shaped by Iteration 2 to suggest improvements to the supplier selection model and SoMeDoA method. Measuring significant improvement of the research requires careful evaluation in order to prove efficiency (March & Smith, 1995). Assessing the progress made in the problem domain is done by applying by analysing and examining two real-life cases of pharmaceutical organisation activities on Twitter. In particular, the author examines the current Twitter activities in use for the following top five largest pharmaceutical organisations, as defined by The Annual Report of Fortune Global in 2010: Johnson & Johnson, Pfizer, Roche, GlaxoSmithKline and Novartis. The underlying reason for choosing these cases is that each one is unique in nature and signifies an innovative artefact in the pharmaceutical industry; therefore, they are deemed appropriate to provide a comprehensive evaluation of the supplier selection model. Indeed, the use of real-life cases is one of the main evaluation methods in design-science research ((Pries-Heje and Baskerville, 2008; Hevner *et al.*, 2004)).

Executing the research in a Design Research incremental iterative manner enables learning to emerge from Iteration 1 by applying methods from the knowledge base to Web services. Table 3.5 summarises the three Design Research iterations and illustrates the objectives and

output artefacts of each. Research iterations are described in more detail in the following chapters.

Iteration	Activities	Output	Artefact Type
1.	1.1 Reviewing literature, the existing approaches and comparisons using the SLR method	Identifies flexibility factors	Construct. Method.
	1.2 Develop an initial framework	FEPM	Model.
	1.3 Understanding the temporal aspects of specific flexibility types and within specific domains- comparing flexibility factor to other available factors in literature	Identified domain of concern Lack of analysis on pharmaceutical organisations	
	1.4 Evaluate the flexibility framework by interviewing pharmaceutical organisations (business needs)	Important flexibility factors Problem pharmaceutical organisations have in selecting flexible suppliers	Method.
	1.4.1 Analysis 1- Content analysis- Grounded Theory technique		
	1.5 Suggest an improvement and extension of existing supplier selection process	List of requirements to improve the approach in next iteration	Theories.
2.	2.1 Structured interviewing of procurement teams/managers using RG technique	A structured model of supplier selection process in pharmaceutical organisations	Method. Model.
	2.2 Analysis 1- categories Coding the elicited constructs- Grounded Theory technique		
	2.3 Analysis 2- Identification of key		
	2.4 Suggest an improvement and extend existing supplier selection process using social network analysis	List of requirements to improve the approach in next iteration	Theories.
3.	3.1 Validate research by analysing SoMeDoA	Extracting and analysing domain specific data for use in the supplier selection process	Method

	<p>3.2 Extend model and evaluate</p> <p>Data gathering tools are selected and run against the selected social media sites.</p> <p>Data gathering tools are selected and run against the selected social media sites.</p> <p>Public information, news and communications are extracted in order to determine the public activities of organisations (with associated timelines)</p>	<p>List of software tools.</p> <p>Generated data files.</p> <p>List of software tools.</p> <p>Generated data files.</p> <p>Date-time lists files for each organisation.</p> <p>Date-time lists files for each organisation.</p>	<p>Constructs</p>
	<p>3.2 Analysis 1- Temporal data in order to uncover topics of importance (with timeline)</p>	<p>Keyword lists</p> <p>Domain ontology</p> <p>Data-time data lists for each keyword, code or category</p>	<p>Method.</p>
	<p>3.3 Extend framework</p>	<p>Improved FEPM</p>	<p>Model.</p> <p>Instantiation.</p>
	<p>3.4 Evaluate framework</p>	<p>Social commerce</p>	<p>Model.</p>

Table 3.5: Summary of Research Iterations

3.7 Summary

This chapter set out the research methodology in accordance with the tenets of Design Research. The methodology is executed in the following five Design Research steps as adapted from Vaishnavi & Kuechler (2004): (1) problem awareness (supplier selection in pharmaceutical organisations); (2) suggestion of suitable techniques (analysing internal and virtual human activities in pharmaceutical organisations in order to find a flexible supplier selection model); (3) development of the main Design Research artefact (Social Commerce); (4) evaluation of the artefact based on synthesising Design Research evaluation methods; and (5) conclusions. In order to achieve the research aim and objectives, the research is executed in three incremental Design Research iterations. Each iteration is used to build and evaluate a set of artefacts aimed at improving the process of supplier selection within the pharmaceutical domain. In the first iteration, a systematic literature review method is conducted in order to understand the existing knowledge base (literature review of EPMS) and identify the business-need gap (by interviewing experts from the pharmaceutical organisations). The second iteration extends the model to better articulate the organisation's perceptions of supplier selection. Finally, the third iteration extends the supplier selection model by applying the SoMeDoA method. Hevner's et al. (2004) Design Research product classification is adopted to illustrate the research outputs produced from iteration. The research products are identified in the form of consequent constructs, models, methods and instantiations. In summary, the current Design Research shows explicitly its associations with design-science research, the chapter presents a mapping process between the design-science research reasoning activities and artefacts, and the current research processes and outputs.

CHAPTER 4 ITERATION I

4.1 Introduction

Following a comprehensive review of the existing knowledge base (literature review) and business need (expert views), this iteration principally employs the Systematic Literature Review (SLR) and grounded theory method (GTM) (as illustrated in Chapter 3, Iteration 1) to provide a hierarchical taxonomy of the flexible e-procurement marketplace (EPM) concepts from which to develop a more comprehensive framework. This iteration comprises three fundamental aspects. First, it organises cohesively the SLR to address the longitudinal view in recent periods of volatility, during which time, many have occurred, and to understand the viability of EPM in relation to current and future flexibility. Second, the temporal aspect presents the increased popularity of flexibility in EPM in the research community at different points in time. Finally, a set of interviews is conducted in order to narrow the findings arising from the SLR analysis.

The remainder of this chapter is structured as follows. First, Section 4.2 discusses how Design Research is applied to this iteration. Design Research artefacts are identified along with the iteration plan, research products and the underlying rationale is provided for developing a unified framework of EPM concept. Next, the different viewpoints of authors within flexibility, e-procurement marketplaces and an analysis of Web evolution with respect to EPM flexibility is constructed in order to better understand the relationships between flexibility and EPM are outlined (Section 4.3) and analysed, and a table is constructed to demonstrate these. Domain impact analysis is carried out to show the annual distribution of primary studies within each flexibility aspect, as well as the frequency of application within different domains. In the next section (Section 4.4) set of interview on the selected domain (Pharmaceutical industry) is conducted in order to discover what changes have occurred in the organisations over the last 10 years and how they manage to be flexible. Finally, Section 4.5 summarises the chapter.

4.2 Design Research and Output Artefacts

This iteration applies Design Research as a miniature iterative process through which the problem space is achieved through artefact development. A method can be seen as a set of steps to follow in order to accomplish a certain task (March and Smith, 1995). In this iteration, a method is conducted in order to construct the taxonomy of flexible EPM and find an industry-specific gap.

In doing so, this chapter provides an SLR on flexibility and EPM. Also, a conceptual framework of the flexible e-procurement marketplace (FEPM) is presented, which is comprehensive and appropriate to the complex nature of today's online business. The FEPM structure synthesised by the author from the literature provides the baseline for the main design constructs that need to be incorporated within the desired traditional EPM-based organisations. As illustrated in Figure 4.1, an iterative cycle of artefact building, development and evaluation is employed based on the general methodology of Design Research by Vaishnavi & Kuechler (2004).

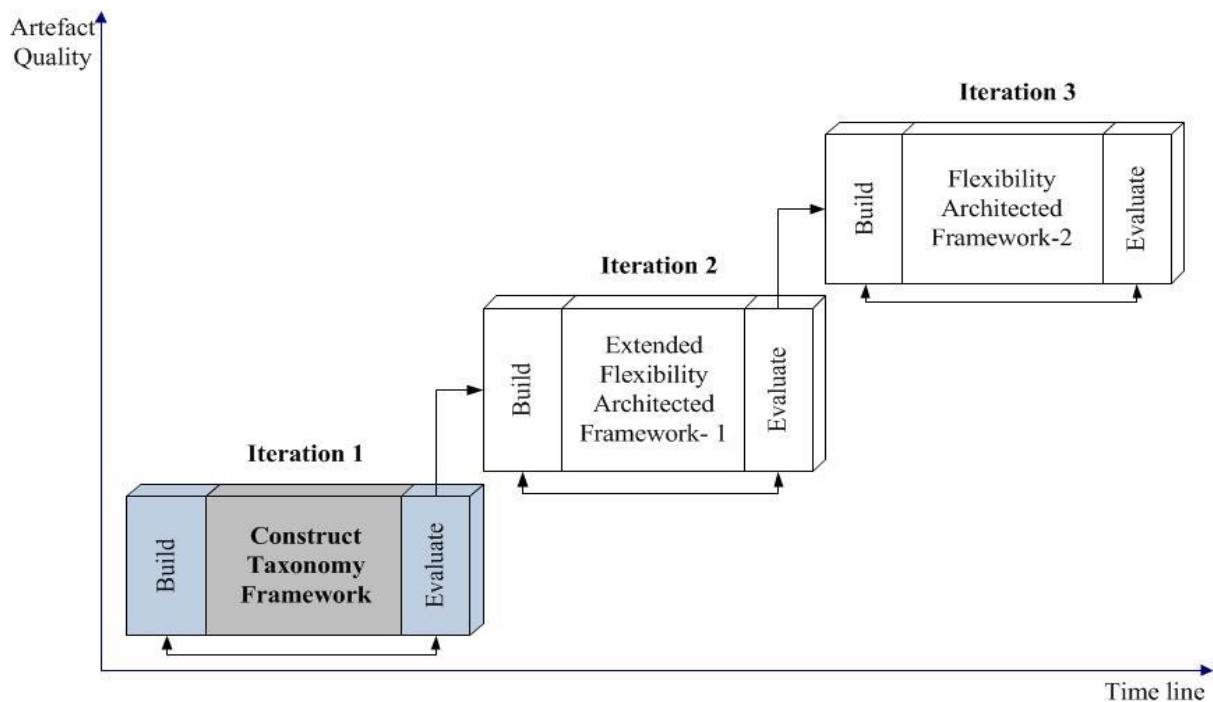


Figure 4.1: Iteration 1 overall framework

To this aim, this iteration analyses and synthesises the different viewpoints relating to the EPM and flexibility factors presented in the conceptual framework in Chapter 2 (Figure 2.4). This provides an understanding of the viability of EPM with respect to current and future

flexibility. Aiming to work as a solid foundation for the research, this iteration seeks to provide simple, but tight and comprehensive, answers relating to the fundamental issues by:

- (1) Analysing the longitudinal view of literature in times
- (2) Analysing domains of volatility in order to identify the practical gap.

4.2.1 Design Science Artefact

The aim of this iteration is to construct the framework and identify the practical gap that embodies the FEPM by analysing the EPM and flexibility literatures from longitudinal view. The technique involves applying a two-step process resulting in two outputs. As illustrated in Table 4.1, each step applies a method to an input and results in an output that is used as the input for the next step.

Steps	Method	Input	Output
Constructing taxonomy of flexibility and EPM	SLR method	Literatures about flexibility and EPM	FEPM model Pharmaceutical organisation as a domain of concern in EPM
Identifying the practical gap in pharmaceutical domain	Semi-structured interviews-GTM	Pharmaceutical organisation as a domain of concern in EPM	Gap in supplier selection process

Table 4.1: Iteration Steps: Input-Output Steps

4.3 Artefact Building and Development

The building stage implies identifying the initial steps for the process of constructing the FEPM framework and explaining what each step involves. The initial stage entails using SLR to review existing literature about FEPMs, and find and analyse the changes that have occurred in EPMs during the last decade.

4.3.1 Systematic Literature Review

This section presents the SLR undertaken for this study to investigate the evolution of EPM over the past decade. Kitchenham and Charters (2007) describes several reasons for

undertaking a systematic review; the most common are to synthesise the available research concerning a treatment or technology, identify topics for further investigation and formulate a background in positioning new research activities. This thesis uses SLR to address the need for a longitudinal view during periods of great volatility and understand the viability of EPMs with respect to current and future flexibility. The SLR was conducted using the aforementioned template, and has taken into account the guidelines provided by Biolchini *et al.* (2005) and Kitchenham and Charters (2007). The volatility of EPM utilisation as the Web continues to develop warrants a systematic analysis of research over the early period of Web evolution. The steps undertaken in the SLR are documented below.

4.3.1.1 The Search Process

The search strategy undertaken is based primarily on identifying alternative keywords and synonyms for terms used in the research questions (such as EPM and flexibility). This is performed in order to minimise the effect of terminological differences. The search process (Figure 4.2) comprises a manual search of appropriate conference proceedings and journals. The journal/conference lists were those suggested by Kitchenham and Charters (2007) and were deemed appropriate for this review of the coverage of highly-cited EPM and flexibility literature.

The search process has two phases: phase one involves the identification and selection of papers containing the specific search term; phase two entails scanning paper references and aims to identify further key literature. In the first phase, a number of recognised electronic databases are used (detailed below). The chosen sources contain high-quality published research recognised within the e-business research community.

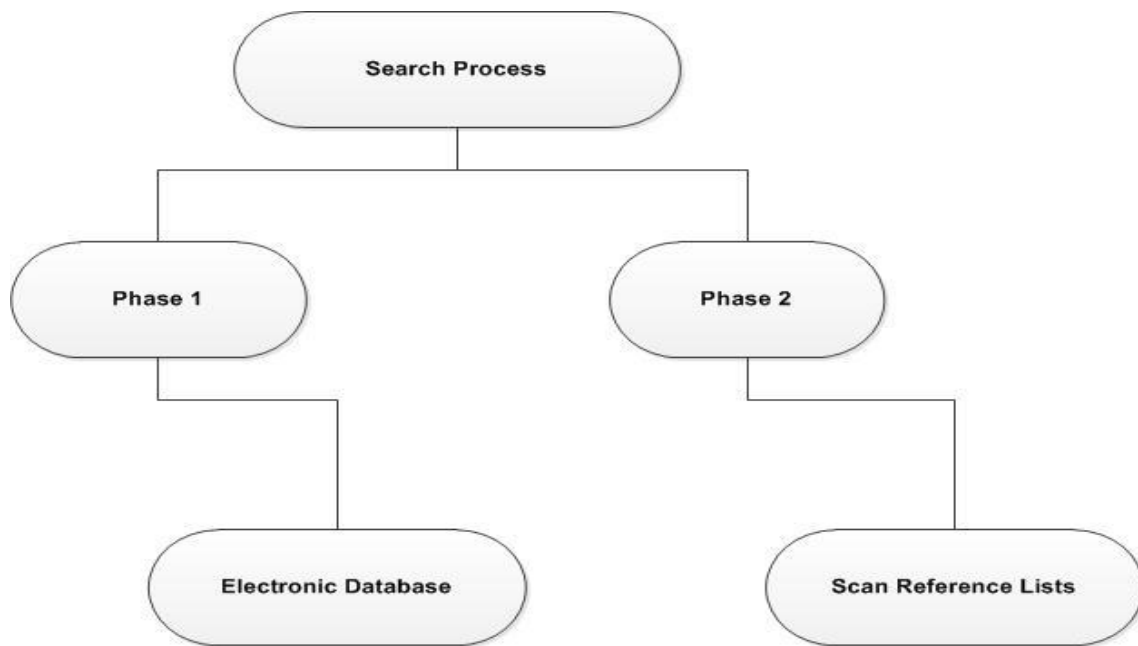


Figure 4.2: Research Process Phases (adopted from Afzal (2009) (Afzal, Torkar and Feldt, 2009))

The selected journals and conferences are presented below in Table 4.2. Each journal and conference proceeding in phase one is reviewed based on title, abstract and keyword; the papers addressing EPM were identified as potentially relevant.

Source	Website
IEEE Xplore computer Society Digital Library	http://ieeexplore.ieee.org/
ACM Digital Library	http://portal.acm.org/
Citeseer Library	http://citeseerx.ist.psu.edu/
ScienceDirect	http://www.sciencedirect.com/
Web of knowledge	http://portal.isiknowledge.com/

Table 4.2: Journal/Conference Sources

During the second phase, the reference lists of those selected papers are scanned and further papers identified. All searches were performed between July and August 2011 and are based on title, keyword and abstract. For all sources, a set of simple search strings are defined. The search results are then combined:

1. (*Marketplace AND Electronic Procurement AND Flexibility*)
2. (*Marketplace AND E-Procurement AND Flexibility*)

3. (E-Marketplace AND E-procurement AND Flexibility)

4. (Flexibility AND E-procurement Marketplace)

Certain synonyms and terms related to the concept of model within the scope of FEPM were also considered in the search process. Specifically, the terms “diagram”, “view” and “concern” are as synonyms for “model”. The information retrieved through this search string was used as a guide for the development and validation of the major search terms (Khan, Niazi and Ahmad, 2010). The final list of sources, the number of publications found for each resource and the number of duplicate papers, are listed in Table 4.3. The scoping of the study followed Kitchenham et al. (2007, 2009) and identified an initial list of papers. These were updated gradually during the scoping study. Some papers that were already known to be relevant were used to check the validity of the search terms (Kitchenham *et al.*, 2009).

Resource total	Results found	Duplicated papers	Initial selection	Final selection
IEEE Xplore	104	82	44	2
ACM Digital Library	86	85	56	5
Citeseer Library	21	21	6	0
ScienceDirect	478	407	276	7
ISI web of science	219	156	111	8
Total	908	751	493	22

Table 4.3: Data Sources and Search Strategy

The first phase of research identified a total of 908 candidate papers. After eliminating duplicates in more than one electronic database, we were left with 751 papers. Table 4.3 outlines the distribution of papers before duplicate removal. The corpus of papers initially found and finally utilized are similar to both Afzal et al. (2009) - 35 selected from 501 – and Kitchenham et al. (2009) – selected 19 from 2,506.

The exclusion was carried out using a filtering approach (Figure 4.3). To begin with, initial analysis by the researchers excluded 258 references out of all unique publications using title and abstract. These were clearly beyond the scope of this study and did not relate to the research questions. The remaining 493 references were subject to detailed exclusion criteria, involving two researchers. First, each researcher applied the exclusion criteria independently. Out of 493 references, the two researchers were in agreement on the exclusion of 295

references and the inclusion of 13, while a meeting was required to reach a consensus on 146. In meetings, researchers tried to convince others; if agreement could not be reached, a third party was asked to analyse the paper and a majority decision was taken. This application of detailed exclusion criteria resulted in 53 remaining references, which were further filtered out by reading the full-text. A final figure of 20 primary studies was reached after excluding similar studies published in different venues. The 20 primary studies were supplemented with two further papers from phase two of the search strategy (Figure 4.3). The few resulting papers from phase two indicate the effectiveness of the earlier search process.

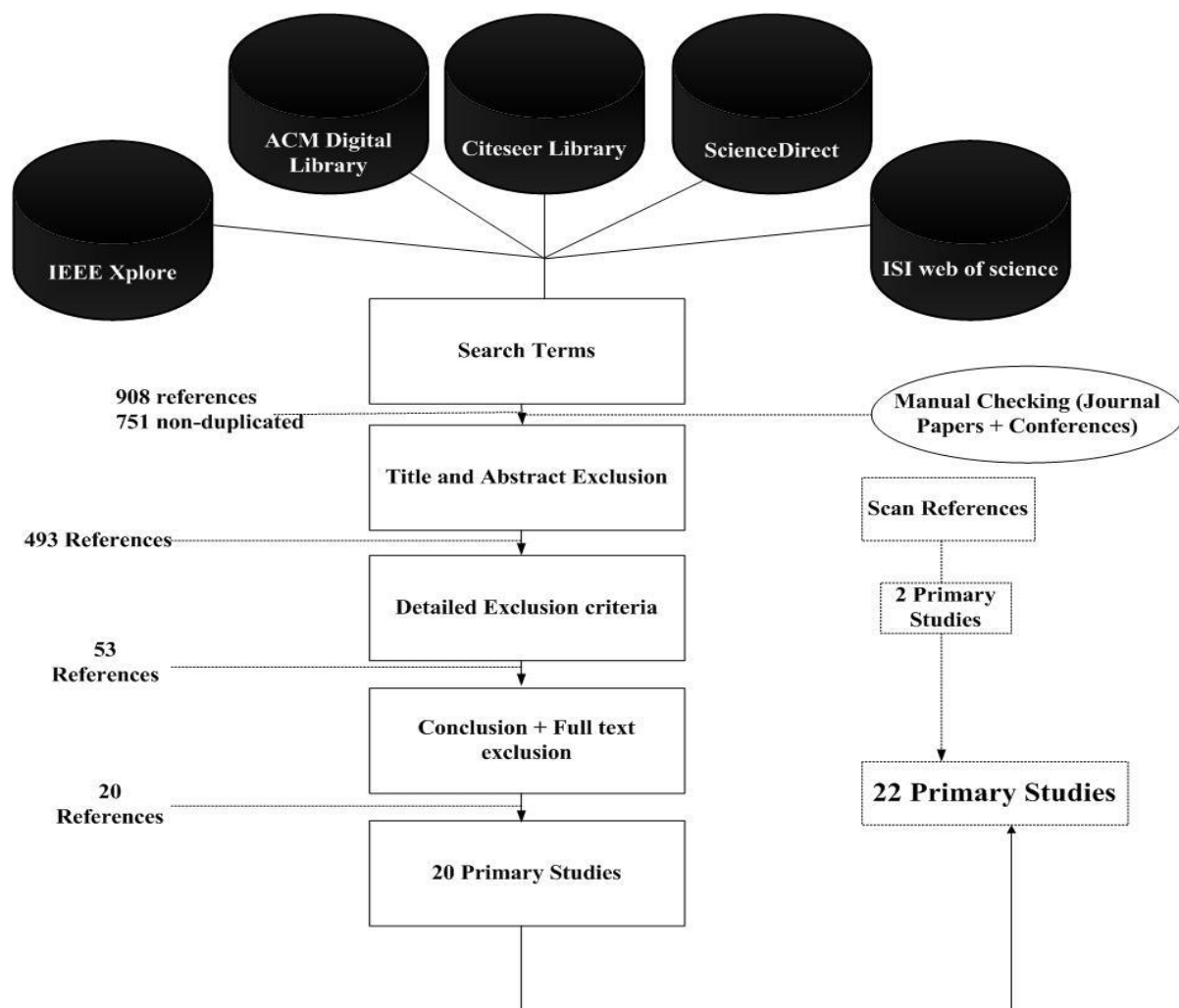


Figure 4.3: Multi-step Filtering of Studies and Final Number of Primary Studies (adapted from Afzal et al. (2009))

4.3.1.2 Inclusion and Exclusion Criteria

Inclusion criteria attempt to find the most appropriate papers to support the research questions. Data inclusion criteria determine which journals or conferences (found by the

search terms) are used for data extraction. A selection process that uses candidate search terms has shown that, in many cases, interpreting the paper title provides adequate support for inclusion in the study. Unsurprisingly, when the terms of the query are commonly used in literature (as in this study), many papers unrelated to the subject of this SLR are found. When the title is insufficient to determine whether the paper should be included, the abstract is then read followed by the introduction and, finally, the whole paper if necessary. The criteria used to determine whether the literature found by the search term should be included are studies that describe: market-based e-procurement; the flexibility factors in the selection process of procurement marketplace; the relationship between flexibility and EPM and motivations in flexible market-based e-procurement.

The intention is that this SLR should concentrate on identifying flexibility concepts (and taxonomy) for flexible market-based e-procurement. Since (1) it is difficult to obtain access to all the flexibility aspects within a single paper and (2) markets change continuously, it is important to extract papers that allow analysis of evolution. Again, duplicate reports of the same study are excluded in the SLR; only the most complete versions of the research are included. Studies were excluded if they are not directly relevant to the research questions or do not describe flexibility with respect to market-based e-procurement or e-procurement processes.

4.3.1.3 Threats to the Validity of this SLR (Quality Assessment)

Each paper was evaluated using the Database of Abstracts of Reviews of Effects (DARE) criteria (Centre for Reviews and Dissemination, 2007). DARE was produced by the University of York, Centre for Reviews and Dissemination (CDR). The criteria are based on the following four quality assessment (QA) questions:

QA1. Are the review's inclusion and exclusion criteria described and appropriate?

QA2. Is the literature search likely to have covered all relevant studies?

QA3. Is it clear that the de-motivated factors in EPM are to be more flexible?

QA4. Are the architectural components of FEPM clear?

The questions were scored as follows: QA1: Y (yes), the inclusion criteria are defined explicitly in the study; P (Partly), the inclusion criteria are implicit; N (no), the inclusion

criteria are not defined and cannot be readily inferred. QA2: Y, the authors have either searched 4 or more digital libraries and included additional search strategies, or they have identified and referenced all journals addressing the topic of interest; P, the authors have searched 3 or 4 digital libraries with no extra search strategies, or they have searched a defined but restricted set of journals and conference proceedings; N, the authors have searched up to 2 digital libraries or an extremely restricted set of journals. QA3: Y, the authors have explicitly defined quality criteria and extracted them from each primary study; P, the research question involves quality issues that are addressed by the study; N, no explicit quality assessment of individual primary studies has been attempted. QA4: Y, information is presented for each study; P, only summary information about primary studies is presented; N, the results of the individual primary studies are not specified. The scoring procedure was Y = 1, P = 0.5, N = 0, or Unknown (i.e. the information is not specified). Kitchenham *et al.*, (2007, 2009) coordinated the quality evaluation extraction process. Kitchenham *et al.*, (2007, 2009) assessed every paper, and allocated 4 papers to each of the other authors of this study to assess independently. When there was a disagreement, the issues were discussed until an agreement was reached. When a question was scored as “unknown”, the authors of the paper were contacted by email and asked to provide the relevant information; the question was then re-scored appropriately.

4.3.1.4 Data Extraction

A data extraction form adapted from Biolchini et al. (2005) is completed for each selected work (Table 4.3). Data extracted from each study includes a full reference, the author(s), their institution and the country in which it is situated, and the number of citations.

4.3.1.5 Data Analysis

Data was tabulated (Table 4.4) to show: (1) the number of journal/conference papers published annually about EPM and their sources (Addressing RQ1); (2) whether or not the journal/conference papers referenced the characteristics of EPM (addressing RQ2); (3) whether or not those journal/conference papers referenced flexibility aspects (Addressing RQ3). The architectural components of flexible EPM (Addressing RQ4) are discussed later.

4.3.2 Discussion

In this section, the evaluation of the assessed literature in relation to the research questions is described. Each of the 22 primary studies is allocated to previously-identified specific flexibility types: environmental, technical, strategic and organisational. The number of primary studies covering each flexibility type is: 7 (Environmental), 12 (Technical), 12 (Strategic) and 4 (Organisational). Additional details of the distribution of primary studies within each flexibility type are provided in Table 4.4.

Flexibility Types	Author(s)	Year	References
Environmental	Das, TK	1995	73
	Byrd, T.A.	2000	321
	Legorreta, L.	2001	7
	Gosain, S.	2004	141
	Fredericks, E.	2005	26
	Fitzgerald, G.	2009	4
	Merschmann, U.	2010	1
Technical	Byrd, T.A.	2000	321
	Legorreta, L.	2001	7
	Ozer, M.	2002	9
	Shi, D.	2003	44
	Skjott-Larsen, T.	2003	88
	Pujawan, I.N.	2004	51
	Giunipero, L.C.	2005	32
	Avittathur, B.	2007	22
	Fitzgerald, G.	2009	4
	Hallgren, M.	2009	18
	Tachizawa, E.M.	2010	2
	Gosling, J.	2010	4
Strategic	Das, TK	1995	73
	Grewal, R.	2001	319
	Duclos, L.K.	2003	123
	Johnson, J.L.	2003	87
	Shi, D.	2003	44
	Pateli, A.G.	2003	94
	Pujawan, I.N.	2004	51
	Fredericks, E.	2005	26
	Giunipero, L.C.	2005	32
	Hallgren, M.	2009	18

	Fitzgerald, G.	2009	4
	Tachizawa, E.M.	2010	2
Organisational	Das, TK	1995	73
	Duclos, L.K.	2003	123
	Fredericks, E.	2005	26
	Swafford, P.M.	2008	40

Table 4.4: Distribution of Primary Studies per Flexibility Aspects

In order to explore the evolution of EPM, a number of axes require analysis. Understanding is also required of the temporal aspects of specific flexibility types within specific domains. Figure 4.4 shows the annual distribution of primary studies within each flexibility aspect, as well as the frequency of application within different domains. Each bubble depicts the underlying literature and contains the name of the author(s) and the number of citations for the contribution(s). It is evident from the chart that the manufacturing and market domain are the most widely studied with respect to flexibility. In the left quadrant of Figure 7, each bubble represents the author name (s) of primary studies within each flexibility aspect for 1995–2010. The pharmaceutical domain has had been subjected to little analysis over the past decade; moreover, finance has not had full coverage of all flexibility aspects. Flexibility aspects have also gained popularity in the research community at different points in time. Technical flexibility has been popular recently, as opposed to strategic flexibility, which peaked in 2003. Organisational flexibility appears to have had regular coverage between 2003 and 2008, but little coverage in the recent past.

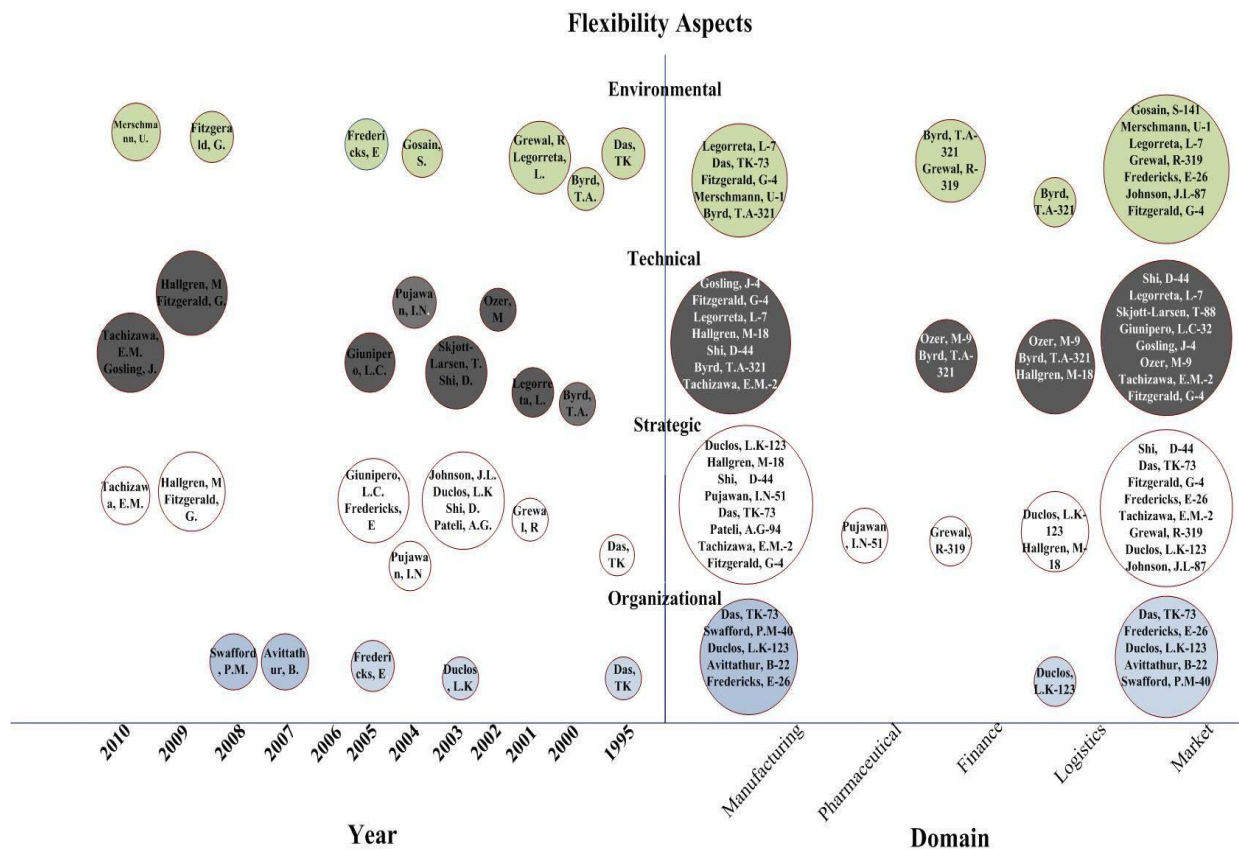


Figure 4.4: Distribution of Flexibility Research Since 1995

4.3.2.1 Domain Impact

Each bubble represents the author name(s) of primary studies within each flexibility aspects for 1995–2010. As the distribution of flexibility concerns shows in Figure 4.4, the number of authors working on flexibility has decreased somewhat. From 1995 to 2001, the majority of the published papers cover technical and environmental flexibility. This gradual increase from 2002 to 2005 has focused typically on strategic and technical flexibility. From 2006 to 2010, only one of the papers published covers three out of four flexibility aspects. It is evident that more research is required covering flexibility across all criteria.

Research on e-procurement in the manufacturing domain is more mature than that in information systems (IS). To explain, Harrigan et al. (2008) (p. 2) made a general observation and stated that, strategically, procurement can encompass, “the entire operation including a company’s requisitioning, transportation, warehousing, and inbound receiving processes”, where the dominant goal is process efficiency. In a recent study, Fitzgerald et al. (1990) considered all aspects of flexibility in manufacturing and marketplaces. They found that

manufacturers are more likely to require flexibility in their strategic, environmental and technical activities.

The pharmaceutical domain has been subjected to little analysis over the past decade. Buyers and suppliers must work together toward standardisation, including agreeing on a universal product numbering system (Nakane and Hall, 1991). There is only one related work on flexibility in e-procurement. This is surprising as it has been clear to the authors that flexible e-procurement is an important strategic goal for pharmaceutical organisations and their networks. Within the finance domain, it is often difficult to explore procurement; this is due partly to complexity and security concerns.

Complexity results from the synthetic nature of services (and products) offered and the variation in supporting products and services. In addition, e-procurement literature indicates that many corporate-level executives hold a traditional view of procurement and do not fully recognise its impact on all areas of financial performance. Many professionals do not understand the language of finance and, thus, fail to articulate the real value of their solutions at the corporate level (Presutti, 2003). In Figure 4.4, there are only three papers published in the financial domain, mainly around technical and environmental concerns.

Finally, the pharmaceutical domain has been subjected to little analysis over the past decade, and has not received full coverage of all flexibility aspects. Flexibility aspects have also gained popularity in the research community at different points in time. Technical flexibility has achieved recent popularity, whereas strategic flexibility peaked in 2003. Organisational flexibility appears to have had regular coverage between 2003 and 2008, but little coverage in the recent past. It is clear that more research is required in the under-analysed pharmaceutical domain, unpicking the differing aspects of flexibility. Therefore, set of interviews with a pharmaceutical industry is conducted in order to discover what changes have occurred in the organisations over the last 10 years and how they manage to be flexible.

4.4 Pharmaceutical Industry

4.4.1 Background to Pharma

For reasons of confidentiality, the term “Pharma” will be used. Pharma, an international pharmaceutical company, uses EPMS to increase its sourcing and procurement activities. In 2012, Pharma was the fourth largest pharmaceutical company in the world with sales of £26.4

billion. Pharma's global and diverse employee comprises nearly 100,000 employees, and they contract goods and services on a significant scale. Last year, Pharma's manufacturing supply chain spent around £9 billion with 6,000 suppliers across 73 countries. Pharma implemented a global centralised procurement organisation that could deploy systems and processes rapidly worldwide. Pharma also implemented a suite of e-procurement tools to minimise purchase spending and facilitate negotiations with suppliers. The suite included online ordering systems, content aggregators and internally-developed decision-support tools. Pharma used the Emptoris negotiation suite to implement reverse auctions, send requests for information, collect sealed bids, analyse complex bids and optimise sourcing decisions. Pharma negotiates 90 per cent of its annual spending online relative to an industry average estimated between 0 to 15 per cent.

The company purchased direct materials, indirect materials, and services of approximately \$11 billion, comprising 40 to 45 per cent of total company costs. Of total purchases, Pharma spends approximately \$3 billion per year on direct products and services (for example, raw materials used in the production of a drug) and \$8 billion per year on indirect, non-strategic products and services (for example, travel related costs). During the last decade, Pharma has faced a series of changes. Two examples are provided here of Pharma's sourcing and procurement activities, and the mechanisms implemented to improve the organisation. During 2003, Pharma conducted a large reverse auction for hotel rooms around the world. The 90-day project cost \$80 million. The procurement team was contracted for 419,920 room-nights in 39 countries, covering 1,226 hotels. Overall, it estimated savings of between 5 and 35 per cent per market. In the second example, during the third quarter of 2002, Pharma changed its procurement process for lab and research supplies. It implemented an Ariba online ordering system and simultaneously installed SciQuest's Spend Director. The SciQuest site aggregated content from 72 supplier catalogues or 80 per cent of Pharma's spending for lab and research supplies. The supplier catalogues hosted in the aggregated Spend Director marketplace contain over 2.1 million items or 90 per cent plus of the content required by researchers. Pharma's move to this solution and methodology saved approximately \$2.0 million in the first 12 months.

4.4.2 Pharma Finding: Flexible Supplier Selection Process

This section will explain the GTM of Pharma based on the main four flexibility factors discussed in Section 4.4: technological, environmental, strategic and organisational. As

illustrated in Chapter 3, Iteration 1, this section provides a hierarchical taxonomy of the flexible EPM concepts from which to develop a more comprehensive framework from the analysis of expert interviews using GTM. A list of the flexibility factors mentioned by interviewees is illustrated in Figure 4.5.

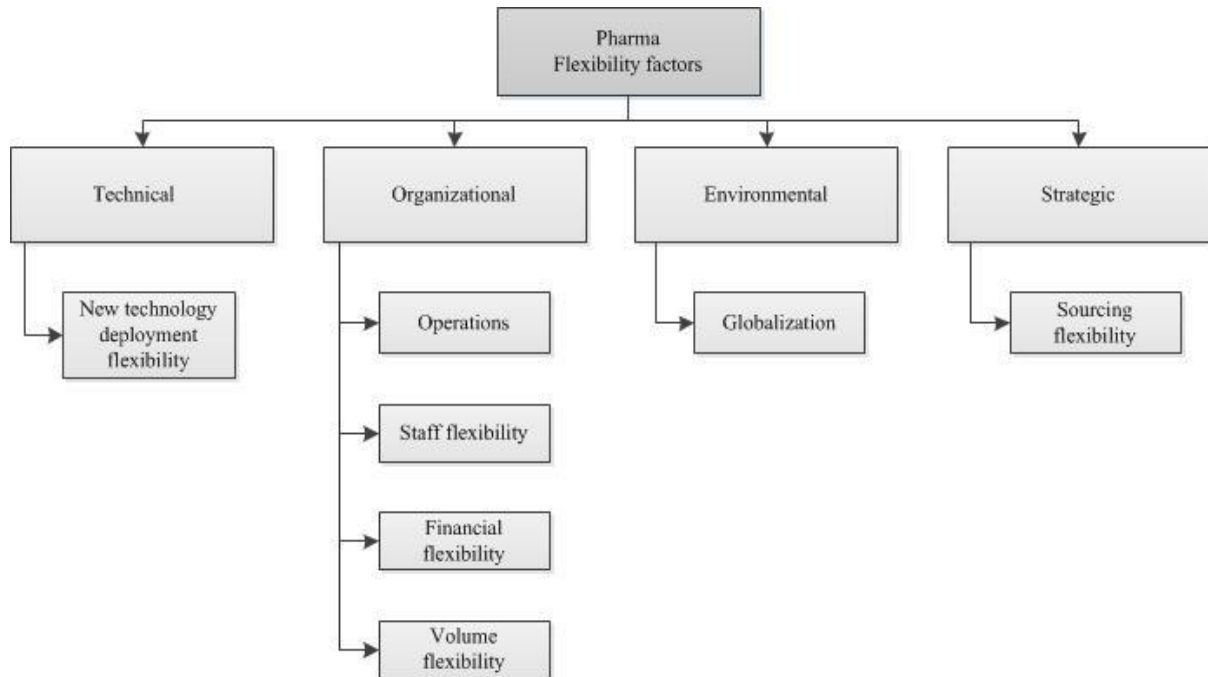


Figure 4.5: Pharma Flexibility Factors in Selecting Suppliers

4.4.2.1 Technological Flexibility

In the context of technological flexibility, the study’s findings illustrate that Pharma’s procurement system changed significantly the industry’s IT infrastructure within the last couple of years. The primary meetings with the Head of Procurement (HP) and the Head of Global Resourcing and Procurement (HGRP) emphasise the fact that significant changes took place in Pharma. The HGRP stated:

“.... It was literally month by month the paper stack would go down, so there are empty seats, another paper stack going down other empty seats. But taking them from data, or piece of paper, they are now on the phone helping people to process choosing goods talking to suppliers so their roles became more interesting. But it was very significant change...”

Moreover, since there was a plethora of IT vendors specialising in supporting inter-departmental business activities, there was confusion over the selection of the appropriate IT partners in order to support the external business activities. The findings of the study for

Pharma indicate that the IT department was mainly responsible for implementing the system but did not use any evaluation framework or any other processing tools to assess the flexibility of IT suppliers. Regarding this issue, the HGRP commented that:

“... Some suppliers are not integrated..... can't accept order through the sales systems, the reason for considering a flexible selection process is that according to the performance analysis, Pharma faces with more changes in future. So we need to engage externally with more flexible suppliers. ... ”

As a result of a blurred procedure and lack of formal processes for selecting appropriate IT suppliers, the Director of Vendor Management (DVM) took the final decision by relying only on the selected supplier's expertise. Implementing and adopting such systems should be considered a high risk as it is concerned with future industrial changes and how those new IT suppliers are coping with the future changes. Despite the critical nature of this process, Pharma underestimated the time and effort it takes to make a well-informed decision. For instance, the HP pointed out that:

“...Considering the fact that educating suppliers is the most time consuming process, adopting the flexibility factors is a reduction in the time spent on educating suppliers with the processing system, the cost of implementing IT structures for them and improvements in business process...”

4.4.2.2 Organisational Flexibility

In the context of this study, this category focuses on organisational flexibility factors mentioned by interview participants in Pharma. The findings of the study illustrate that Pharma considered flexibility in the work processes, including operations, finance and volume. Each interviewee appointed the flexibility factors as the main coordinator in the marketing of the industry. For instance, the DVM remarked that operational flexibility is required to meet the suppliers/customers commitments. He categorised the commitments by:

“... (a) Temporarily maintaining, (b) redistributing or (c) changing the focus, mix, functionality, location, or workload of resources...”

Conversely, the Procurement Operation Manager stated that:

“...In order to exist with the competition between suppliers networks (in terms of commitments and cash flow), you need to have flexibility in finance...”

He further mentioned that they faced some challenges with suppliers regarding different financial networks:

“...The fact that we got old core financials [data] - it does not really help, it's not technologically advanced enough to handle the platforms so I think again some challenges exist in different financial network ... in terms of commitments and cash flow...”

The interviewees had a mutual belief that, since the volume of supplier/customer requirements is high, there is a need to consider and manage the changes in requirements. The Head of Global Resourcing and Management mentioned it as volume flexibility that solved it by using online catalogues:

“...From the customer/supplier side I think there are few challenges: Some customers/suppliers are very familiar with e-procurement and very comfortable with it, other struggle with it,....., people are expecting to see an online environment with online catalogues and not shocked by it...”

Furthermore, the Procurement Operation Manager commented that:

“...I want to concentrate on the strategy for my area and my customers so I expect people in procurement have got knowledge and expertise”

4.4.2.3 Environmental Flexibility

As described in Chapter two (Section 2.5.3), this category focuses on the external pressures that influence the industry. The findings for Pharma illustrate that globalisation is one of the factors that impacted severely on the industry, both internally and externally. Globalisation refers to any changes in market conditions or the business environment. Pharma's DVM mentioned that:

“...There is need for flexible processes and systems to support globalization and that doesn't mean that just doing it in old traditional centre, it means doing it everywhere, ...across the world ... China, India - you know Japan or Australia are implementing what we have already done within UK, US (its Pharma collaboration across Pharma globally in terms of what's the right answer)...”

4.4.2.4 Strategic Flexibility

In the context of this research, this category focuses on flexibility to provide the resources from multiple sources. The HGRP refers to it as sourcing flexibility. He remarked that:

“..managing the changes in organizational infrastructure was very much fragmented with respect to suppliers selection, different IT structures with no integration with supplier processing systems, lack of supplier’s knowledge about the organisational infrastructure, transparency and visibility of procurement process prevailed...”

Pharma’s efforts to develop and implement sourcing strategy plan for selecting suppliers have been remarked by HP. Moreover, its efforts to educate suppliers working with the new EPM platform have been hindered by organisational performance that has grown over the years.

4.5 Summary

This iteration reviewed the IS-related literature, classified the flexibility types and extracted a hierarchical taxonomy that was used as a guideline on which to develop a more comprehensive and general flexible EPM conceptual framework. The SLR method, used to develop an initial FEPM consisting of automatically-extracted domain concepts, has provided a conceptual understanding of EPM constructs and flexibility. Furthermore, the iteration has demonstrated that the evolution of the Web from individual organisation flexibility to cross-organisation flexibility has resulted in the entire EPM platform needing to be flexible. Moreover, issues remain about what specific EPM flexibility components require consideration. The SLR contribution was a lack of studies on pharmaceutical domains. Therefore, set of interviews was conducted to identify the changes and issues in the organisation in the last ten years and how they managed to be flexible.

The interview analysis has resulted in Pharma implementing various IS and strategic planning in order to enhance their internal and external information with other suppliers in order to reduce the mismatch and loss of suppliers. These systems did not solve all the problems as suppliers used a variety of operation systems and applications. These problems became an obstacle to Pharma’s flexibility during periods of rapid change as they had business goals for reducing the internal organisation cost. Some of the other issues with suppliers mentioned in the interviews include: supporting issues; integrating with new platforms; challenges in terms of outsourcing; pressure to reduce the cost of implementation; selecting suppliers according to future changes to the organisation (supplier optimisation processes).

As a result of analysing the interviews, a list of flexibility factors is identified. The outcome of this iteration illustrates that there is significant issue in selecting suppliers with respect to rapid changes taking place within Pharma. There is a need to further investigate the process of selecting flexible suppliers. Finding the process of flexible supplier selection is brought forward for the next Design Research iteration.

CHAPTER 5 ITERATION II

5.1 Introduction

The aim of this iteration is to articulate the organisational perceptions of supplier selection by refining and extending the flexible e-procurement marketplace (FEPM) framework developed in Chapter 4; the research focus is to extract supplier selection processes (SSPs) from pharmaceutical industries. To address the gap identified in Iteration 1, managers and the teams responsible for procurement in two pharmaceutical industries were interviewed using a structured Repertory Grid (RG) interview technique taken from psychology, which is particularly effective at uncovering the characteristics of the selection process. The process is then integrated into the FEPM in order to identify the motivating factors for developing more common approaches to appraising suppliers and improving flexibility and consistency.

The remainder of this chapter is structured as follows. Section 5.2 provides the Design Research and the outputs of this iteration. Section 5.3 presents the building and development of the design artefact – illustrating and detailing the actual supplier selection process in pharmaceutical industries. Section 5.4 describes the data collection process for this iteration by interviewing experts in two pharmaceutical organizations in UK. The learning outcome of this iteration is presented in section 5.5. analysis of the research outputs with the details of the experimental setting and finally the chapter is summarized in section 5.6.

5.2 Design Research and Output Artefact

The purpose of this Design Research iteration is to build actual, practical processes through which pharmaceutical organisations can select their suppliers. An extended framework involves semantic processes of supplier selection. As noted in Iteration 1, pharmaceutical e-marketplace adoption has been volatile over the past decade. This iteration aims to further explore the SSP to identify the motivating factors for developing more common approaches to appraising the suppliers. Only then can flexibility and consistency be improved.

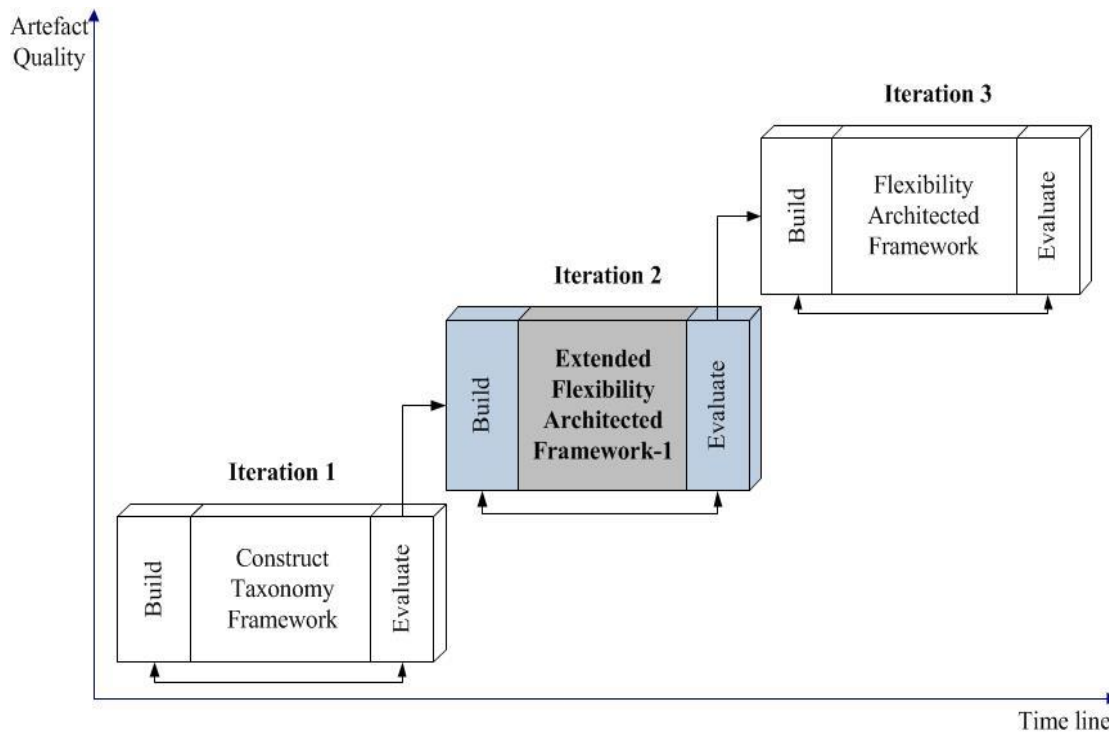


Figure 5.1: Research Iteration 2

5.2.1 Design Research Artefact

This iteration introduces an approach for improving the developed framework to include the SSP. This will be achieved by interviewing the procurement team in two pharmaceutical industries in UK and analysing the yielded data in order to discover the actual process. To achieve the aim of the research, this iteration executes the following steps (see Table 5.1).

Steps	Method	Input artefact	Output artefact
Identifying the supplier selection process (SSP)	SSP Process	FEPM model (Iteration 1)	SSP Model
Refine and extend the FEPM model by incorporating the extracted process	SSP Framework	SSP Model	Improved FEPM model and method

Table 5.1: Iteration Steps: Input-Output Steps

5.3 Artefact Building and Development

This section presents the building and development of a refined FEPM, as illustrated in Figure 5.2. Figure 5.2 illustrates the three phases Pharma goes through when selecting new

suppliers. Each step is further described in the following sub-sections, which integrate SSP and the extracted process to represent a model of the underlying domain (pharmaceutical).

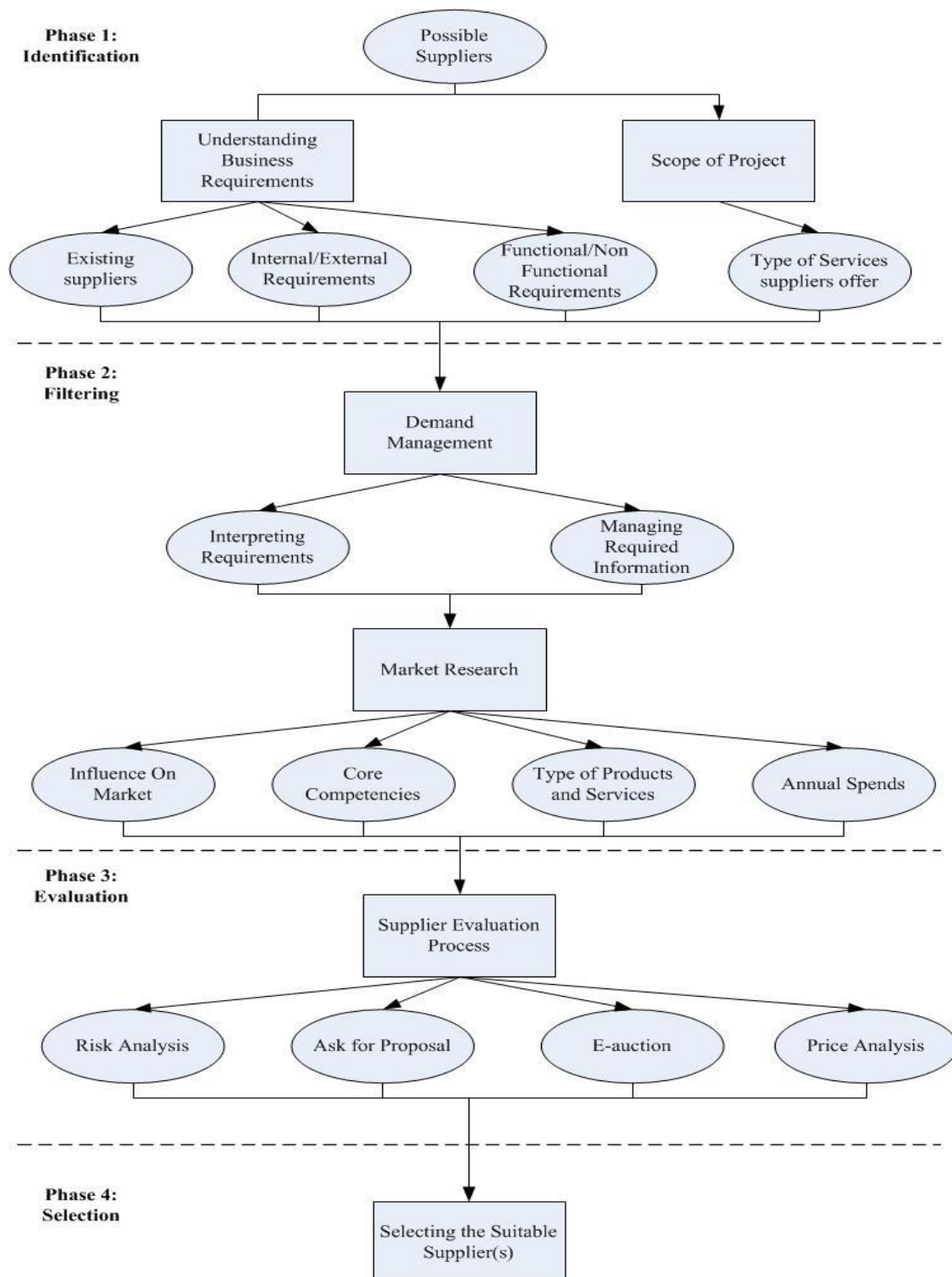


Figure 5.2: Pharma's Decision-making Model of Supplier Selection

5.4 Data Collection and Analysis

The analysis of enhanced SSPs has been conducted in order to identify the process with respect to their relating interview transcriptions. We have tried to focus on the dimensions that follow a meaningful procedure, which could help enhance our understanding of SSP. The results have been grouped into common themes in the following sections to facilitate comparison between the categories.

A total of six RG sessions were conducted with procurement and marketing managers from two UK-based pharmaceutical organisations, and the saturation point was reached during the fifth session. Table 5.2 presents the demographic information of the participants, who have an average work experience of 18 years.

Job Position	Number of Participants	Work Experience	Pharmaceutical Industry
Head of Procurement	1	30 Years	Pharma 1
Procurement Manager	1	17 Years	Pharma 2
Global Director of Innovation	1	15 Years	Pharma 1
Procurement Operations Manager	1	12 Years	Pharma 1
Director, Head of Hub Northern Europe	1	23 Years	Pharma 2
Analysis Manager	1	15 Years	Pharma 1

Table 5.2: Demographic Information

Most sessions lasted approximately 1 to 1 ½ hours. All participants were able to identify their organisation’s process for selecting new suppliers during the RG session. The saturation point for the study was reached after the fifth interview. The first five participants included individuals with extensive work experience; one has 30 years’ experience. In terms of their managerial duties, responsibilities typically include the evaluation of colleagues, providing feedback and assessing required training improvements. Therefore, it is not surprising that the saturation point was reached after the fifth participant’s session. However, an additional interview was conducted to enhance the richness and validity of the findings, and to confirm that the point of redundancy or saturation had been reached.

5.5 Research Results

The RG data has been analysed to provide an understanding of the SSP dimensions of two pharmaceutical companies in the UK. First, a frequency and variability analysis has been performed on the RG results to identify the most important selection process. Second, a detailed qualitative analysis of the interview transcripts was performed.

5.5.1 Quantitative Analysis of Repertory Grid Data

A quantitative measure of the importance of each value category has been conducted using two parameters proposed by Goffin et al. (2006): Frequency and Variability. *Frequency* is defined as the percentage of respondents who have mentioned constructs in a category. It is also used to identify a “common” construct (Lemke et al. 2003; Jankowicz, 2005; Goffin et al. 2006). A construct’s frequency count is a good indication of its importance (Lemke et al. 2003). However, it does not cover the relative importance of the constructs in relation to the respondents as it ignores the RG values (i.e. the element ratings against each construct).

The relative importance of constructs can be quantified by determining its variability. *Variability* is a mathematical measure of the spread of ratings for a construct (Goffin et al. 2006). It is calculated as a percentage of the total sum of the squares of elements’ ratings for each single construct in a grid. A higher spread of elements’ ratings for a construct demonstrates that the interviewee perceives it as a more important dimension; for example, “Understanding initial knowledge of supplier/Final selection of suppliers” has the highest variability in the first interview (Table 5.1). In accordance with Lemke et al (2003), value dimensions with a frequency value of at least 25 per cent are identified as being of high importance. However, Goffin et al. (2006) caution that a high frequency value may indicate that a category is obvious to respondents without being important; therefore, a combination of frequency and variability will be used to measure importance. This section will investigate these parameters in more details for the two participating companies.

The variability measure is dependent on the number of constructs in a grid, and this varies across grids. For example, if eight constructs have been elicited from a respondent, the average variability would be 12.5% (i.e. $100/8$), whereas if five constructs have been extracted, the average variability would be 20% (i.e. $100/5$). Therefore, following the method proposed by Goffin et al. (2006), the variability calculated for single constructs has been

normalised across the grids by multiplying the variability of each construct by the number of constructs in that individual grid, then by dividing this by the average number of constructs across for all respondents – 10.2. The average variability per construct for each grid is given in Tables 5.3 to 5.8.

Procurement Manager	
Constructs	Variability
Identifying potential suppliers/not potential suppliers	7.13
Identifying realistic price/not actual price	8.76
Initial SSP/end of SSP	7.95
Checking the number of suppliers/inviting for proposal	10.39
Pre-experience in market evaluation/risk evaluation supplier	11.20
Process of engaging with requirements/process of selecting criteria	11.20
Core competencies-deliverables and services/adds on process	8.35
Checking similar value/different value	10.60
Understanding initial knowledge of supplier/final selection of suppliers	12.63

Table 5.3: Interview 1 Constructs Variability

Head of Operation Manager	
Constructs	Variability
Establishing finished products/finished products	14.54
Informal/formal info	12.39
Happening /not happening	7.54
External suppliers/internal suppliers	8.62
External info-understanding of market/internal info	9.16
Enough info/not that much info	7.0
Understanding of info/end result info	13.47
Proceeding info/delivering info	9.69
External detail info/high level Info	7.0
Supplier input/relation to stakeholder	9.16

Table 5.4: Interview 2 Constructs Variability

Head of Innovation	
Constructs	Variability
Functional requirements/non-functional requirements	7.28
Input checking/output checking	9.70
Subjective/objective	19.80
Paper-based process/pilot-based process	10.51

Table 5.5: Interview 3 Constructs Variability

Director, Head of Hub Northern Europe	
Constructs	Variability
External/internal	10.74
Balance of project team/compliment project scope	11.83
Demand management-outcome of discussion/external outcome	10.20
Emotional evaluation/logical evaluation	11.01
Interpreting internal requirements/interpreting external requirements	8.45
Managing demand/managing offers	8.70
Evaluating suppliers/RFQ getting answer	6.90
Scope of project/no scope	10.60
Evaluating non-potential/evaluating potential	9.87

Table 5.6: Interview 4 Constructs Variability

Head of Operation Manager	
Constructs	Variability
Small amount of spend/large amount of spend	15.58
Internal risk/external risk	12.45
Service providing/not providing service	12.84
Existing supplier/new supplier	10.51
Functional process/non-functional process	10.90
Functional tool/research-based tool	9.53
External influence on market/broad influence on market	11.43
Influencing factors/non-deciding factors	7.19
External factors/internal view of organisation	6.82
Internal management/external management	5.05
Internal negotiation/commercial negotiation	8.37

Table 5.7: Interview 5 Constructs Variability

Analysis Manager	
Constructs	Variability
Comparing the existing partner/new partner	13.08
Marketing research/benchmarking	14.53
Request for price from supplier/request for information form supplier	12.01
Internal information/external information	11.65
External market value checking/broad influence on the market	9.87
Risk analysis/budgeting analysis	11.20

Table 5.8: Interview 6 Constructs Variability

Subsequently, in order to calculate the average normalised variability (ANV) for each category, we need to calculate the average of the constructs belonging to that category. Before initiating the normalisation process, we need to categorise the constructs. Therefore, the constructs generated from the RG were categorised according to Strauss and Corbin's (1998) grounded theory methodology (GTM). As mentioned previously (Chapter 3), Strauss and Corbin's (1998) GTM was used to analyse the qualitative data collected and to develop a conceptualization for them. The strength of this approach is that it provides a means by which theory can be grounded in categories of data that have been developed through the identification of distinctive relationships. Hence, GTM is an appropriate technique for developing a grounded theoretical conceptualisation of SSP. More specifically, the constructs generated by participants were coded according to the open coding methodology outlined by Strauss and Corbin (1998) and the sorting procedure described by Moore and Benbasat (1991), in which bipolar pairs describing similar constructs were grouped together and kept separate from those bipolar pairs describing different constructs. The next section explains the categorisation process.

5.5.2 Qualitative Analysis of RG Data

The process of coding starts begins with the open-coding process. Open coding was carried out by examining 49 bipolar characteristic pairs generated by participants and identifying their similarities and differences using the sorting procedure described by Moore and Benbasat (1991). Then, categories were dissected into richer sub-categories as appropriate.

Axial coding, on the other hand, entails relating different levels of subcategories to higher-level categories, and identifying overarching categories as *themes*. By relating back to the bipolar ends and the anecdotal evidence in the transcripts, the names and definitions of categories and sub-categories were refined and themes were identified. Table 5.9 outlines the nine categories that emerged from the analysis along with the number of times each category and sub-category was mentioned by the participants. Table 5.9 also provides definitions of the categories and sub-categories, as well as examples of their bipolar ends.

Category	Sub-category	Examples of positive and negative bipolar ends	Definitions
Understanding business requirements (7)			Understanding the needs and what services they require
	<i>Internal and external requirements (4)</i>	<i>Internal/external</i>	Are they internal or external requirements?
	<i>Functional and non-functional requirements (2)</i>	<i>Functional and non-functional</i>	Categorise the requirements based on functionality and non-functionality
Defining the Scope of Project (4)			What is the scope of project? How long will it take? How many people are required?
	<i>Type of service they are looking for (2)</i>	<i>Subjective/objective</i>	<i>Create the chart of project for having new supplier</i>
Demand Management (4)			Categorise the demands based on requirements
	<i>Managing demand (1)</i>	<i>Managing demands/managing offers</i>	<i>Categorise the demands</i>
	<i>Interpreting the requirements (1)</i>	<i>Interpreting the internal requirements/interpreting the external requirements</i>	<i>Managing and interpreting the internal and external requirements</i>
	<i>Demand management (1)</i>	<i>Demand management-outcome of discussion/external outcome</i>	<i>Managing demands</i>
Managing the Required Information (6)			Managing and categorising the required information
	<i>Information required</i>	<i>Enough information/not enough information</i>	Gathering the required information
	<i>Categorising</i>	<i>Formal/informal</i>	Categorising the information

	<i>information</i>		
	<i>Understanding the source of information</i>	<i>External information/internal information</i>	Where the information comes from (internal/external)
	<i>Understanding the information</i>	<i>Input information/output information</i>	Understanding the content and from where the information comes
	<i>Proceeding Information</i>	<i>Proceeding information/delivering information</i>	Processing the information
Looking at Existing Suppliers (5)			Process of selecting suppliers
	<i>Evaluating existing supplier</i>	<i>Evaluating suppliers/RFQ to get answer</i>	Evaluating supplier based on spreading RFQ
	<i>Categorising suppliers</i>	<i>Evaluating potential/not potential suppliers</i>	Categorising the suppliers based on their potentiality
	<i>The need for new suppliers</i>	<i>Existing suppliers/new supplier</i>	Do they need the new suppliers or not?
	<i>Type of suppliers</i>	<i>External suppliers/internal suppliers</i>	Categorising the type of suppliers in order to have list of capable suppliers
Market Research (9)			Undertake market research on the Web, colleague (internal, external info)
	<i>Influence on market</i>	<i>External influence on market/broad influence on market</i>	Identifying suppliers who have the influence on market
	<i>Influencing Factors</i>	<i>Influencing factors/not deciding factors</i>	Identifying the influencing factors
	<i>Supplier experiences</i>	<i>Pre-experience suppliers in market evaluation/risk evaluation suppliers</i>	Identifying the suppliers' experience of markets
	<i>Checking core competencies</i>	<i>Core competencies-deliverables and services/adds on process</i>	Identifying the suppliers core competencies
	<i>Type of products and services suppliers offer</i>	<i>Establishing finished products/finished products</i>	Identifying the type of products and services suppliers offer
	<i>Comparing value</i>	<i>Checking similar value/</i>	Identifying values suppliers

	<i>suppliers offer</i>	<i>different value</i>	offer
	<i>Annual spend</i>	<i>Small amount of spend/large amount of spend</i>	Identifying suppliers annual spend
Supplier Evaluation Process –Short listing process (7)			Evaluating the capabilities of suppliers
	<i>Different type of evaluations</i>	<i>Emotional Evaluation/Logical Evaluation</i>	Evaluation types
	<i>Study on the suppliers background</i>	<i>Paper based exercise/ pilot based process</i>	Evaluating the suppliers
	<i>Suppliers tools</i>	<i>Functional tools/research based tools</i>	Evaluate suppliers based on tools they are using
	<i>checking available suppliers</i>	<i>Checking number of supplier/inviting for proposal</i>	Checking available suppliers
	<i>Evaluating suppliers based on knowledge</i>	<i>Understanding the initial knowledge of supplier/final selection of suppliers</i>	Understanding suppliers knowledge in order to select them
	<i>Suppliers proposal analysis</i>	<i>Suppliers input / regarding to stakeholder</i>	Analysis of suppliers and stakeholders proposals
Risk Analysis (4)	<i>Price analysis</i>	<i>Identifying the realistic price/end of supplier selection process</i>	Identifying the costs
	<i>Identifying the risks</i>	<i>Internal risks/external risks</i>	Identifying the internal and external risks
Supplier Final Evaluation Process-Selecting supplier (2)			Selecting final supplier
	<i>Process of selection</i>	<i>Process of engaging with requirements/process of selection criteria</i>	Analysing market research and internal data
	<i>Decision making process</i>	<i>Internal negotiations/commercial negotiation</i>	Evaluating suppliers internally based on negotiations and their commercial benefits

Table 5.9: Open-Coding Constructs Categorisation

Several overarching themes emerged during axial coding through the common axes found among categories sharing similar or related properties and dimensions. These themes, and the categories that fall under them, are presented in Table 5.10.

Theme	Related Categories
Business Requirements Understanding	<i>Understanding internal and external business requirements, Defining the scope of the project</i>
Demand Management	<i>Demand management, Managing the required information, Looking at existing suppliers capabilities</i>
Market Research	<i>Market research</i>
Risk Analysis and Evaluation Process	<i>Supplier final evaluation process - selecting suppliers, risk analysis, decision making</i>

Table 5.10: Themes Arising from Axial Coding

Research participants indicated that the SSP requires a high understanding of business. The common dimensions of factors associated with one's business understanding brought together the category of understanding internal and external business requirements. This defines the scope of project and was identified as the theme of *business requirement understanding*.

Participants identified various ways to manage the collected information from supplier factors among the process of selecting suppliers. Dimensions that highlight demand management emerged from the categories of *demand management, managing the required information, and looking at existing supplier capabilities*. The theme for the commonality among these categories is labelled *demand management*.

Participants indicated that interactions with other pharmaceutical companies through market research in order to find further information are necessary in selecting appropriate suppliers. This is considered an important factor in the selection process. Different types of market research were mentioned in the interviews, from magazines to websites. The theme for the commonality among these categories is labelled *market research*.

Research participants pointed to the factor that the supplier evaluation process is started after collecting all necessary data from the suppliers and internal systems. They identified the set of evaluation processes, including internal and external risk analysis and price analysis, and

shortlisted the suppliers accordingly. The theme for the commonality among these categories is labelled *risk analysis*.

Research participants mentioned the final evaluation process by analysing and evaluating suppliers internally based on negotiations and the commercial benefits they will yield for the company. Some mentioned that, in this process, they invite the potential suppliers to make a final presentation. The theme for the commonality among these categories is labelled *supplier final evaluation process*.

5.5.3 Key Construct Categories

The final process is to obtain the importance baseline for the ANVs (Goffin et al. 2006) for construct categories; we have to calculate the average variability per construct, which is the average number of constructs for all respondents expressed as a percentage. For example, in the Procurement Manager Grid, the categories with an ANV greater than 10.2 are considered to differentiate more strongly among the elements; thereby indicating higher importance for respondents. In Table 5.11, the categories with a frequency percentage and an average variability are highlighted. These have been sorted first by frequency and then by variability.

Construct Categories	Frequency	Average Normalized Variability (ANV)
Understanding Business Requirements	11- 22.44%	13.81
Demand Management	14- 28.57%	9.65
Market Research	9- 18.36%	12.75
Decision Making Process: Risk and Evaluation Analysis	13- 26.53%	11.04

Table 5.11: Key Construct Categories

The final stage of GTM, selective coding, is the process in which a core category is identified and “the process of integrating and refining the theory takes place” (Strauss & Corbin, 1998, p. 143). This step also entails integrating the concepts that emerged from the data analysis, as noted by Strauss and Corbin:

“...If theory building is indeed the goal of a research project, then findings should be presented as a set of interrelated concepts, not just a listing of themes. Relational statements, like concepts, are abstracted from the data. However, because they are interpreted

abstractions and not the descriptive details of each case (raw data), they (like concepts) are 'constructed' out of data by the analyst. By 'constructed,' we mean that an analyst reduces data from many cases into concepts and sets of relational statements that can be used to explain, in a general sense, what is going on (p. 145)...The essential element is that categories are interrelated into a larger theoretical scheme (p. 146)."

The results have been grouped into common themes in the following sections to allow comparisons to be made between categories.

5.5.3.1 Understanding Business Requirements

Understanding Business Requirements is one of the most important categories to emerge from our research (overall frequency 22.44% and variability 13.81). It highlights that the companies' starting point for selecting supplier is to identify the requirements, the internal resources such as existing suppliers and the scope of project and type of services they offer.

A Pharma Procurement Manager comments on the importance of business requirements understanding:

"We do need to know about the company business needs now and in future including long term, short term, tactical and strategic requirements and also business models."

However, the Pharma's desire for suppliers with good *functionality and non-functionality requirements* analysis with good *specialist knowledge about the type of services offer* competes with their fear of losing control in the rapidly-changing market. It can be seen in the analysed data that the category of *functional and non-functional requirements* has a high variability (10.9) and is mentioned by at least two respondents. The Head of Innovation highlights that:

"In order to get more information about the business requirement, we do need to know their geographical coverage and what and how they want to deliver to us."

All respondents mentioned the fact that after gathering business requirements internally and externally, managing and interpreting the received information is required.

5.5.3.2 Demand Management

As mentioned in Tables 5.3-5.8, the next step defined by participants in the SSP is to categorise the demands based on the requirements. At this stage, Pharma 1 and 2 have investigated the gathered information in order to find out the criteria suppliers set for the requirements (strategic requirements or transactional requirements). The Pharma 1's Head of Procurement mentioned that:

“The criteria that suppliers set is a critical point in our relationships and setting up these criteria is depends on the nature of requirements too.”

Based on the responses from the participating companies, demand management mainly involves categorising demand, and managing and interpreting the internal and external requirements. Interestingly, this not perceived as an important process (frequency 28.57%-variability 9.65), which may indicate that, in general, all suppliers are able to deliver high quality services for Pharma 1; therefore, it is not a differentiator process between suppliers.

The Head of Operation Manager in Pharma highlights the importance of the suppliers' attitude:

“Suppliers can easily turn a negative into a positive by the way they handle the issue, so if there's a service failure and they handle it extremely well, often the client feels very positive about them bizarrely, missing the point slightly that they should have been an issue in the first place and that doesn't always happen. Therefore, managing the initial criteria is quite important for us.”

It is clear that interpreting internal and external requirements and managing the outcome of interpretation all contribute to the suppliers' experience of service quality. Moreover, they can be regarded as supporting elements that ensure the customer is kept informed about the quality of the overall service. In summary, the consistency of the quality of requirements over time is essential, particularly for customers in the mature phases of a supplier relationship.

5.5.3.3 Market Research

Based on the responses from Pharma 1 and 2, the market research can be divided as follows: how the suppliers influence the market (activities of suppliers on virtual environments); what are the existing influencing factors; how experienced are the suppliers; checking the core

competencies; type of products and services they offer; comparing value suppliers offer; and annual spend of the suppliers. The Procurement Manager mentioned market research as an important and decisive factor of selecting suppliers:

“Market research is an important factor for selecting our suppliers. We usually do market research on Web or asking the other colleague (internal, external info) who already worked with that supplier(s).”

The other respondent (Director, Head of Hub Northern Europe) refers to market research as the method by which suppliers identify the core competencies for Pharma. She defined core competencies as how potential suppliers are in terms of products and services deliverables and add-on processes.

Interestingly, as can be seen in Table 5.11, the overall frequency and variability of the market research category are high (18.36% and 12.75). This shows how important this category is for selecting suppliers.

5.5.3.4 Decision-making Process: Risk and Evaluation Analysis

The next process mentioned by the respondents was decision-making, followed by risk analysis and evaluation. According to Table 5.11, the overall frequency and variability for this category is almost high (26.53% and 11.04).

The decision-making process (Figure 5.2) for selecting a suitable supplier continues by having different forms of exercise, such as presentations or proposals. Furthermore, the internal staffs of Pharma 1 and Pharma 2 compare and contrast the information they have based on different criteria, such as functional tools, initial knowledge of suppliers and supplier input data. The result of the market research is also interpreted at this stage. The process of finalising and selecting appropriate suppliers is continued by undertaking a risk analysis, such as price analysis and considering the internal and external risks to the company.

5.6 Summary

This iteration of the research has investigated the SSP using the RG interviewing technique for two UK-based pharmaceutical companies. Quantitative and qualitative results have been applied in order to achieve a better understanding of dimensions and the patterns in which

they emerge. These have shown that customer companies' expectations from provided suppliers are not only based on financial and technical attributes, but also on a wide range of intangible value dimensions that play a key role in sustainable supplier-industry relationships.

As proposed previously in relation to Social Cognitive Theory, self-efficacy can be related to expectations of future outcomes, the behaviours in which individuals choose to engage, the persistence and vigour in which one invests, and their emotional responses and thought patterns (Bandura, 1986). However, in the context of supplier selection, the market research factor, which includes perception of market research by doing domain analysis, asking the other pharmaceutical staffs about the references and finding the influencing factors provides a greater explanation for having flexible suppliers.

As a result of analysing the interviews, the decision-making process model for selecting supplier is identified. The outcome of this iteration illustrates that Pharma industries spent some time on researching suppliers online in order to find the market's influencing factors. With the large amount of information potentially available to organisations, the Internet has become a prominent platform for the exchange of information between consumers and industry suppliers, intermediaries, and organisations that are inexperienced in EPMs. A number of differing technological interfaces, such as search engines and intermediaries, facilitate the exchange of marketing information between online organisations. As markets grow, firms find themselves part of social networks (Pitt et al., 2006) – whether or not they want to be. Consequently, increasing connectivity to customers results in enhanced competition with rivals worldwide. Social media, which enables interaction among virtual organisations, has emerged as an integral element of this communication. One way of improving this process is by analysing the social network activities of suppliers. Discovering the process and method of flexible supplier selection using social network data is brought forward to the next Design Research iteration (Chapter Six: Iteration III).

CHAPTER 6 ITERATION III

6.1 Introduction

This iteration addresses the organisational requirements gathered from the first iteration to improve and extend the developed flexible e-procurement marketplace (FEPM) in relation to supplier selection. The FEPM framework from the first iteration comprises a set of extracted concepts from literature and narrow data analysis from interviews. This iteration applies a social network analysis in order to access a wider data set. EPM from first iteration was expanded in the second iteration to include the actual supplier selection process present in pharmaceutical organisations. Social networking was chosen as the means by which to facilitate the supplier selection process and extend EPM. Thus, this research seeks to enrich the FEPM model by investigating how social network data could facilitate the process of selecting suppliers in organisations.

This chapter is structured as follows. Section 6.2 provides the research design and the outputs of this iteration. Section 6.3 presents the building and development of the design artefact (Social Media Domain Analysis (SoMeDoA)), while Section 6.4 describes the developed social commerce framework. Section 6.5 illustrates the evaluation of the research outputs using the appropriate evaluation metrics, with details of the experimental settings. The learning outcome of this iteration is presented in Section 6.6 and, finally, the chapter is summarised in Section 6.7.

6.2 Design Research and Output Artefact

The purpose of this Design Research iteration is to improve and extend the developed FEPM with respect to supplier selection. This involves finding semantic relationships between social media network and supplier selection concepts by investigating spatio-temporal analysis. As noted in the first and second iterations, in line with the rapid evolution of the Web and associated technologies, pharmaceutical e-marketplace adoption has been volatile over the past decade. This iteration aims to provide further exploration and validation of the role of social media websites in order to identify the motivating factors for pharmaceutical organisations to enter e-marketplaces and consider their valuable temporal and geospatial components. While the second iteration looked inward at the actual supplier selection

process, this iteration aims to look to the wider marketplace by analysing the data gathered from social networks. Consequently, this chapter proposes a method for investigating how social media networks could assist organisations in the selection of flexible suppliers.

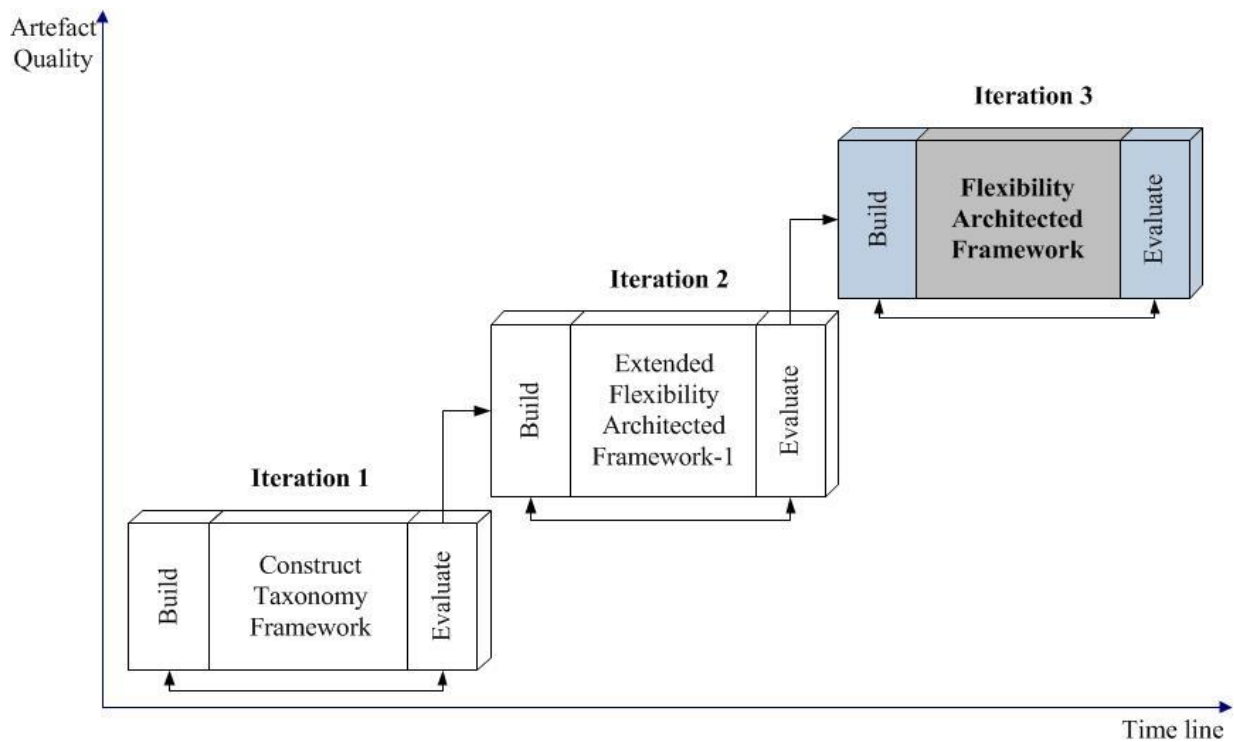


Figure 6.1: Research Iteration 3

6.2.1 Design Research Artefact

A new artefact has been designed within this iteration in order to improve and extend the supplier selection framework developed in Chapter 5. To achieve the aim of the research, this iteration executes the following steps (see Table 6.1) that involve core elements of social media data gathering and data analysis (including Grounded Theory approaches). Data from specific social media websites is extracted using domain-specific search terms that target spatial and temporal data sets for particular organisations. The generated data files are then analysed using a mix of visualisation and analytical tools.

Step	Method	Input	Output
Data Selection	-	Social media websites are selected as suitable sources for the study domain.	List of social media platforms and associated search terms.
Data Gathering	-	Data-gathering tools are selected and run against the selected social media sites.	List of software tools. Generated data

			files.
Geospatial Analysis	-	Location data is extracted in order to determine organisational locations, clusters and connectivity.	Organisation-location lists.
Temporal Separation	Grounded Theory	Public information, news and communications are extracted in order to determine the public activities of organisations (with associated timelines).	DateTime lists files for each organisation.
Temporal Coding	Grounded Theory	Further analysis of temporal data in order to uncover topics of importance (with timeline).	Keyword lists and domain ontology. DataTime data lists for each keyword, code or category

Table 6.1: SoMeDoA Research Framework

Figure 6.2 summarises the research approach “in action”, which comprises three main stages: *geospatial*, *temporal separation* and *temporal coding*. Each stage converts the data gathered from LinkedIn and Twitter into spatial and temporal aspects of the organisations’ information.

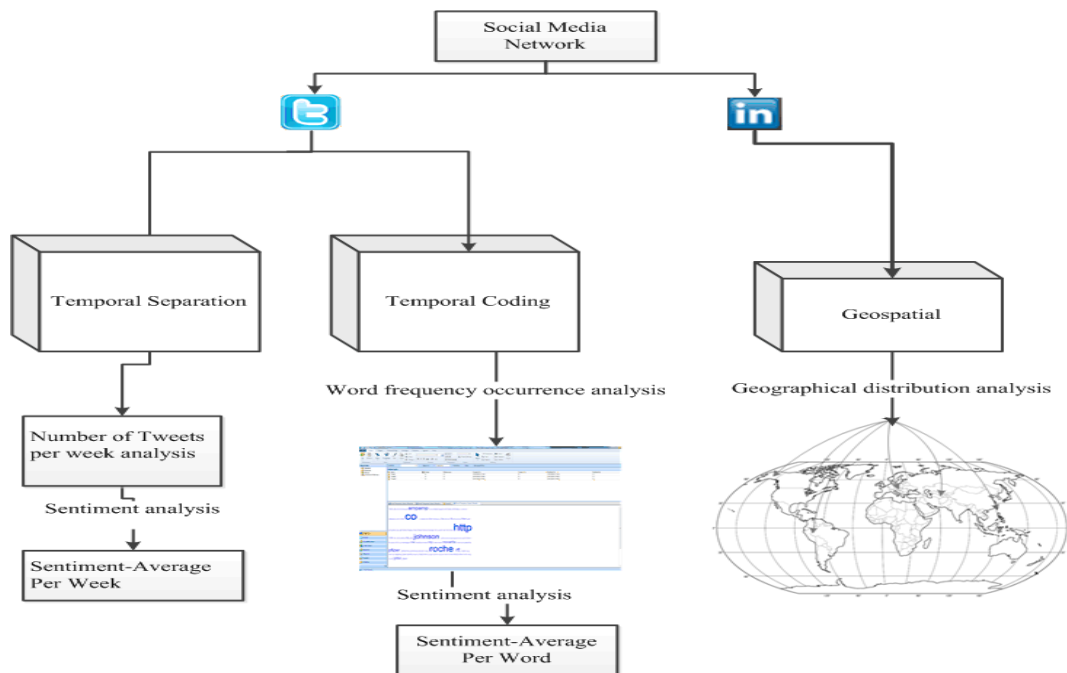


Figure 6.2: Research Model

6.3 Artefact Building and Development

This section presents the building and development of a refined FEPM, as illustrated in Figure 6.3. Each step in the FEPM is further described in the following sub-sections, which integrate social media platforms. According to Alexa (2012) (Alexa Internet Inc., 2012), a Web information company that provides website traffic rankings, the top five global social media websites by late 2012 that have a significant presence for enterprises are: (1) Facebook, (2) Twitter, (3) LinkedIn, (4) MySpace and (5) Google Plus+. Some of these are more likely to be accessed by young people with instant messenger experience, such as Facebook and Google Plus+, while others, such as LinkedIn and Twitter, target professional use from the outset. According to a recent study (Skeels and Grudin, 2009), one-third of employees in enterprises are have LinkedIn and Twitter accounts. Professionally-oriented structures within these two sites facilitate their popularity among organisations.

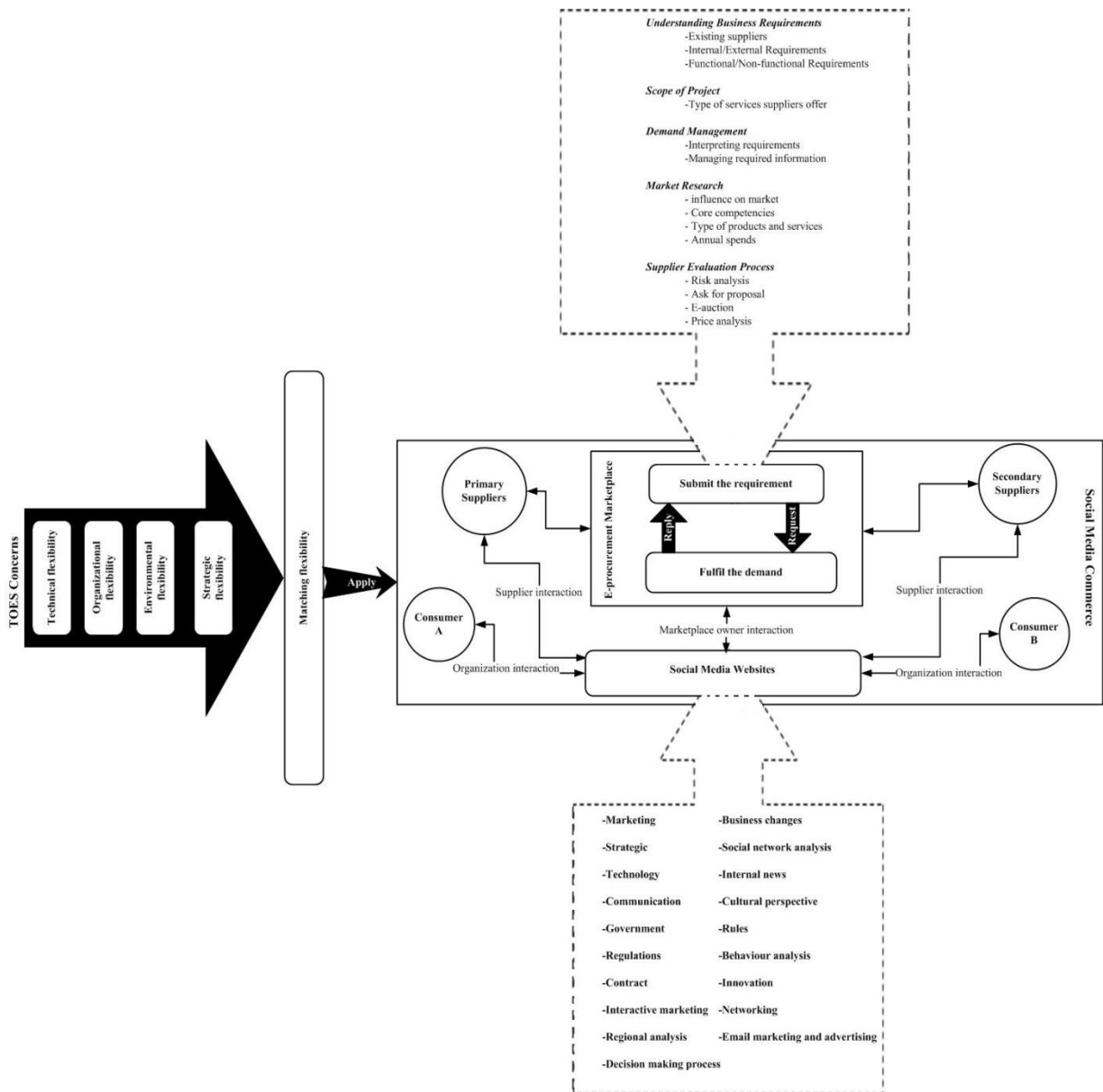


Figure 6.3: Social Commerce EPM framework

The data used in this study was collected in November 2012 and October 2013. A total of 927 LinkedIn posts and 54365 and 140530 Tweets were captured from selected organisations. Social media data (including data interfaces) offer structure to data not found with traditional Web mining. Field descriptors in the websites' data interface or annotation (e.g. hashtags) both offer opportunities for improved analyses.

6.4 Research Results

6.4.1 LinkedIn

Web-crawling software written in Java is used to retrieve data for the related organisations from LinkedIn in order to initiate a geo-spatial estimation. The software retrieves organisation names, locations, Tweet ID, founded year and speciality (the “who” and “where” within a domain). In short, organisation information in domains filtered by industry code is collected and analysed on the desktop. Subsequently, LinkedIn data is used to visualize the geographical distribution of organisations on a map. In general, this map aims to provide an idea of the number of organisations that are active worldwide. Batchgeo¹, a Web-based mapping application, is used to generate map visualisations, providing the locations of related organisations at a range of scales. Batchgeo is particularly useful for studies using data retrieved from social media websites. By clicking on the marker, the organisation information on the map is made available. The user can then view the main institutes or organisations depicted therein. The visualizations reveal the number of organisations active in social networks over time within a selected domain. Geographical proximity is particularly useful in identifying key domain or supplier hubs, especially with a continuous flow of new information. Hubs are seen as key drivers for industries (and business) to collectively innovate; for example, finance in the City of London, technology, new media or pharmaceutical.

6.4.1.1 Geospatial Analysis

The primary objective of LinkedIn is to integrate the results of the data analysis from pharmaceutical organisations with geographical visualisation in order to improve the understanding of new entrant businesses; notably, the connection between organisations and places. As mentioned previously, Web-crawling software written in Java is used in the data collection process. Example search strings used with LinkedIn to query locations, industry type and company size are presented in Table 6.2.

¹ www.batchgeo.com

private	String	<i>PHARMA_SEARCH_QUERY</i>	=	"http://api.linkedin.com/v1/company-search:(companies:(name,website-url,specialties,founded-year,locations:(address:(city,postal-code)),status:(code),twitter-id))?count="	+	<i>COUNT_STEP</i>	+	"&location&company-size&industry&facet=location,gb:4573&facet=company-size,B,C&facet=industry,3,4,5,6,84,96,118";
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Table 6.2: LinkedIn Search Query

Figure 6.4 presents the geographical location and distribution of these organisations. By clicking on each bubble, the number of organisations and the address becomes visible. The resulting data from the LinkedIn investigation provides a useful spatial representation of a domain. Interestingly, the data also indicates that only 5% of users include their Twitter details within their profiles. Although no direct link between social media websites can be used, the results directed us to investigate Twitter activity in more general terms. To achieve this aim, we choose the top five organisations in the pharmaceutical sector. The annual report of Fortune Global in 2010 reported these as: Johnson & Johnson, Pfizer, Roche, GlaxoSmithKline and Novartis. They were used to create a general Tweet query extracting any content including these specific company names, with the assumption that this would include customers, suppliers etc.

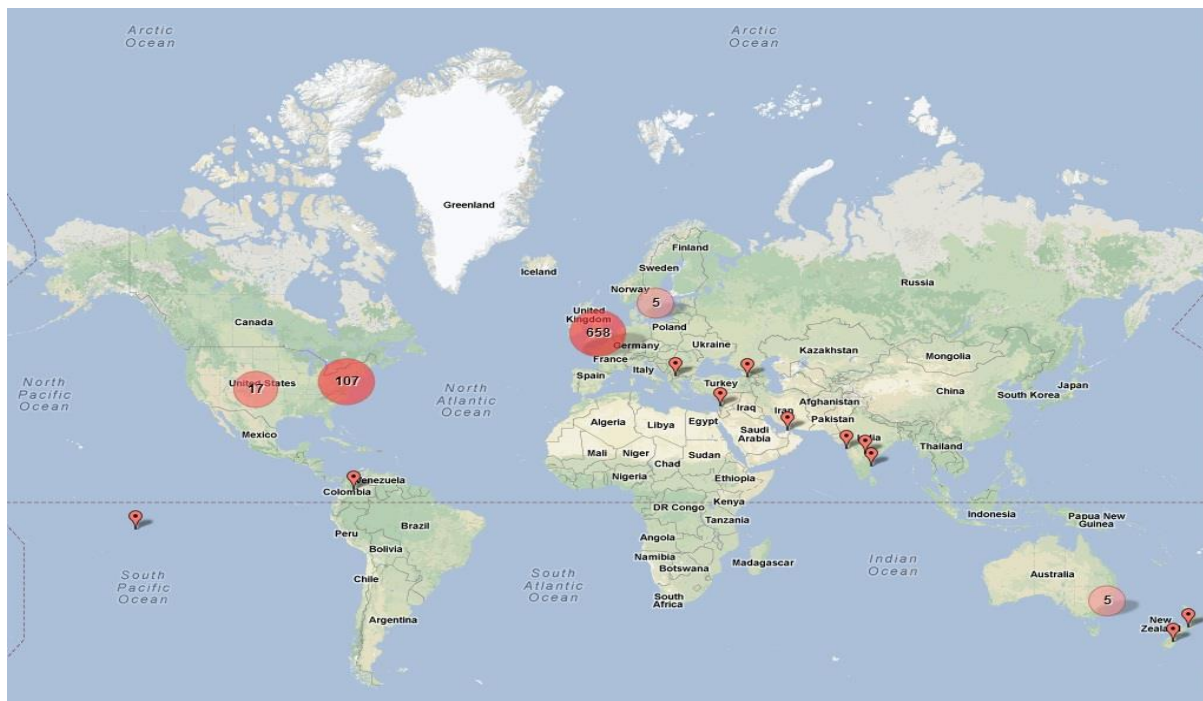


Figure 6.4: Geographical Visualization of the Pharmaceutical Organisations on LinkedIn

6.4.2 Twitter

Twitter is selected in order to detect effectively the real-time activity of organisations within a domain (the “what” and “when”). Our work began by identifying leading organisations in the selected domain (from the earlier LinkedIn analysis). We use the name of the organisations as a query term to obtain the Tweets that they (and others) publish. Subsequently, Tweetcatcher2 (an application developed as part of the MATCH project at Brunel University) is used to retrieve Tweets and related data, such as published date, user, number of followers, re-tweet count and sentiment analysis. Sentiment analysis assigns scores to each distinct entity within the text, indicating positive, neutral and negative opinion (Pak and Paroubek, 2010). The *temporal separation and coding analysis* activities are developed for handling Twitter message streams, and to categorise them in relation to the number of Tweets published and the occurrence frequency during the selected timeslots. Temporal separation analysis was carried out using Microsoft Excel 2010. The dataset is visualized based on the time and number of Tweets generated (Figures 6.5 and 6.6). Table 6.3 presents the pseudo-code of the data analysis process.

Capture Tweets from Tweetcatcher

Get Tweet frequencies per week

Get sentiments of Tweets per week

Do

Analyse Tweets for most frequent words using Nvivo10

Remove irrelevant tweets

For each Tweet

Remove non-meaningful words

End

Re-analyse Tweets for most frequent words

Use most frequent words to get determinants

Represent determinants onto graph

Display sentiment analysis of determinants

While not end of file

Table 6.3: The Pseudo-code of the Data Analysis Process

The second part of the Twitter analysis utilised temporal coding. The approach to temporal coding analysis was based on the Grounded Theory method (GTM) (see Chapter 3). Nvivo9 (software that supports GTM) was used in order to analyse Tweet data for content analysis:

1) storage and categorising datasets; 2) conducting searches for further analysis in order to generate reports about frequency of word occurrences and associated categorisations; and 3) creation of categories through computer-assisted coding. For example, a financial innovation category was created that had associations with acquisition, finance and investor. Tweet frequency was used as a guide to categorise and sub-categorise importance (Section 6.5.2.1.1). Both temporal separation and coding continue with sentiment analysis with respect to time and wording in order to understand the emotions or sentiment underlying the Tweets.

6.4.2.1 Twitter Temporal Separation

Temporal analysis deals with time components (Lauw *et al.*, 2005); therefore, we experiment and evaluate our proposed approach using two datasets collected from Twitter. The analysis will be performed in two phases; the first dataset was obtained in 2012, and the second in 2013. Tweets have been monitored daily from 11th to 29th of November 2012, and from 2nd to 31st of October 2013. From the top five pharmaceutical organisations listed previously, 54,365 and 99,175 Tweets were posted respectively in November 2012 and October 2013, and were subsequently downloaded for analysis. In order to calculate the proportion of organisation activities on Twitter, the dataset is divided into three weekly time buckets. Later, we decide to analyse Twitter activity on specific days for practical reasons; each Wednesday for weeks in November 2012 and October 2013.

6.4.2.1.1 Tweets per Week

Firstly, we analyse the overall number of Tweets and how these numbers vary from week to week. Figures 6.5 and 6.6 present graphs outlining the total number of Tweets made between 14th November 2012 and 28th November 2012, and 2nd October and 31st October 2013. The first and last Tweets in all time slots were published respectively at 00:00 and 23:59. The columns are positioned over a label representing the date and time that Tweets are posted. The height of the column indicates the number of Tweets posted by the chosen organisations (under analysis), defined by the column label. As mentioned earlier, the data obtained in 2012 was analysed first, followed by the data gathered in 2013. The analysis highlighted that the greatest rise in Tweet numbers occurred on 28th November (Figure 6.5-C), when a total of 3474 tweets was published. Whereas, the number of tweets posted on the 14th (Figure 6.5-A) and the 21st (Figure 6.5-B) were 2708 and 2906 respectively. The other interesting aspect is that the number of Tweets per minute presented in Figure 6.5-C is greater than for the other

time slots. For example, on 28th November, a peak in Tweet content focused on the online buying of medicine from Roche (one of the chosen organisations).

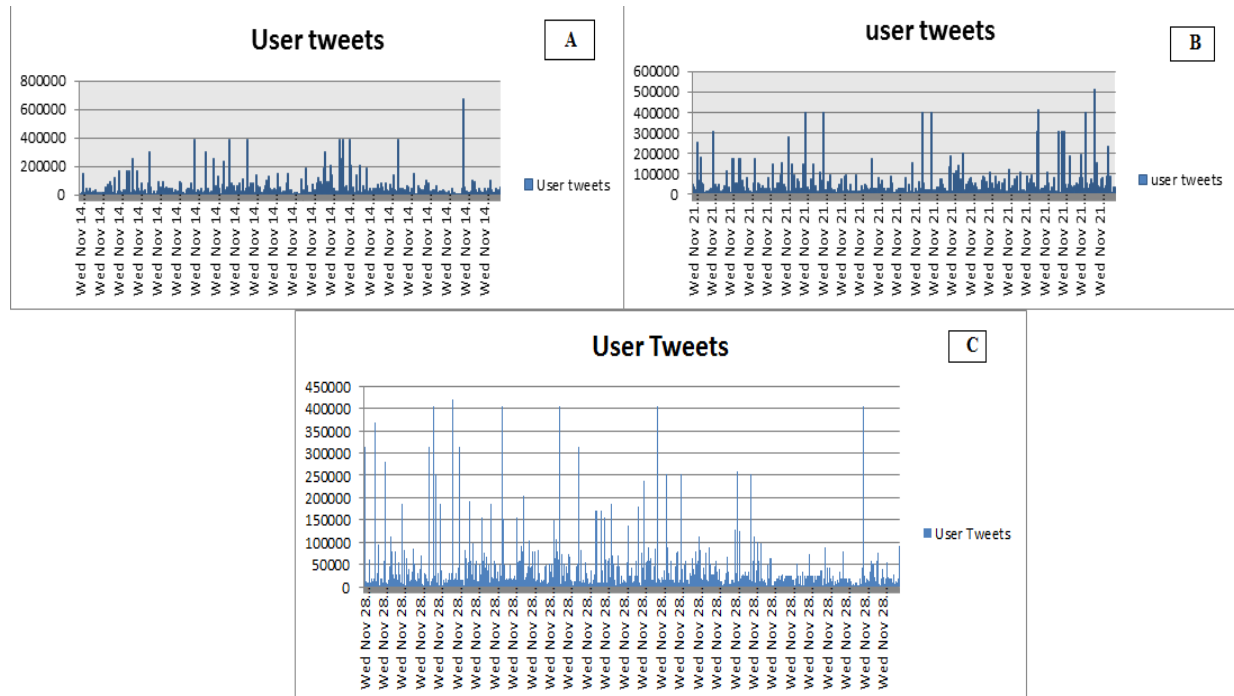
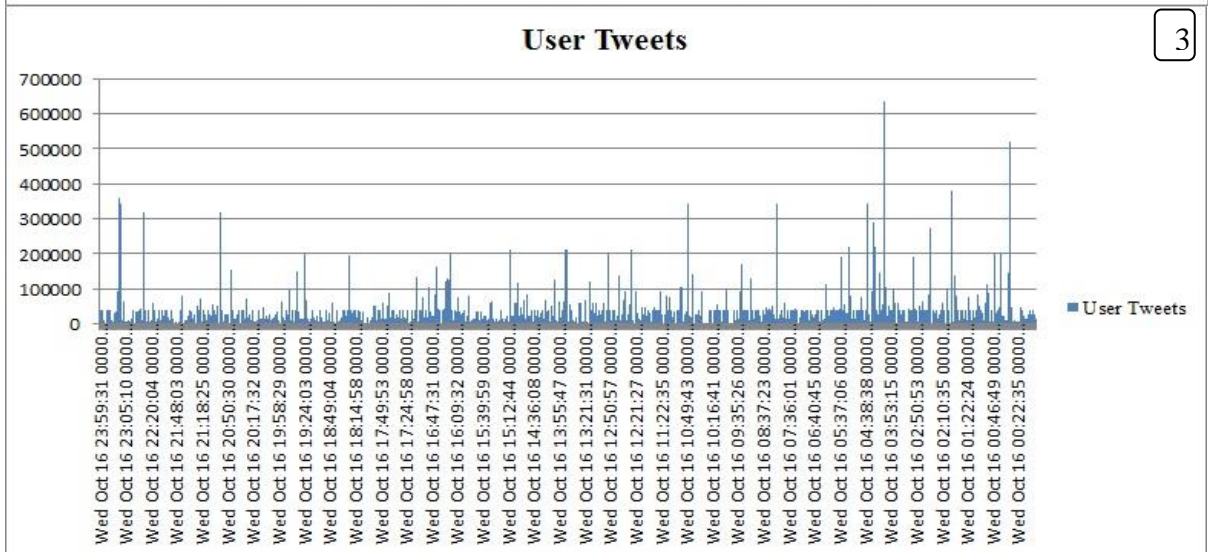
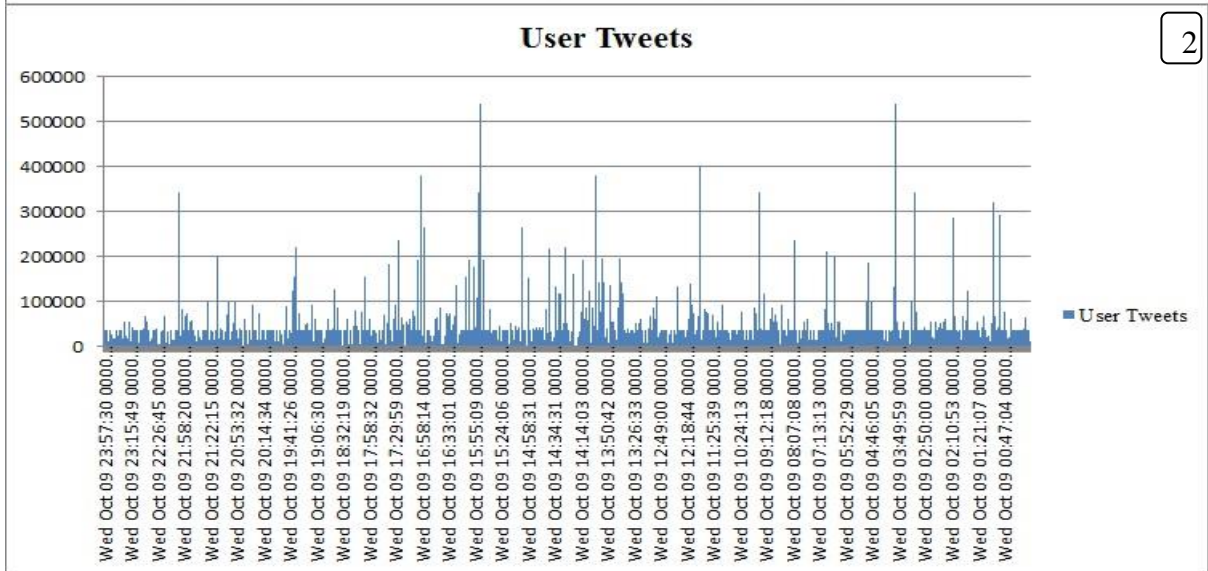
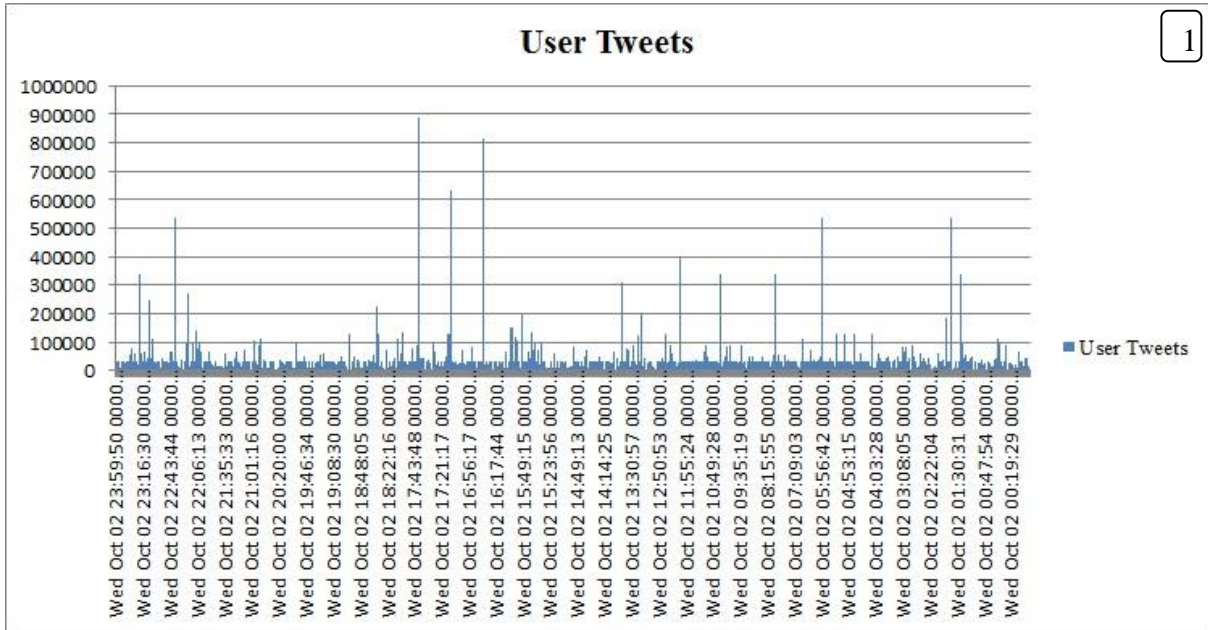


Figure 6.5: User Tweets per Week - 2012

The analysis shows that greatest rise in Tweet numbers occurred on the 9th and 23rd October (Figure 6.6-2, 4), when a total of 3252 and 3844 tweets was published respectively. Whereas, the number published on the 2nd (Figure 6.6-1), 16th (Figure 6.6-3) and 30th (Figure 6.6-5) were 3066, 3009 and 3001 respectively. The other interesting factor is that the number of Tweets posted per minute, as presented in Figure 6.6-4, is greater than for other time slots. For example, on 23rd October, a peak in Tweet content focused on new rules and regulations for buying medicine from Roche (one of the chosen organisations).



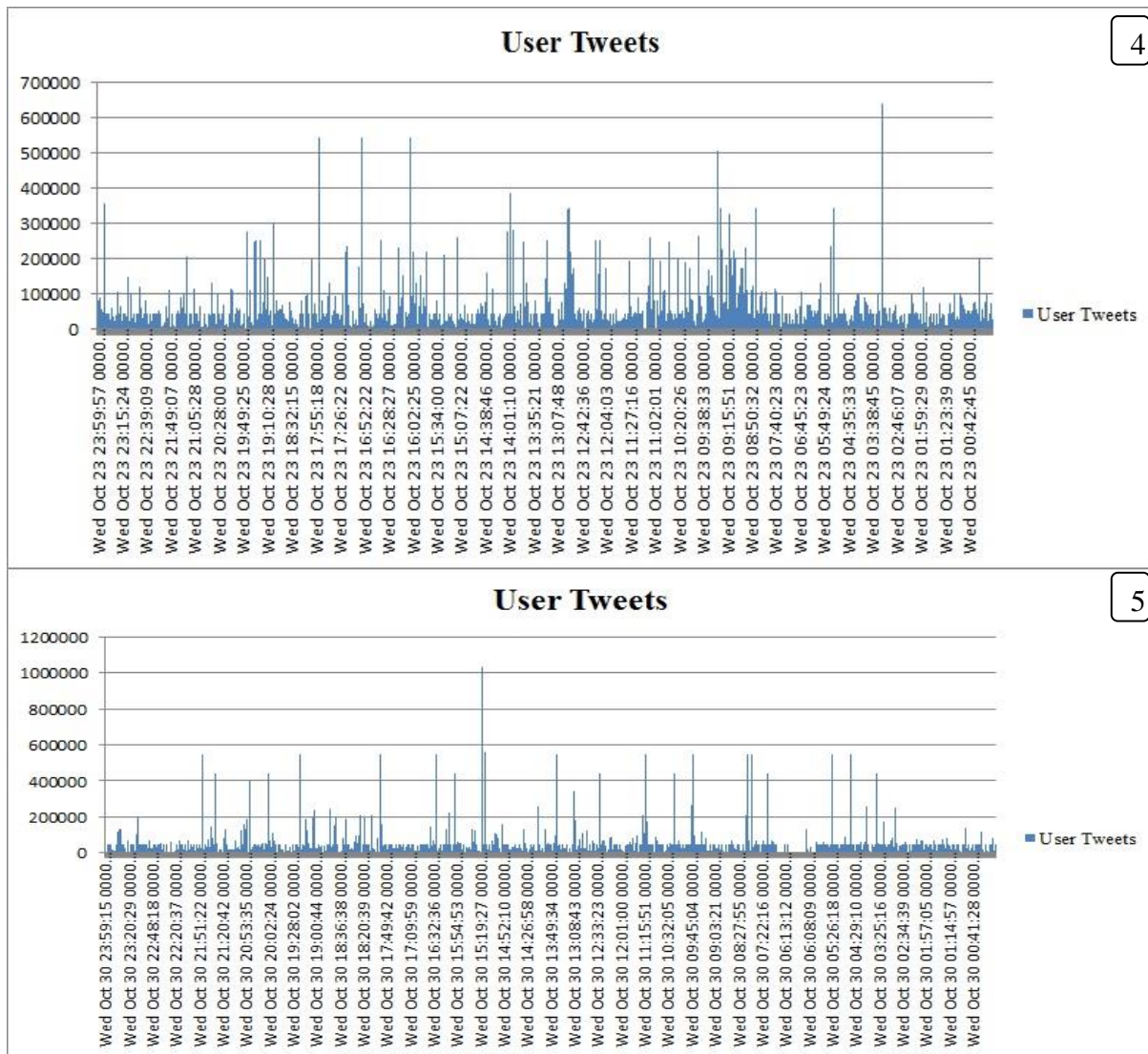


Figure 6.6: User Tweets per Week - 2013

Most of the Tweets retrieved in 2012 and 2013 centred on new ways of buying of medicines online through a new portal, and the rules and regulations applied to the online buying process. Moreover, the highest number of re-tweets is for same organisation. The motivation behind this is in investigating the use of the sentiment lexicon developed for Tweets posted during these three time slots. Peaks can be investigated for additional knowledge. In one example, a peak includes Tweets about Warren Buffet’s Berkshire Hathaway, whose sale of Johnson and Johnson shares is reported in the mainstream media.

6.4.2.1.2 Sentimental Average per Week

The SentiStrength 7 tool developed by Thelwall et al. (2010) and implemented in Brunel’s Tweetcatcher is used to assign numerical scores to sentiments of an individual sentence. This

tool assigns simultaneously both a positive and a negative score to pieces of English text, with the idea that users can express both types of sentiment at the same time; for example, “I love you, but I also hate you” (Kucuktunc *et al.*, 2012). Positive sentiment strength scores range from +1 (not positive) to +5 (extremely positive) and, similarly, negative sentiment strength scores range from -1 to -5 (Kucuktunc *et al.*, 2012). The final positive sentiment strength for a piece of text is then computed by extracting the maximum score from all individual positive scores. The negative sentiment strength is similarly calculated. Figure 6.7 outlines the distribution of sentiment scale using Qlikview 11² in 2012 and 2013.



Figure 6.7: Tweets - Sentiment Average

² <http://www.qlikview.com/>

The vast majority of sentences are assigned a neutral +1/-1 sentiment score. Slightly negative (+1/-2) and slightly positive (+2/-1) scores are also common. Tables 6.4 and 6.5 present the percentage of each score for each time slot in each year.

Time Slot	Senti-Positive	Senti-Neutral	Senti-Negative
14 th November 2012	32%	47%	21%
21 th November 2012	25%	53%	22%
28 th November 2012	27%	48%	25%

Table 6.4: The Distribution of Sentiment Scores 2012

Time Slot	Senti-Positive	Senti-Neutral	Senti-Negative
2 th October 2013	27%	55%	18%
9 th October 2013	26%	56%	18%
16 th October 2013	26%	53%	21%
23 th October 2013	22%	49%	29%
30 th October 2013	24%	57%	19%

Table 6.5: The Distribution of Sentiment Scores 2013

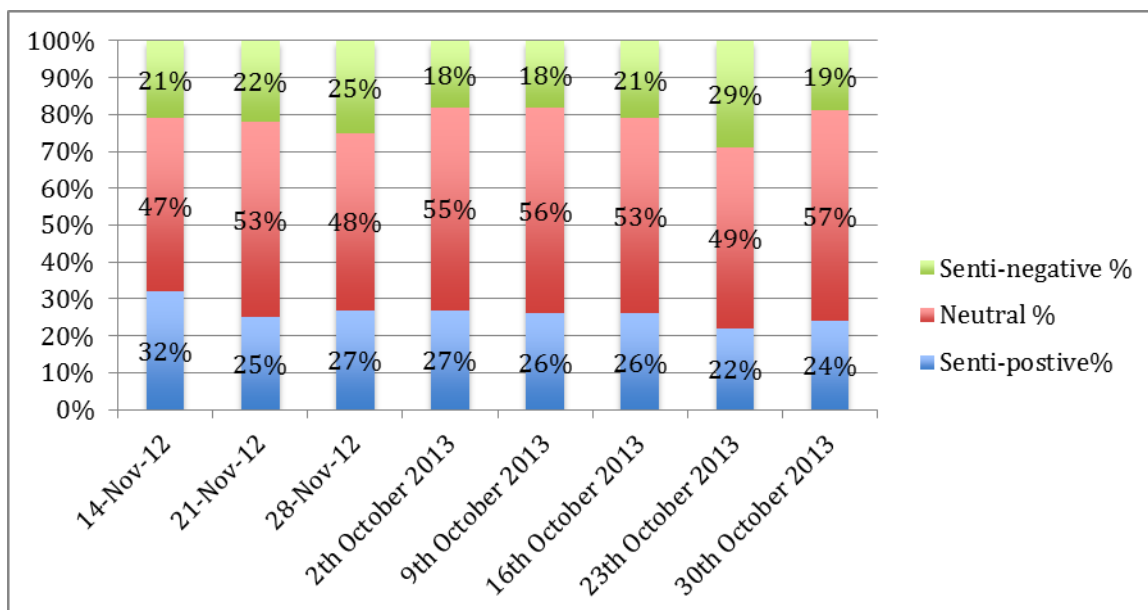


Figure 6.8: The Distribution of Sentiment Scores - 2012 and 2013

Table 6.4 and Figure 6.8 demonstrate clearly that the percentages of positive and negative Tweet sentiments for the first dataset from 2012 are much higher in first and last weeks of the month. Conversely, for the second dataset from 2013 (Table 6.5 and Figure 6.8), the percentage of positive sentiment decreased while the percentage of negative sentiment

increased. Further analysis of Tweet content across time slots did not yield specific reasons for this volatility, but one possible reason could be attributed to external factors, such as the associated equity markets. Figures 6.9 and 6.10 show the changes to the share price of pharmaceutical industries during this period and the dip in value in the middle of the month for 2012 and 2013.



Figure 6.9: Pharmaceutical Industries Share Price Trend – 2012

(<http://uk.finance.yahoo.com/>)



Figure 6.10: Pharmaceutical Industries Share Price Trend- 2013
(<http://uk.finance.yahoo.com/>)

The weekly sentiment analysis does not indicate the actual content of the Tweets (for example, Berkshire Hathaway's share sale); therefore, temporal coding was conducted. The need for additional depth leads us to analyse Tweet content by counting the word frequency for all datasets and perform sentiment analysis on frequently-occurring words.

6.4.2.2 Temporal Coding

As mentioned in Chapter 3, NVivo9 is used for to organise, categorise and search textual, recorded data. This software was found to be comprehensive in its functionality, stable in its operation, easy to use, error free, and had a large number of standard reports and export facilities. It proved to be ideal for manipulating and analysing the data gathered in this exercise. NVivo9 supports all of these formats so all notes and documentation will be imported into the system for analysis. Figure 6.11 presents the process of importing and categorising the tweets.

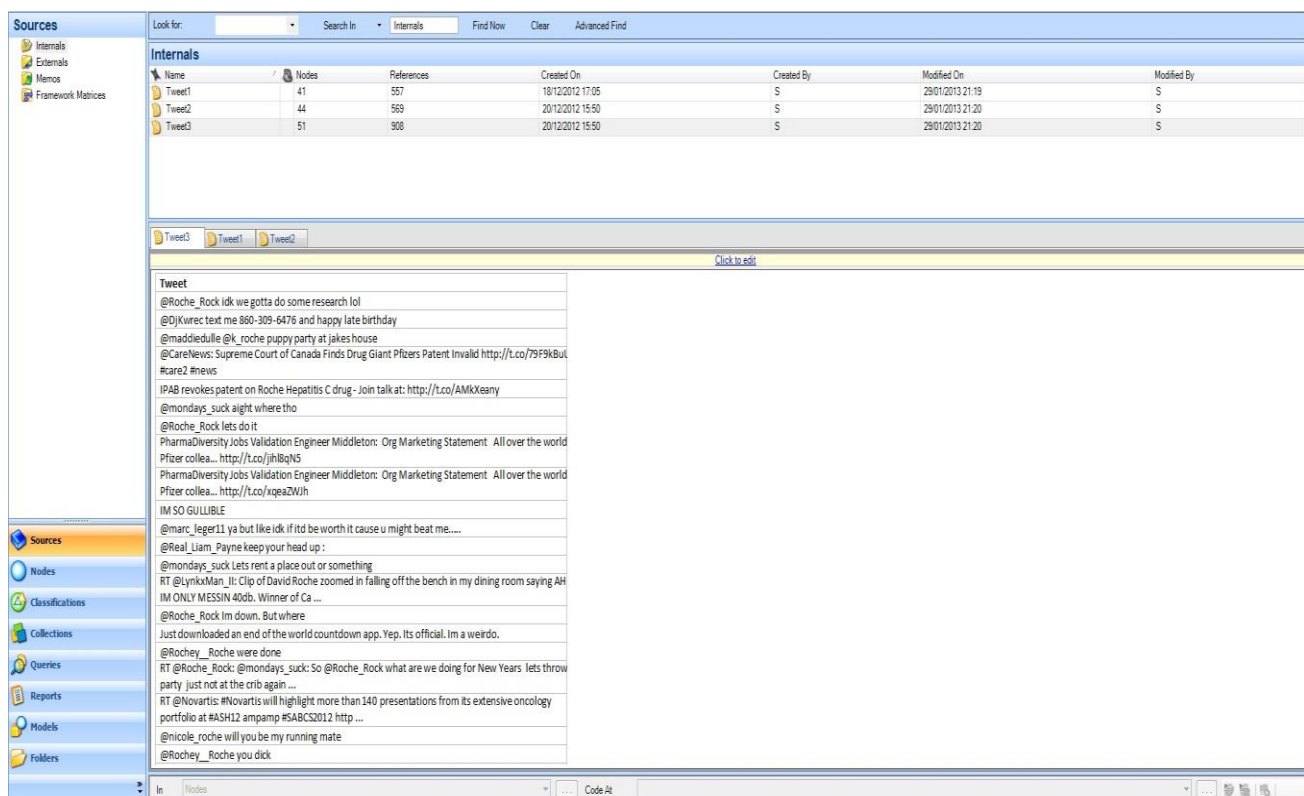


Figure 6.11: Tweet Categorisation

6.4.2.2.1 Tweet per Word

In the first instance, frequently-used words or topics must be identified in order to obtain a picture of the actual Tweet content. Data needs to be subject to careful scrutiny and interpretation, which is achieved largely through a coding process. The approach taken for analysing content makes use of GTM (Chapter 3). The process was conducted by counting the word frequency for the dataset of Tweets using Nvivo9. The most frequent words were “http” followed by other parts of URLs that appeared in most Tweets; these should be discounted. After excluding articles and other terms that did not provide meaningful context, Table 6.6 presents the most frequent words.

Frequent words in tweets - 2012	
Between 3000-4000 occurrences	Roche
Between 2000-3000 occurrences	Johnson & Johnson
Between 1000-2000 occurrences	Pfizer, Novartis
Between 0-1000 occurrences	Glaxo, GSK, innovations, news, marketing, Yahoo, finance, healthcare, acquisition, city, advertising, business, development, manufacturing, products, research, investors, competition,

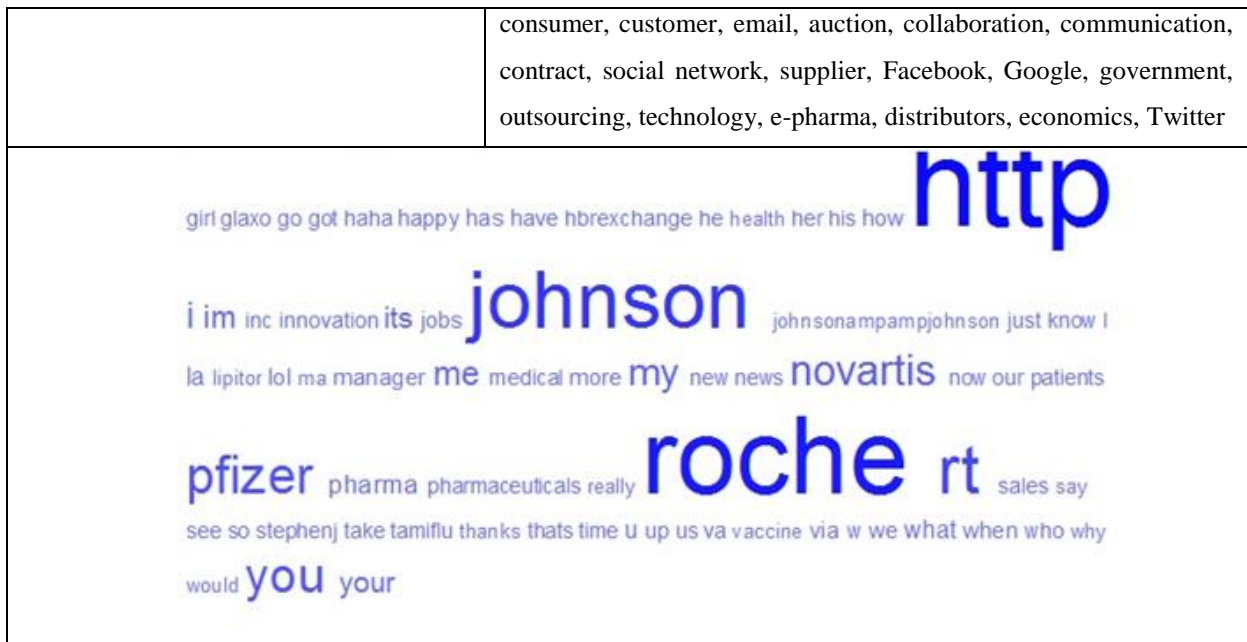


Table 6.6: Frequent Words in Tweets 2012

As table 6.6 presents, the most frequent words are “Roche” followed by “Johnson”, which appear in most of the Tweets posted in the 2012 time slot.

Frequent words in Tweets - 2013	
More than 4000 occurrences	Elements, rules, changes, governments, protections, representatives, dealings, community, scientist, Johnson & Johnson, functional and non-functional
Between 2000-4000 occurrences	Controlling, decision making, required information, judging, drug, interactive environment, effective, Pfizer,
Between 0-2000 occurrences	Devices, geographical locations, constructions, administrative issues, products, content, development, business operations, Novartis, profits, commercial management, performance analysis, authorizations, distribution, finance issues, Glaxosmithkline, duties, agreement, publicity issues, acquisition, ability to accomplish, demand management, challenges, consumptions, human assurance, competition, business intelligence websites, manufacturing, construction, industrial relationships, innovation, design innovators, population, grantee, retail, security issues, Twitter, Facebook, social networks, economics, commitment

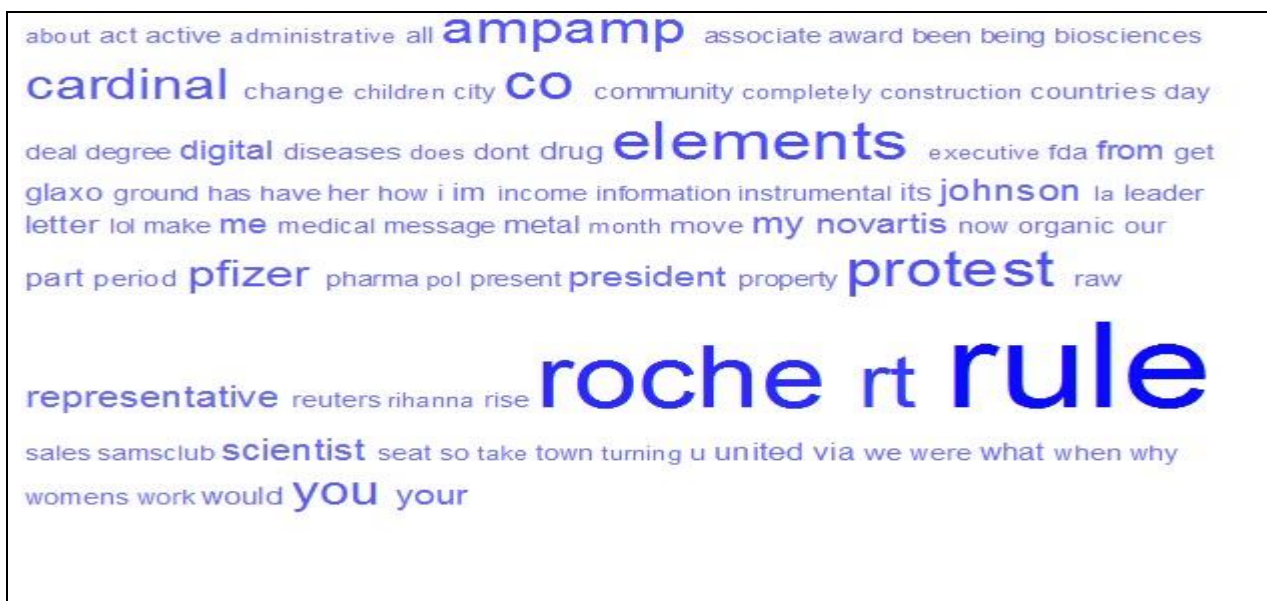


Table 6.7: Frequent Words in Tweets 2013

Table 6.7 shows the most frequently-used words during the 2013 period. The most frequent was “rule”, followed by “Roche”. At this level, we can gain a general impression of key players and typical work associations (e.g. news, sales). Sentiment analysis of the most frequently occurring words will help us to understand more about positive or negative Tweets over time.

6.4.2.2.2 Formalising the Reporting with an Ontology-based Concept Network

Computation ontologies (and semantic web technologies) are able to support the SoMeDoA framework in a number of ways. Firstly, ontologies are commonly deployed for the specification and explication of concepts and relationships related to a given domain. SoMeDoA has the same purpose but with a focus on social relations and entities, hence domain ontologies describing social entities and relations can be designed and deployed. Secondly, through reasoning and inference techniques ontologies restrict the modelling of contradictory or inconsistent information. SoMeDoA framework with ontologies could ensure the validity of the information encoded. Thirdly, ontologies, together with the inference mechanism, allow information to be gained through deploying rules to infer new information. Inference mechanisms can be utilised over ontology based social networks to uncover new relations and concepts from those existing between social entities i.e. people, organisations and events, locations. Codes and categories (from GTM analysis) are modelled in a computational ontology through important relationships or implied similarity. As

mentioned in the SoMeDoA approach, GTM is used in order to analyse the textual content of Tweets.

The first activity taken from GTM is open coding. Each imported file is reviewed and every significant sentence, phrase or even word, will be allocated a code (a Free Node in NVivo9 terms). These base codes will then be reviewed and a process of consolidation will merge codes that had, or appeared to have, the same meaning. Axial coding will then be used to review all remaining codes (Free Nodes), while those that are related to each other are grouped together under a new higher level code. The process of axial coding will undergo several iterations as ideas change and new relationships emerge. This is the “constant comparison”, which is a key feature of the method proposed by Glaser and Strauss (1967). This is similar to the circumscription feedback loop of the Design Research stages, as defined by Vaishnavi and Kuechler (2004), and in practice means that the taxonomy undergoes a number of iterations where sometimes the changes were minor and sometimes involved a major restructuring of the hierarchy.

The axial coding of content resulted in a number of categories and sub-categories, including: Technology, Finance, Innovation, Suppliers, Government, Healthcare, Investors. For example, a financial innovation category was created with associations to acquisition, finance and investor. Figure 6.12 presents the process of storing and categorising datasets.

Name	Sources	References	Created On
Communication	3	15	29/01/2013 20:05
environment	2	10	12/02/2013 15:30
Healthcare	3	59	29/01/2013 18:53
Healthcare news	2	2	12/02/2013 15:55
Med news	1	1	12/02/2013 16:05
Innovation	3	166	29/01/2013 16:57
Acquisition	2	62	29/01/2013 18:58
E-pharma	3	28	29/01/2013 20:51
evolution	1	1	12/02/2013 15:52
Finance	3	61	29/01/2013 18:27
investor	3	42	29/01/2013 19:55
Intermediary	1	1	12/02/2013 15:58
Ariba	1	1	12/02/2013 15:42
Intermarket	1	1	12/02/2013 15:59
Matchmaker	1	1	12/02/2013 16:04
merchandise	2	2	12/02/2013 16:06
Management	3	115	12/02/2013 14:28
Marketing	3	107	29/01/2013 18:04
Auction	1	16	29/01/2013 20:04
Business	3	85	29/01/2013 19:12
Procurement	2	5	29/01/2013 21:05
Social network	2	11	29/01/2013 20:08
Facebook	3	5	29/01/2013 20:33
networking	2	2	12/02/2013 16:08
news social	2	3	12/02/2013 16:09
Twitter	3	26	29/01/2013 20:55
Strategic	3	17	12/02/2013 14:35
Technology	3	24	29/01/2013 20:46
Advertising	2	39	29/01/2013 19:06
Communication	2	11	12/02/2013 14:38
email	3	25	29/01/2013 20:01
Google	2	7	29/01/2013 20:34
Internet	1	1	12/02/2013 15:58
Maintenance	1	1	12/02/2013 16:03
software	3	8	12/02/2013 15:35
Video	3	30	12/02/2013 14:32
Yahoo	3	68	29/01/2013 18:18

Figure 6.12: Tweet Coding

Subsequently, we analyse the data and create the ontology graph using the Protégé 4.2 OntoGraf. The same sentiment can then be reported by key codes and categories (Figure 6.13 and 6.14).

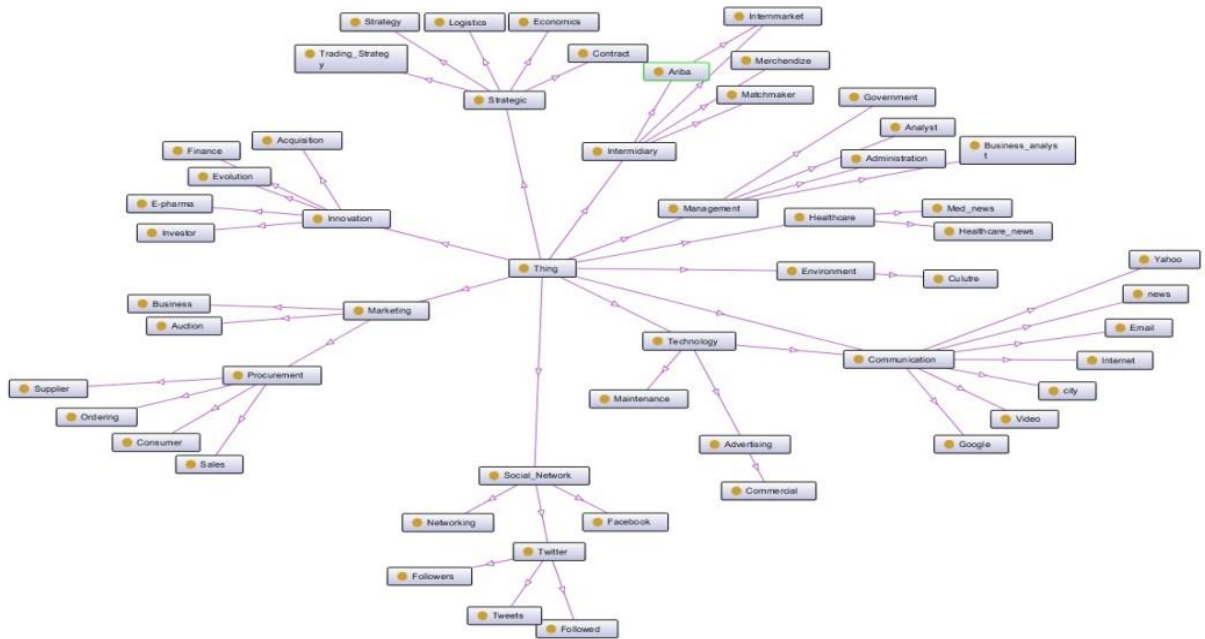


Figure 6.13: Content Network - 2012

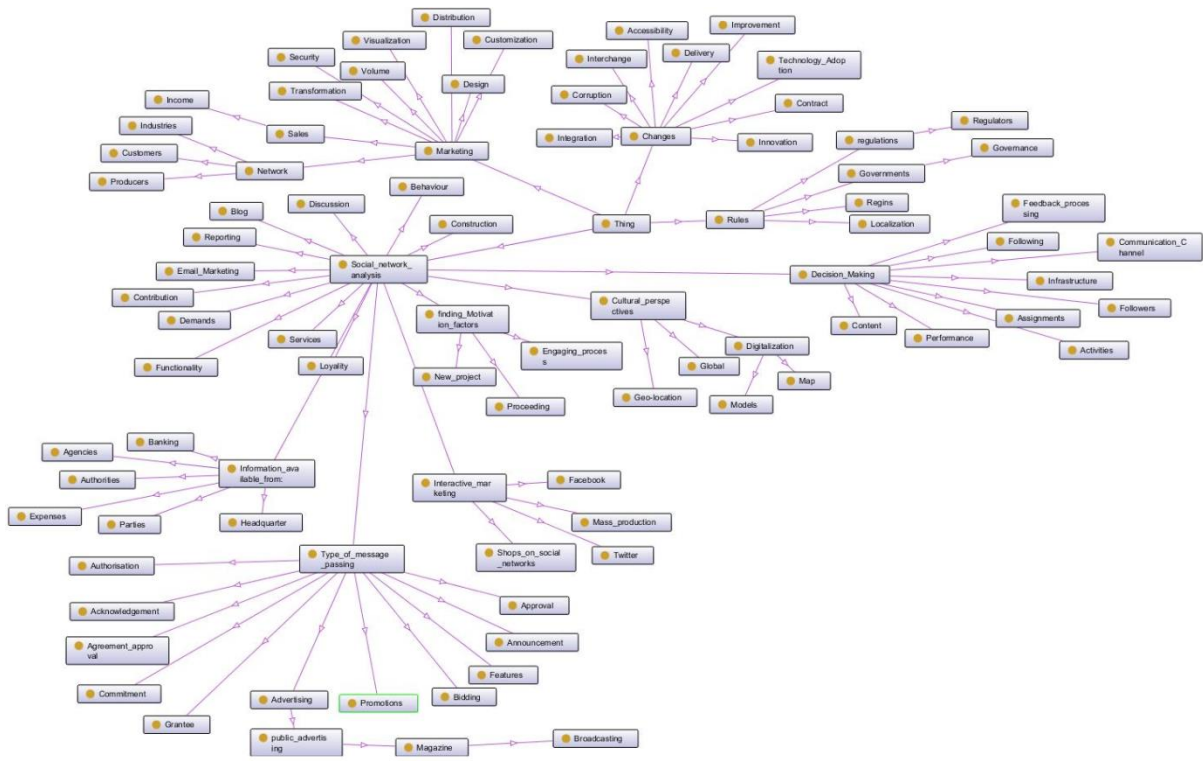


Figure 6.14: Content network- 2013

6.4.2.2.3 Sentimental Average per Word

Unsurprisingly, the pharmaceutical organisations feature heavily in the most frequently-occurring words (unsurprising, as they are the search terms in question). Therefore, we first decide to perform sentiment analysis on Tweets to ascertain how many positive and negative Tweets are published under each organisation name. Tables 6.8 and 6.9 present the overall view of the number of positive and negative Tweets published in 2012 and 2013, and the average frequency of occurrence for each organisation.

Name	#Senti-Pos.	#Senti-Neg.	Senti-Pos. percentage	Senti-Neg. percentage	Senti-Pos. Average	Senti-Neg. Average
Roche	5304	4444	56%	48%	1.33195	-1.56133
Johnson & Johnson	2134	848	23%	9%	1.363636	-1.35142
Pfizer	1058	2653	11%	28%	1.413043	-1.39224
Novartis	747	1205	8%	13%	1.570281	-1.62905
GSK	166	163	2%	2%	1.150602	-1.20245
Marketing	53	40	57%	43%	1.7	-1.13
Social network	38	3	93%	7%	0.35	-1.4

Technology	17	8	68%	32%	2.56	-1.75
Communication	8	9	47%	53%	0.75	-1
Environment	40	25	62%	38%	0.675	-1.72
Management	25	24	51%	49%	0.31	-0.12
Intermediary	10	15	40%	60%	2	-1.82
Strategic	22	28	44%	56%	0.84	-0.33
Innovation	12	155	7%	93%	0.17	-1.02
Healthcare	19	24	44%	56%	0.53	-0.32

Table 6.8: Senti-average per Frequent Word (Organisations) - 2012

The coding and categorising of content yielded a number of themes, including: Technology, Finance, Innovation, Suppliers, Government, Healthcare and Investors. The same sentiment analysis is conducted on these themes to determine their respective time lines of sentiment. These can then be generated for both the companies, categories or codes, as outlined in Figures 6.5 and 6.8 and Table 6.6.

Name	#Senti-Pos.	#Senti-Neg.	Senti-Pos. percentage	Senti-Neg. percentage	Senti-Pos. Average	Senti-Neg. Average
Roche	4793	6534	41%	59%	1.4125	-1.153
Johnson & Johnson	2563	953	73%	27%	1.3519	-1.257
Pfizer	957	754	56%	44%	1.4674	-1.4002
Novartis	1556	1341	54%	46%	1.324	-1.333
GSK	356	104	77%	23%	1.9605	-1.2435
Rules	5031	8501	37%	63%	1.8021	-1.341
Changes	5941	6753	47%	53%	1.1356	-1.6723
Marketing	2044	1057	66%	34%	1.107	-1.2733
Social network analysis	4671	2350	67%	33%	1.9751	-0.739
Decision Making	2351	1125	68%	32%	1.805	-0.8702
Cultural perspective	295	479	38%	62%	0.705	-1.253
Regulations	626	793	44%	56%	1.006	-1.9083
Government	150	273	35%	65%	0.674	-1.8472
Regions	77	94	45%	55%	0.5701	-1.3201
Localisation	35	79	42%	58%	1.462	-1.024

Innovation	436	532	45%	55%	1.739	-0.849
Contract	25	67	27%	73%	0.53	-1.002
Technology adoption	142	191	43%	57%	1.329	-1.832
Improvement	11	3	43%	57%	0.793	-0.329
Delivery	3	17	15%	85%	0.932	-1.543
Accessibility	7	2	78%	22%	0.682	-0.0320
Interchange	23	12	66%	34%	1.3801	-0.981
Corruption	14	72	16%	84%	0.985	-1.783
Integration	33	16	67%	33%	1.502	-1.821
Design	3	7	30%	70%	0.739	-1.004
Customisation	15	6	71%	29%	1.009	-0.382
Distribution	7	2	76%	22%	0.831	-0.034
Visualisation	13	10	57%	43%	1.2002	-0.780
Volume	23	4	85%	15%	1.7301	-0.8056
Transformation	19	2	90%	10%	1.583	-0.341
Security	13	16	45%	55%	1.0045	-1.6501
Sales	12	18	40%	60%	1.2031	-1.395
Networking	19	9	68%	32%	1.642	-1.019
Construction	5	3	62%	38%	1.012	-0.035
Behaviour analysis	97	41	70%	30%	1.846	-1.003
Discussion	32	17	65%	35%	1.9301	-1.563
Blogs	14	11	56%	44%	0.901	-0.834
Reporting	22	3	88%	12%	1.403	-0.25
Email marketing	11	3	79%	21%	1.484	-0.874
Contribution	5	1	83%	17%	1.022	-1
Demand analysis	72	28	72%	28%	1.486	-1.034
Functionality	13	17	43%	57%	1.389	-1.6301
Services	21	2	91%	9%	1.284	-1.25
Loyalty	14	31	31%	69%	1.207	-1.8703
Information available	60	53	53%	47%	1.367	-1.893
Communications	39	14	74%	26%	1.2309	-0.969
Finding motivating factors	16	12	57%	43%	0.9851	-1.014
Interactive	32	18	64%	36%	1.358	-1.589

marketing						
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Table 6.9: Senti-average per Frequent Word - 2013

As a result of analysing two datasets, a list of communal concepts is created. Figure 6.13 presents the comparison of these two datasets and the communal concepts.

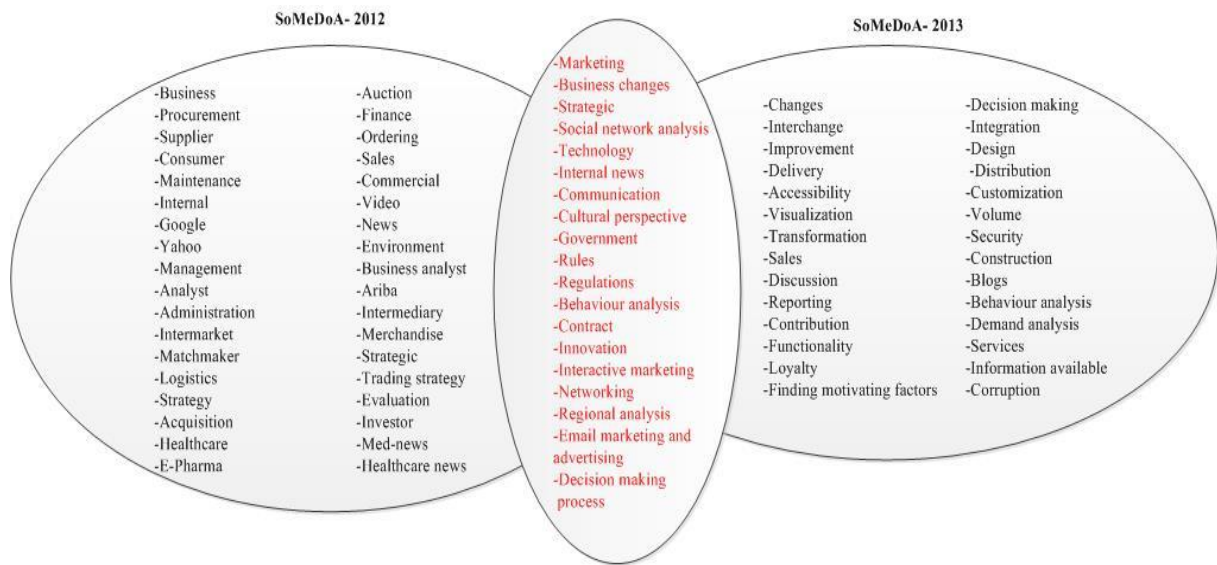


Figure 6.15: Venn Diagram of SoMeDoA Comparison for 2012 and 2013

Based on the findings in this iteration, there are common attributes in analysing two datasets. Figure 6.15 presents the set of common attributes derived from evaluating SoMeDoA. However, the differences over the year are significant; thus, highlighting the need to undertake timely systematic analysis. In the following section, the framework implication is disclosed with respect to the analysis conducted in this study (Iterations 1-3).

6.7 Framework Implication of This Study

Research into partnerships is an important topic for both academics and practitioners. While the notion of supplier selection is often discussed in the literature, there has been little empirical work carried out to identify the process and attributes of supplier selection in EPM, especially within the pharmaceutical domain. On the basis of analysing the data collected from the three different sources (literature, semi-structured and structured interviews, and social network analysis) (see Chapter 2, iterations 1-3); we identify the fact that there is no communality between internal (interviews with the procurement team - iteration 2) and external data (iteration 3) and the literature review (Chapter 2 and iteration 1). Figure 6.16 presents the outcome of the study.

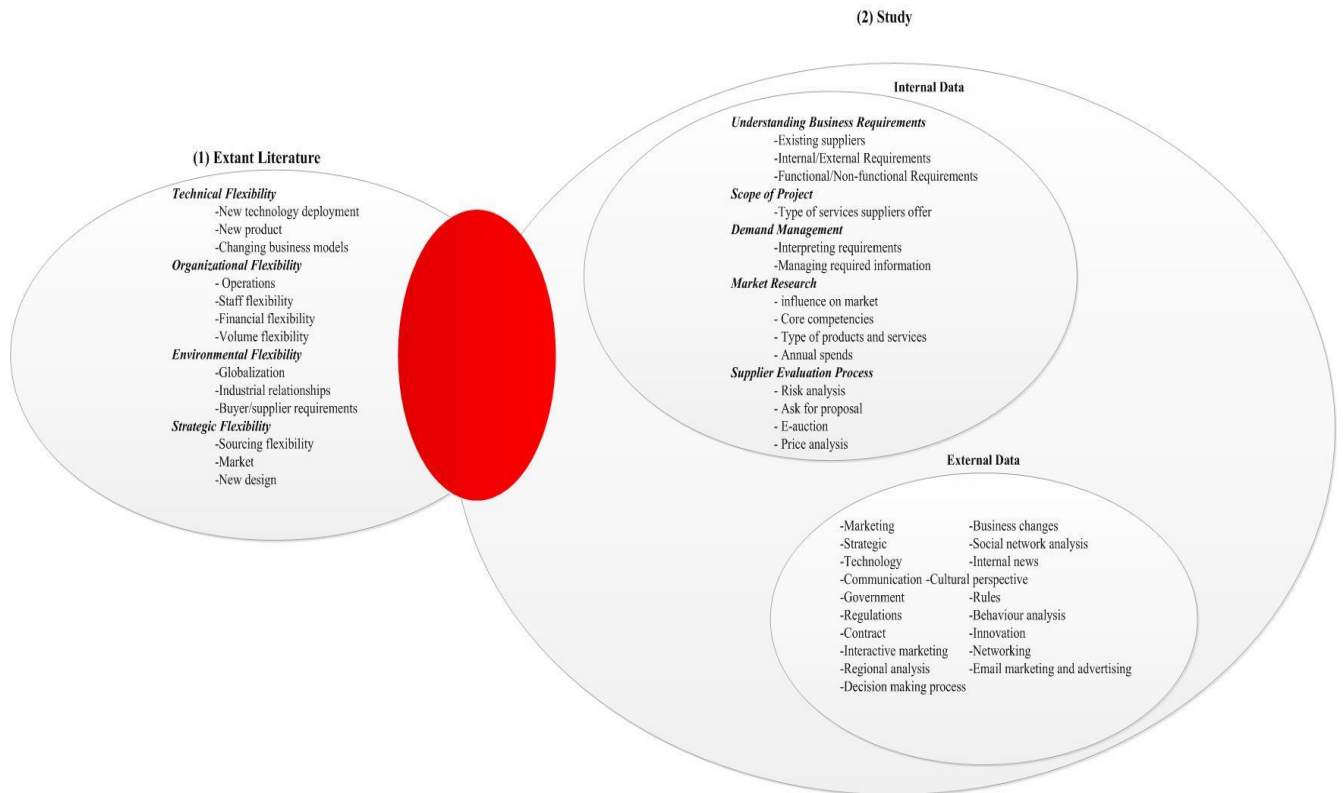


Figure 6.16: Venn Diagram of the Study

The results of the study have implications for researchers and practitioners, who need to capture a greater understanding of the supplier selection process by analysing the data (internally and externally). Rather than defining a partnership concept before embarking on data collection, it seems more flexible and sensible to first explore the attributes and potential of suppliers via a qualitative research approach and analysing social network activities.

6.5 Summary

This chapter builds and validates the theory of this research; SoMeDoA is capable of improving the domain of knowledge, including concepts and semantic relations from social network domain analysis. This iteration contributes an improved social commerce EPM framework (Figure 6.3). This iteration combines the outcomes of Chapters 4-6 in order to demonstrate the previously-discussed gap (Chapter 4). Another main contribution of this chapter is a thorough construction and evaluation process of SoMeDoA. The evaluation method is illustrated through a detailed experiment and demonstrates that there is not enough like between internally and externally-analysed data and the literature review. The approach adopted in the SoMeDoA proved efficient in extracting domain concepts and linking them; thereby, proving reasonable preciseness and coverage. Overall, the method proved efficiency

by introducing new concepts and relations. Finally, the learning emerging from this iteration highlights a number of issues and challenges that can be employed to direct future research.

CHAPTER 7 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

7.1 Research Summary

The supplier selection process has changed tremendously over the past few years. Consequently, the tools, techniques and considerations applicable to selection or new selection processes are equally relevant to this type of process. Moreover, the degree of organisational complexity is determined by a wide range of features, such as the characteristics of organisational culture, the organisational technology, and the scarcity of organisational resources and the weakness of standing organisational strategy. Procurement principles are organisational values and, as such, they contribute to the degree of organisational complexity. This, in turn, influences participants' perceptions and behaviours with respect to the supplier evaluation and selection process. In short, organisational complexity acts as a stress multiplier for those with a stake in the outcome of source selection. Personal interests and group effects interplay with organisational complexity and with the change prospects associated with the supplier evaluation and selection process; thereby, creating a series of organisational anomalies (i.e., ambivalent behaviour) that are manifested throughout the various phases of the procurement process. These anomalies can be corrected through the implementation of proper management techniques, such as effective internal and external negotiation analysis. The evolution and increasing adoption of social networks has, in part, been attributed to improved networking and electronically transfer functionality in solution areas, such as e-procurement, e-invoicing and supplier management. To maximize their utility for the buyer-supplier relationship, it is therefore critical for procurement teams and sourcing professionals to broaden their understanding of how to connect with suppliers and the information that can be shared or generated within these social networks. Given the vital role played by data published on social networks in achieving the full potential of selecting flexible supplier, a faster development process is clearly required.

To make the decision of selecting suppliers a practical reality, data published on social networks needs to evolve by embedding the existing knowledge base (literature review) and business need (expert interviews); artefacts. Consequently, this thesis has sought to assist industries, especially those involved in e-procurement marketplaces (EPMs), in relation to building, selecting and maintaining relationships with suppliers. This aim was achieved by developing a social media domain analysis (SoMeDoA) framework to analyse the data extracted from social networks and existing knowledge. The objectives set out in Chapter 1 are summarised below:

Objective 1 - Investigate existing flexibility factors and EPMs with the aim of learning about their strengths, weaknesses and best practice for utilising them in the supplier selection process.

Objective 2 - Investigate the existing EPM structure with the aim of finding the associated gaps in their development processes, which are believed to eliminate flexibility factors.

Objective 3 - Identify the requirements for a flexible supplier selection approach in EPM development methodology in order to improve the state-of-the-art (taking into account the findings of Objective 1 and Objective 2).

Objective 4 - Develop a methodological framework (SoMeDoA) that considers and covers the findings of Objective 3 to provide semantic clarity and coherence.

Objective 5 - Evaluate and demonstrate the practical adequacy of the proposed framework on datasets for the analysis domain.

In achieving the aim and objectives of the work, Chapter 2 reviewed critically the three intersecting fields of study required for this research: EPM), flexibility factors and Web evolution to the development of flexible EPM (FEPM). Web evolution analysis with respect to EPM flexibility is conducted in order to better understand the relationships between flexibility and EPM. The aim of this review was to attain a deep understanding of the state-of-the-art in the aforementioned fields and comprehending how flexibility factors may facilitate the matching process in EPM-based organisations. The evolution of the Web has played a large part in the flexible nature of EPM over the review period. Web technologies have been adopted by EPM platforms in order to support businesses of varying size and with differing technological capabilities; for example, the requirements of an infrequent supplier

of widgets require less technological integration than that of a key supplier. The variation in technological integration with newer Web technologies provides support for differing collaborations. EPMs have also provided a channel for technology adoption by the vast network of buyers and suppliers in the market – supporting and distributing technologies within (or interfacing into) their platforms. The literature review provided an insight into the flexibility factors that have been used to standardise the process and development; thereby, minimizing the number of challenges. The review uncovered a lack of robust guidelines for designing the conceptual framework for matching appropriate flexibility factors with respect to the rapid changes taking place in the organisations, in a broader sense, for designing high-quality FEPM framework. It also led to an understanding of the potential benefits of different flexibility factors in achieving inter-organisational interoperability and their usefulness in the EPM process.

Chapter 3 established the means for achieving the objectives via Design Research. This approach provides a means by which to engage in the design problem - providing the necessary learning to improve the proposed solution, whilst simultaneously enriching the solution space with the Design Research output. The main Design Research artefact is a SoMeDoA methodological framework. Following Design Research guidelines, this study was undertaken in an iterative manner, whereby each iteration built upon the outcome of its predecessor. Accordingly, this research was composed of two build iterations and evaluation iteration. The ultimate artefact of this research is the SoMeDoA methodology and the result of the methodology on two datasets of pharmaceutical domain is a set of ontological models.

Chapter 4 described the first iteration, which concentrated on investigating the existing knowledge base (literature review) and business need (expert interviews). This review assists in identifying the gap in the selected domain (pharmaceutical industries), primarily to achieve greater flexibility in selecting suppliers during periods of rapid change. The findings suggested further investigation into identifying and understanding the actual supplier selection process in pharmaceutical industries. An initial set of constructs, models and a method were built, thus meeting Objectives 1 and 2, and part of Objective 3.

The Systematic Literature Review (SLR) technique formed the pre-processing stage of the framework. The first stage laid out the foundation of the flexible FEPM from a longitudinal view in times of great volatility in order to understand the viability of EPMs with respect to current and future flexibility. The successful use of this technique was achieved through

identifying the domain of analysis (pharmaceutical industry). The SLR evaluation results will show that the pharmaceutical domain has been the subject of little analysis over the past decade. Therefore, a set of interviews with e-procurement experts was conducted. Utilising Grounded Theory Method (GTM) to analyse the interviews showed that pharmaceutical organisations faced problems of selecting flexible suppliers with respect to rapid changes in e-marketplaces. Therefore, the importance of carrying out empirical research throughout the next iterations is clear, whilst utilizing and building on the initial framework. This observation highlighted the need to further investigate how pharmaceutical organisations select their suppliers and initiate another Design Research iteration to address the actual supplier selection process.

Chapter 5 extended the framework by adding a set of guidelines for the processes encountered by pharmaceutical organisations for the selection of flexible suppliers in addition to the defined conceptual model outlined in Chapter 2. This iteration contributed a secondary Design Research structured interpretation model of supplier selection by conducting studies on pharmaceutical industries to identify and understand the actual process. Therefore, a psychological technique (reparatory grid interview technique) (Siau, Tan and Sheng, 2010) originating from Kelly's (1955, 1963) Personal Construct Theory was conducted. This aided in breaking complex personal views into manageable sub-components of meaning. Goffin (2002) also discussed the usefulness of this technique, particularly for exploring topics where the respondent knows the answer indirectly and tacit knowledge cannot be conveyed directly. As a result, the behaviour of research participants in defining the process of supplier selection, rating the important processes, has been analysed. This chapter also provided a view of a particular business domain. This is not only useful in understanding the internal structures and functions, but also in realizing the nature of the connection to their external environment and how they interact with it. Moreover, it demonstrated that designing a new supplier selection process requires close examination of the supplier's capabilities, as well as matching the business models and trends with services value elements. The Aberdeen Group (2011) also mentioned that understanding the information generated within the social networks and how they connect with each other are critically important to analyse and maximize the utility for the buyer and supplier relationship. It was clear at end of the second iteration (Chapter 5) that the selection processes of pharmaceutical organisations focused typically on internally-sourced data. In order to justify and theorise the flexible supplier selection process, a further iteration was required to elevate the research to the next level.

This was achieved by proving links from internal and external data and analysing social network data to determine how practically analysing social networks is applicable when decision-making for the appropriate supplier.

Chapter 6 presented the evaluation iteration of this research with the aim of demonstrating the utility and practical adequacy of social network data on the process of supplier selection. This was achieved by developing a SoMeDoA framework for extracting and analysing domain-specific data to feed into the supplier selection process. The main focus of this chapter was the SoMeDoA phases of pharmaceutical organisations, which are key and could be used commonly for developing relationship with new suppliers or formalising existing relationships. The reason for choosing social networks was: (a) to access a wider dataset and view of suppliers and organisations; and (b) to analyse the generated or shared information within social networks in order to improve the supplier selection process. The evaluation method was illustrated by applying this method to two datasets. The integrated evaluation proved that the data analysed from social networks recommend a new set of concepts that can be used to supplement the manual-based supplier selections. Finally, the learning that emerged from the third iteration highlighted a number of issues and challenges that could be employed for direct future research.

Table 7.1 presents how various chapters of this thesis addressed the objectives of the research defined in Chapter 1.

Objective	Chapter	Outcome
<u>Objective 1</u> - Investigate existing flexibility factors and EPMS with the aim of learning about their strengths, weaknesses and best practice for utilising them in the supplier selection process.	Chapter 2	Studying the characteristics of EPMS and flexibility factors and analysing the changes with respect to evolution of the Web, modelling an initial conceptual framework of FEPM.
<u>Objective 2</u> - Investigate the structure of the existing EPMS with the aim of finding the associated gaps in their development processes, which are believed to eliminate flexibility factors.	Chapters 3,4	This objective is fulfilled by reviewing the literature systematically and expert interviews in the following related fields: EPM and flexibility and design science research method (since flexible process itself is aimed at designing some artefacts).

<u>Objective 3</u> - Identify the requirements for a flexible supplier selection approach in EPM development methodology in order to improve the state-of-the-art (taking into account the findings of Objective 1 and Objective 2).	Chapter 5	Conceptual framework developed in Chapter 2, which covered defining flexible EPM conceptual models was extended and refined in Chapter 5 for covering the actual supplier selection process.
<u>Objective 4</u> - Develop a methodological framework (SoMeDoA) that considers and covers the findings of Objective 3 to provide semantic clarity and coherence.	Chapter 6	Developed a domain analysis method by extracting data from Twitter and LinkedIn
<u>Objective 5</u> - Evaluate and demonstrate the practical adequacy of the proposed framework on datasets for the analysis domain.	Chapters 4,5,6	Prove that SoMeDoA works by testing it across two datasets from the top five pharmaceutical industries active on social networks.

Table 7.1: How the objectives of the research are addressed in various chapters

7.2 Research Contributions and Conclusions

This research follows the design science research guidelines (March, Smith 1995, Peffers et al. 2007, Vaishnavi, Kuechler 2007, Hevner et al. 2004), in which, as with any other research paradigm, contribution is of significant importance. The main contributions of Design Research are one or more artefacts taking the form of a method, model and/or instantiation (Vaishnavi, Kuechler, 2007, Hevner et al., 2004). Proposing the use of ontology as a basis for standards and their development process is the core utility theory in this research, around which the other artefacts are built. This research has a set of artefacts, which are summarised as follows:

(A) SoMeDoA Methodological Framework: the main contribution made by this research and a generic method that enables application in different domains. Typically, selecting suppliers is carried out through internal system analysis. SoMeDoA is applied as one step within a more integrated supplier selection development process. As capabilities evolved with SoMeDoA, the selection of high performance and compliant suppliers focuses on transmitting data of electronic purchase orders between buyer and supplier would facilitate faster order processing. SoMeDoA found that different social media network platforms have complementary information; for example, LinkedIn provides network structure from

professional data about organisations, whereas Twitter supplies more informational content. Such a subtle difference leads us to think more about semantic integration of social networks to achieve interoperability and, ultimately, content integration facilities on the Web. Semantic integration can provide an enhanced view of individual or organisational activities in distributed social networks. Therefore, more intuitive semantic methods are required for presenting and navigating data in social media networks. In contrast, analysing data published on social networks provides a unique opportunity to observe the dynamics of community development for new entrant organisations, as the data is easy, cheap and accessible to all. Therefore, this approach has the potential to be integrated as a first step of the decision-making process in relation to supplier selection. The SoMeDoA can be used to extract semantic information from social network artefacts and is capable of building a domain ontology model to represent the knowledge embedded within the selected domain. The SoMeDoA targets different tasks: (1) geographical analysis of extracted data; (2) domain concept extraction analysis; and (3) domain ontology.

(B) Matching flexibility of the EPM conceptual framework: the literature review continued in Chapter 2. The referred chapter focuses on the analysis and synthesis of literature from varying disciplines in order to develop a series of conceptual frameworks to support the specific research project. This conceptual framework is a generic framework envisaging that each flexibility factor will be addressed practically when either designing or choosing an appropriate marketplace or planning its usage. Matching flexibility represents the use and adoption of flexibility elements (technical, organisational, environmental and strategic concerns) in the process of e-marketplace selection to guide firms in matching their requirements to types of e-marketplaces and facilitate the process of matching requests and responses (*bids* and *offers*) of the suppliers and customers, including their specification (see Figure 2.4).

Typically, the literature applies heuristic flexibility elements, in accordance with Das (1995) and Evans (2002), which normally apply generic types. The framework contributed by this research is a systematic process of matching appropriate flexibility types to EPM users. The framework aims improve the knowledge between transaction partners by matching the organisation's requirements (internal and external data); thereby, guaranteeing low risks of ineffective mismatches between partners. Figure 6.3 presents an improved version of the initial framework presented in Figure 2.4 in Chapter 2. It combined the outcome of this study

to highlight the aforementioned gap (Chapter 4) under the name of social commerce EPM framework.

(C) More general learning over the course of the research: first, for the rigorous evaluation of the SoMeDoA, a practical evaluation framework is contributed in Chapter 6 to prove its validity and generality across other pharmaceutical industries. The evaluation constitutes a step-by-step SoMeDoA method that integrates two datasets from Twitter and one from LinkedIn, as illustrated in Chapter 6. The evaluation framework is designed to effectively provide an understanding of how the social networks operate and to prove SoMeDoA utility on improving selecting supplier process by using mixed approaches (e.g. GTM), and ontological approaches have been used for visualising and analysing sentiments. This is because Twitter users provide a mix of information which cannot easily be distinguished by automatic means. Sentiment analysis (coupled with GTM categorisation) offers a number of opportunities to better understand the wider business network for companies. It can be observed that LinkedIn and Twitter channels offer promising starting points from which crawlers can collect related data, where time and location matter.

Second, using multiple methods provides additional insight because the research problem is approached from different perspectives. Without examination of the research problem from multiple viewpoints, these research goals (Section 1.4) cannot be attained. In this research, the examination of problems using diverse research methods established a firm foundation of knowledge. Utilising a mixed-method approach has been acknowledged in many studies. McGrath and Joseph (1981), Jick (1979) and Robey (1996) acknowledged that thoughtful use of mixed methods can capitalise on the strengths and diffuse the weakness of each method. Kaplan and Duchon (1988) commented that mixed methods “can lead to new insights and modes of analysis that are unlikely to occur if one method is used alone” (p.582). The methodological framework presented in Chapter 6 adopted from the evaluating literature (Chapter 2) and, more specifically, using SLR (Chapter 4), also prescribes research designs for integrating qualitative and quantitative methods (Chapters 5 and 6).

The above improvements would be of benefit to: (1) data analysts, modellers and implementers by allowing them to achieve their strategic goals on considering internal and external data and objectives through better utilisation of modelling; (2) organisations that conform to a specific process for selecting suppliers by providing them with a robust, formal and semantic-based basis for their processes, which helps them achieve their initial goal of

selecting flexible suppliers; (3) the e-procurement-based organisation community, by providing a methodological approach for developing more robust flexible supplier selection processes, formalising and reusing them; and (4) academia, which will benefit from the cross-disciplinary research in the three inter-related fields of design research, conceptual modelling, semantic web and ontologies.

7.3 Research Limitations

Although the research has made a number of valuable contributions to the supplier selection process, a number of limitations and challenges may be noted:

First, actual supplier selection processes have been conducted using the repertory grid's quantitative (frequency and variability) and qualitative data (GTM) and as its usual application by respondents conducting pairwise comparisons. Repertory grid interview technique has individual weaknesses that need to be discussed as follows: in some cases, respondents either found repertory grid confusing, as they perceived the technique as a psychological assessment tool. Moreover, it is highly unlikely that the individual respondents came up with the same set of elements for comparison. Therefore, by applying GTM, this research aimed to categorise similar elements in order to demonstrate the validity of the data analysis.

Another major limitation of this study was the number of interviewees. It was hoped to interview more than six people from the selected pharmaceutical organisations, but this was difficult due to managerial duties and responsibilities. However, considering their managerial duties, saturation point was reached after the fifth participants. However, an additional interview was conducted in order to enhance the richness and validity of the findings, and to confirm that the point of redundancy or saturation had been reached. This made the interpretation of the data a little easier. The other way to support and address this issue was presented through the inclusion of supporting quotes supplied by the interviewees.

7.4 Future Directions

There is scope for this research to be progressed further to form part of the larger business intelligence platform. During the development phase, the following areas for further work were identified:

1) Social media – The rise of ‘citizen sensor networks’ provides an opportunity to understand and analyse data reported by citizen sensors and the fusion of this data with the gesture sensed data to identify further potential trends. Gathering intelligence in this manner may be able to add a new perspective, identifying novel business intelligence (combining physical action and opinion).

2) Data repositories – With the aforementioned fusion of social data, data repositories stored by organisations, such as transaction histories, customer data and internal ERP systems can also be integrated and fused into the sensed data. This then provides the possibility of building supplier profiles out of past data. Data gathered can be used by many departments in for-profit organisations, such as marketing for the effective use of advertising.

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APPENDICES

Appendix A- Ethics approval

School of Information Systems, Computing and Mathematics
David Gilbert, Head of School, Professor of Computing
Jasna Kuljis, Head of Information Systems and Computing, Professor of Computing
Tony Rawlins, Head of Mathematical Science, Professor of Mathematics

The use of e-learning to improve numeracy on Schools

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Date: 6th October 2011

STATEMENT OF ETHICS APPROVAL

Proposer: SARA ROBATY SHIRZAD

Title: MARKETBASED E-PROCUREMENT

The school's research ethics committee has considered the proposal recently submitted by you. Acting under delegated authority, the committee is satisfied that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that you will adhere to the terms agreed with participants and to inform the committee of any change of plans in relations to the information provided in the application form.

Yours sincerely,



Dr. Laurence Brooks, Chair of the Research Ethics Committee
SISCM

Appendix B- Consent information sheet



Sample Interview Consent Information Sheet

Purpose of the research:

This research presents an integrated framework for flexible market-based e-procurement strategies. In order to flexibility categorization schemes and the commonalities of flexibility typologies published in the literature to create a theoretical foundation for analyzing the components of flexible market-based EP. Even though there has been a substantial amount of research on the topic of flexibility and EPM, most of it has been confined to intra-firm flexibility concerns. As e-procurement goes beyond corporate boundaries, flexibility strategies must also extended beyond the firm. A growing body of this research has begun to recognize that in the era of market-based e-procurement it is important to look beyond the flexible categorizations to flexible market-based e-procurement.

In particular, we think that Bank's procurement system makes a very good choice to study because of its well-known excellence as an example of the e-procurement. Therefore we would like to ask you for more information on how the e-procurement system has been developed and managed. The principle behind this interest is creating a theoretical foundation for analyzing the components of flexible market-based e-procurement which actually determines success and allows e-marketplaces to achieve their strategic outcomes by developing flexibility.

What you will do in this research:

If you decide to volunteer, you will be asked to participate in one interview. You will be asked several questions. Some of them will be about e-procurement marketplace. Others will be about market flexibility. With your permission, I will tape record the interviews so I don't have to make so many notes. You will not be asked to state your name on the recording.

Time required:

The interview will take approximately 1 hour.

Confidentiality:

Your responses to interview questions will be kept confidential. At no will your actual identity be revealed. You will be assigned a random numerical code. Anyone who helps me transcribe responses will only know you by this code. The recording will be erased when my dissertation has been accepted. The transcript, without your name, will be kept until the research is complete.

Participation and withdrawal:

Your participation is completely voluntary, and you may withdraw from the study at any time without penalty. You may withdraw by informing me that you no longer wish to participate (no questions will be asked). You may also skip any question during the interview, but continue to participate in the rest of the study.

Contact:

If you have questions or concerns about this research, please contact:

Dr. David Bell
PhD Supervisor
Brunel University, Uxbridge, Middlesex, UB8 3PH, UK,
Phone: (+44) (0) (1895 265845),
Email: david.bell@brunel.ac.uk.

Appendix C- Consent from

MODEL CONSENT FORM

(Please adapt this form to make it suitable to your own research situation)

<i>The participant should complete the whole of this sheet him/herself</i>		<i>Please tick the appropriate box</i>	
		YES	NO
Have you read the Research Participant Information Sheet?		<input type="checkbox"/>	<input type="checkbox"/>
Have you had an opportunity to ask questions and discuss this study?		<input type="checkbox"/>	<input type="checkbox"/>
Have you received satisfactory answers to all your questions?		<input type="checkbox"/>	<input type="checkbox"/>
Who have you spoken to?			
Do you understand that you will not be referred to by name in any report concerning the study?		<input type="checkbox"/>	<input type="checkbox"/>
Do you understand that you are free to withdraw from the study:			
• at any time		<input type="checkbox"/>	<input type="checkbox"/>
• without having to give a reason for withdrawing?		<input type="checkbox"/>	<input type="checkbox"/>
I agree to my interview being recorded.		<input type="checkbox"/>	<input type="checkbox"/>
I agree to the use of non-attributable direct quotes when the study is written up or published.		<input type="checkbox"/>	<input type="checkbox"/>
Do you agree to take part in this study?		<input type="checkbox"/>	<input type="checkbox"/>
Signature of Research Participant:			
Name in capitals:		Date:	
Witness statement			
I am satisfied that the above-named has given informed consent.			
Witnessed by:		Date:	
Name in capitals:		Date:	

Appendix D- Interview questions (1)

Section 1- Basic Information		
Name of Company:		
Address 1		
Address 2		Tel No:-
Address 3		Fax No:-
Post Code		E-mail:-
Contact details of the individuals responsible for decision making regarding e-procurement:		
Contact Name:		
Position:		
Address:		
Tel. No.		
Fax No.		
E-mail:		
No of people you manage:		
\$ IT budget		
Category of products/services supplied:		
Do you have a web site? Yes / No		
If yes, please give the URL:		
Does this site contain your product catalogue?		If yes, can orders be placed through this site?
Yes / No		Yes / No
Section 2 – General Trading Data		
With how many customers/ suppliers (in total) do you currently use e-procurement to send/receive orders and payment? (Approx)		
	Can you receive orders via the following methods?	Can you send invoices via the following methods?

<ul style="list-style-type: none"> • Fax • Email • Post • Telephone • XML • EDI • Other (please state) 	<p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p>	<u>% Split</u>	<p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p> <p style="text-align: center;">Yes / No</p>	<u>% Split</u>
<p>Are you able to accept payment through:</p> <ul style="list-style-type: none"> • a Purchasing card? • a monthly-consolidated invoice? 				
Section 3 - E-Business Strategy				
<p>Have you got a documented E-business Strategy? 7.4.1.1.1.1.1 Yes / No</p> <p>When was the last time you updated?</p> <p>What does it include?</p> <ul style="list-style-type: none"> • initiatives/projects • integration to existing systems • level of financial commitment • dedicated resources • time-scales 				
<p>Who is responsible for the Implementation of the e-Business strategy?</p> <p>If applicable, please give contact details:</p> <p>Name:</p> <p>Title:</p> <p>Phone:</p> <p>e-mail:</p>				
<p>Are there any current initiatives or plans to be implemented within the next 12 months? 7.4.1.1.1.1.2 Yes / No</p>				

<p>If yes, please provide some details and state whether these may impact upon the technology in e-Procurement with UK Executive?</p>	
<p>Explain any major obstacles you may have (if applicable) to supplying your goods and services through an e-Procurement system.</p>	
<p>Do you currently trade through any form of electronic procurement or marketplace (e.g. Ariba CSN, CommerceOne, MySAP.com, Oracle Exchange etc.)? If so, state</p> <ul style="list-style-type: none"> • Names of Customers involved • Names of Marketplaces 	
Section 4 - E-Procurement/EPM Experience	
<p>What are the procurement processes in the organization? And how many admin people are involved in each?</p>	
<p>Which software vendors do you use to support the procurement process?</p>	<p>Which are the elements/components of the procurement system/software you use?</p>
<p>Is your procurement system integrated with other systems of the company (with accounting system, database)?</p>	<p>How did you integrate the organizations' information systems with supplier systems?</p>
<p>With how many suppliers does the company deal?</p>	<p>What are the Electronic Procurement Tools the company adopted?</p>
<p>Have you implemented any sensor-based system? (e.g. RFID, EPC,ONS, Temperature, movement) (EPC: electronic product code, Sorting Item characteristics and movements) (ONS: Object Name Service, Finding information within the network)</p>	<p>Outline the main advantages of your Sensor based procurement process, either direct or indirect, for:</p> <ul style="list-style-type: none"> (a) The company. (b) The suppliers.

Outline the main disadvantages of your Sensor based procurement process, either direct or indirect, for: (a) The company. (b) The suppliers.	Assess some security issues concerning procurement.
Do you measure the performance of your procurement system?	
Which method did you use?	
In your opinion, what is the future of e-procurement in next 5-10 years? (a) The company. (b) In general.	Please indicate your future plans and approx timescales for trading through electronic procurement
Are you involved in any e-procurement marketplaces?	If so, which one?
Were you involved in the initial formation of any e-procurement marketplaces?	How was it formed? (Initial players, contracts, timescale, infrastructure)

Appendix E- Interview transcription (First set of interview- section 3.6.1)

Appendix E- Interview transcription (First set of interview- section 3.6.1)

Interview 1- Head of procurement

We had a Head of Procurement called Joe Mile. He was with us for nearly 40 years in total and he retired in December 2010. Basically, we have a different Head of Procurement and, after a couple of years, that person went off to become Head of Procurement for Look. We have about 700 procurement people worldwide, in the UK and US. The US spent something like £4 billion through procurement system, and the group as a whole. The way procurement is structured is that the Head of Procurement reports to the Head of GMS. So, even though they have a corporate function, they go through GMS because most of the spending was through GMS; manufacturing spend. Then, this was spilt into different groups. At that time, there was IT, R&D manufacturing procurement, commercial procurement; we were split into a particular way with different leads. Below that, there are teams to structure in a particular manner. Responsibility was taken as a commodity code, so what we do at the time of major is try to look at the spend with all of our suppliers, try to identify which suppliers are linked to each other so we can consolidate non-spend or overall spend, and also what commodities. There is no real tool available in the market that can look at the commodity in an easy fashion. The UN has a commodity coding system which is not bad. We talked to Donham Baradstreet at the time to look at the commodity code that worked for them and then we modified it.

Since then, SAS did some work with DNB to try to come up with the commodity code. Still, maybe we are not right, they stood in jail on the way that we are working. So, we settle the commodity code to define and develop ourselves and they are reviewed each year, or regularly, and need to be updated. Personally, I have a specific area or commodity to look after. We back up the structure overall. There will be people who are responsible for a particular commodity code around the world. For IT, this is specifically hardware, someone looking at desktops, laptops and peripherals; looking after servers, and storage or mainframes. They may also look after desktop software, or enterprise software. There is a particular person who is responsible for looking after all the blackcurrants we buy; we buy 30 thousand tonnes each year. That person knows the 10 farms with which we have relationship. We understand the life cycle of the blackcurrant bush: what phase it is in' how it is affected by the weather; the quality; and all issues. It's fascinating. So then, over time, things move, change and develop now that we have split to form a new group within GSK, called call business services (CBS). So IT, HR, FI, Procurement, worldwide real states, so that's FM facility management, are all expanding worldwide. That's five groups that have combined; 4000 people working together. And, in September we will have a new Head of procurement. The whole idea is to recognize we provide a service to the business. We have to work together to become more seamless, support functions within ourselves, and ensure we deliver better to the business. So, in procurement and management, all these particular services have improved, in my opinion, and could be easy for someone who wants to buy something, place an order or find out if there is a catalogue. And we have to understand what it is and be able to place and order simply, and track and deliver correctly.

The next parts of procurement is the invoicing structure, methodology and payment. Denise will be able to give you this information in detail during the afternoon.

I suppose the formation of CBS means that procurement is split, so all our procurement is kept within manufacturing. Potentially, in my personal view, I would see overall a period of time with our new Head running the new indirect procurement team within CBS the organization. When that set up is stable and working satisfactorily, we are moving towards the overall purpose of the organization. But it's a risk to move that part into CBS if it is not performing or delivering because it means we don't get the product into the factory, which delays getting out and selling it to keep the company profitable or making money at least.

Supervisor: What is the worry? It is stagnate or its culture?

Head of Procurement: Stagnation, culture, maintaining our pipeline, maintaining the delivery of products.

Supervisor: Just the manufacturing what to keep it close in that control?

Head of procurement: Yes, this is fair enough.

Our procurement system uses RIBA, and SAP as well. And that presents the only time when IT perspective upgrades our SAP platform. There is a lot of change in manufacturing, so we are going through implementations over the next few months to upgrade our SAP platform. That's going to be done correctly and smoothly, by training our procurement people, business people, people in the factory flow and quality people to make sure

they know and understand how to use the new system. I suppose it will affect our supplies as well, because some of them are linked to SAP systems. So that's part of process we are going through. Ok, what else? That's procurement in very broad perspective. What else do you want to know? Specific questions?

With how many customers/suppliers (in total) do you currently use e-procurement to send/receive orders and payment? (Approx)

Head of Procurement: Did Richard give you this information?

Sara: Roughly

I don't know the specific answer. I am managing particular areas.

Supervisor: Some of these questions are quite general, so you can just say I don't know.

Head of Procurement: I know that we have at least a quarter of a million suppliers GSK worldwide. It's extremely few compared with, say, the manufacturing market. Emerging companies all have about 5000 suppliers. Then, potentially, they all have GPs, investigators, all the people that we pay, experts, so that makes us much larger, but there is no opportunity to rush it at all.

What sort of method are you using to receive orders/send invoices?

No idea; Richard should give you this information.

Do you have a documented e-Business Strategy?

I don't know. There should be something written in the organization. I am not party to it.

Supervisor: Do you see any plan for e-business going forward in the next couple of years?

Head of Procurement: We have to; we really have to. It's got to be seamless. We talk about as a business, we talk about it being as simple as Amazon. We're going to have a simple intranet, webpage, Iod14,xyz. We'll be able to see exactly what it is, or whether it's used by external parties. For Iod14, within my catalogue, I know that I can void it, track it and know the goods have been delivered.

Explain any major obstacles you may have (if applicable) to supplying your goods and services through an e-Procurement system.

There are some obstacles I would see. We buy a phenomenal range of products and services, because we are not just one type of business, we are seven types of companies.

Supervisor: Could it be customer-related, system-related?

Head of Procurement: I think, in my perspective, just case 70 of company corporate function for products and services that you need, go across the whole organization. We have R&D, and a whole range of services we need

to know. These could be buying chemical, test tube, laboratory equipment, analytical equipment specific to R&D, and a range of other things as well. The same applies to manufacturing, where we are buying primary chemicals and services that relate to make and are used in a recipe book. So, we have a recipe book for making a particular compound, and buy those chemical and products around the world. They may be much more common but specific to manufacturing. Then, if you are on the commercial side of the sales services, there are buying services from medium organization, marketing organization. So, each of these have vast range of goods and services that companies may offer us. Once we make restricted things in some areas, say I only want X, Y and Z, in other areas it is prohibited. If we discover a new chemical entity, we may find that it has benefit to humans, whether insisting fibrosis or something like that. Then we want to exterminate, so if someone in the lab said you can buy a combines, you can buy this type flax for that reason, then you hinder us in conducting our business properly. I am saying a lot of people in the organization can be prima donnas, but this is where I feel procurement should be much closer to the customers and understand where they are and where they are going. OK, you may have this catalogue, but what do you need for the future? Engaging externally with the suppliers so they may say I have just requested something like this. I don't know what it is, then either try to find it in a way that I can't. So, has the customer found the right supplier in the first instance? There needs to a better, much stronger relationship with suppliers, procurement and customers! And they need it not only for now, but also for what is happening in the future.

I blow my trumpet, but that's what I have done with IT space when I worked with them. Looking at the new hardware, I knew what the attack was, what I am trying to do, I am deliberately embedded with them, and learn what they are doing. It became an amazing trail of new technology, but maybe I understand what they are trying to do and where they are going to go. I said I'd rather talk to suppliers about what I really like, which puts them up against other competitors or brings in different things to compare with each other. Don't worry about commercial; if they provided us to be experimental or try to improve its capability, it goes through those stages. Then, when you decide to like a particular product, technically that's getting too commercial then sort of move away from that. That was particularly successful. And a very good, long relationship and my raw has moved on to change. But that is my way of approaching it.

Supervisor: I suppose that's real strength in procurement. If you can be close and try to interpret what you need for future, it is mapping that catalogue or marketplace. It can be naturally easier.

Head of Procurement: It is not to be seen as a native, because some people think you have gone native when you are working more closely in the business. No, I am not

Supervisor: Providing services and giving them information?

Head of Procurement: Yes, because as an experience in the core business service, I am a service. Like you say goodbye to me tomorrow, or they can automate it to someone else, or give it to an external organization that can procure generically for you. But that was all about what we want, what we need and why and always they ask why and how. This also understands where the market is; then they take. OK, this is want you want, this is what you need, let's get the best commercial, and let's try to future proof it if you can. So, if you are dealing with

cutting-edge technology in some instances, I am dealing with leading edge technology, I am dealing with ordinary instead of technology, it is now available and also legacy systems, and each of those different approaches. That answers your question about barriers, but what takes them away.

Do you currently trade through any form of electronic procurement or marketplace (e.g. Ariba CSN, CommerceOne, MySAP.com, Oracle Exchange etc.)?

Head of Procurement: We use Ariba. We use SAP, but as products. We set up products internally within our organization to use as a means of ordering. So, if I want to order new battery for my laptop, I go to the internet page and use Ariba solution. Then, I go to the provider, look at the catalogue, order the specific item for my laptop and it is delivered.

What are the procurement processes in the organization?

We are all sorting group managers; we are expected to understand our sorting group by commodities. So, effectively, they say this is your sorting group, this is what you should know and understand about the industry, you should know and understand about companies, you should know and understand about what we doing internally as an organization. We have a five-stage process. If something new comes along with both have situation analysis we are going to initiate, develop strategy, agree and implement that strategy and I see the next point is continuous improvement of that. Now, that works well in parts of the organization but not in others.

Sara: Which part doesn't work well?

Head of Procurement: It varies. IT works very tactically in many respects. So they might say I need some mainframes, but there are very few companies in the world that make mainframes these days and it's a case of which one you are going to choose, negotiating these things the best you can. But the price structure is stipulated by the U.S government because IBM might find heavily because they read market when it has going. So it has not affected the market overall. But, again, some of that is symptomatic of actually going out of blue, knowing your customer and working with them. So, for me, I've done that in other areas and I am working on outsourcing of upgrading of SAP platform. I've got to know the business by working with them. I developed the sourcing strategy with them by reading the sourcing strategy. We implemented the sourcing strategy and now it's running. In some aspects, it is a project. It has a 3-year lifespan and when we want support of the services we will decide how we are going to do that in the next 12 to 18 months. And there is no continuous improvement cycle with the existing plan apart from what we had to do better, whether we could make some improvement. Because, once we implement this in element of academic, we don't need the company anymore, and we want to use it for support.

Which software vendors do you use to support the procurement process?

We use SAP and Arbia. Then, we have platter of other software applications that will be integrated across the organization. Those are the main ordering systems for monitoring and progressing what's being delivered to GSK.

What are the elements/components of the procurement system/software you use?

No Idea.

Is your procurement system integrated with other systems of the company (with accounting system, database)?

It will be, yes. I know for a fact that Ariba connects to some IT desktop providers and now SAP is connected to a number of providers, which can be pretty heavy within GMS functions. So orders will be going out to them for, say, Vitamin C and we could monitor the relevant side, the quantity they require and analytical equipment that assesses the quality of that see and make sure that it is as it is. This would potentially be feeding the suppliers as well.

How did you integrate the organization's information systems with supplier systems?

That would be done on a case-by-case basis. When we chose a desktop provider many years ago, they had a solution that they were better than us, so they set up the customer portal , and we are ordering to them and use that then over time. Things are progressing then Ariba is being brought on board then punch out that particular supplier with a specific GSK catalogue, so there is a connection. I don't know how it worked, because I was not involved with that particular

Sara: So, is it based on a requirement of that?

Head of Procurement: We would have to say we have SAP or Ariba. What do you use, how does it connect it? This is what we want it to look like. We bring two relevant elements of the IT group together from suppliers and our IT organization within procurement. Richard would know a lot more.

What are the Electronic Procurement Tools the company adopted?

I don't really know the answer to that. If I want to order something, I would look on the link on the procurement website. I know that they use Ariba and I know that when I go there I have a choice of ordering stationary or IT or other services. I order stationary or some bit of IT and I know it goes through our preferred supplier networks.

Have you implemented any sensor-based system? (e.g. RFID, EPC,ONS, Temperature, movement)

No idea

Do you measure the performance of your procurement system? I think they do, and there are various metrics that come up. I don't know how it particularly works. There are other ends that I would particularly close that would be monitoring whether my suppliers are paying on time. I would be monitoring for getting the right payments but not the fine details.

Supervisor: Do you have a system that would be easy for monitoring the systems?

Head of Procurement: There are systems. I would say they are not bad; I would say they are a lot better than the other industries, but they could work better. I think they need to be smoother. We have got system processes within procurement for reporting the contract, reporting our savings, reporting the sort of data that comes in. Our finance department has about 20 different finance systems have as company worldwide that comes in world central point that has to be able to provide spend data in all worldwide. But that takes time with such a loyal organization and then the SAP upgrade improves things, so there lots of things are happening. It is just the question of time. But some of the interfaces need to be improved. They are not good and they frustrate procurement and frustrate businesses that want to access to the system and services.

Supervisor: Is SAP a big help?

Head of Procurement: It would help, but it's not. It's not a panacea, it would start making thing better. And some people think the system is brilliant. For retired, they said it is not.

In your opinion, what is the future of e-procurement in next the 5-10 years?

(a) The company.

(b) In general.

Please indicate your future plans and approximate timescales for trading through electronic procurement

I think it has to be smoother, easier and I think I used the analogy earlier of an Amazon-type of approach. A lot of people use that, but I don't think it's the best analogy to prone our pled us to. But most people see it as an ordering system very well most people do it. They want to find something and order it and it appears. Pretty effectively, I think, with e-procurement people. I suppose procurement people have to understand the business need, to be able to translate that through Richard's team to be able to develop the system and services. It is very easy when they become generic systems whether they be GMS or R&D specific systems, but it's going to be a method when someone in R&D actually needs ten tonnes of straw and this is the chosen supplier order it and the price is competitive. What happens in the background works smoothly and it arrives in manual express at the right quality. And, sort of in seamless fashion, rather than saying I want a PC but have received a mug instead. It does all the things, but in some the barrier interferes. And someone knows the pencil will interfere with the computer. It is sort of why it is appropriate to get this sort of thing.

What are your future plans and approximate timescales for trading through electronic procurement?

I have not got a specific answer for that. I am saying that procurement people have increasing knowledge of understanding the procurement system. So, when someone is new to the organization, I am working to pass them on to someone in Richard's team or Denise's team. This is what happens and this is what you need to do. I need to have some understanding and I need to know some details. I want to concentrate on the strategy for my

area and my customer, so I expect people in procurement to have the knowledge and expertise to enable those people.

Interview 2- Head of Global Resourcing and Procurement Technology

If you have been talking to Christian, you have got very sort of date to date of what happens. What I have and hopefully I can bring to this is this week I actually complete my 38 years in procurement. So, I started with paper-based systems and then I led a current team in UK that was supported in the transition from paper to e-procurement in terms of change management. Then I stepped back for a while and did something else, and came back just over a year ago; we have some changes in back in. But I am fully operational now so 6 years of being 100% e-procurement without purchasing order, requisition to purchase order. So it's very much embedded in the way we work. We have a lot of experience. But that's all for you now.

With how many customers/suppliers (in total) do you currently use e-procurement to send/receive orders and payment?

I can talk quite well in the UK. For the UK, I would say the supplier-based activity in a year, in a typical year we use about 10000 suppliers and our customer-base. We have 5000 who use at least once a year; the regular users maybe 2-3 thousand. The turnover is probably 500 per week and it's a billion pound work spend in the UK.

Can you receive orders via the following methods? Can you send invoices via the following methods?

We currently use another step of the revolution, so until few months ago there were two primary methods; one was directly by email through a third-party portal, Ariba, and that was for high volume fewer suppliers that had to be set up. For the balance that what we used to called the auto-fax. This met our system behind the order not the requisition the purchase order would generate the facts, we would not have hard copy but actually it would come out as hard-copy at the supplier. That's what we did a few months ago. We just introduce what we call a vendor portal where a supplier can go on and get an email to say they have an order waiting for them and they can download this from the IS order system in any format. If they want to, they can flip it and give it back to us as an invoice using the same portal. So that's quite new; we are facing the number of suppliers, so gradually the high volume of suppliers are on the old fax systems. And we are about halfway through the transition so, ultimately, there are two ways; email via ariba and supply network I think is good, ASN, or work for the supplier to download from the other portal which is also any invoicing portal or business exchange.

Are you able to accept payment through:

- a purchasing card?

- **a monthly-consolidated invoice?**

We used a purchasing card in three ways; one of them is in procurement. When the order goes from the supplier through Ariba or supplier network ASN, we tend to set up the high volume or lower value, like lab supplies or stationary. If I want one of these, I would pay using the procurement card. The other method is more manual so either as an individual they would use a credit card or something like that. Not much the other way is we called it large card, shared card group card. The first one is used in procurement and is one of the most preferred method for ordering and payment.

Have you got a documented e-Business Strategy?

Probably nothing I can pick up. Our e-procurement has been developing over years so there is always presentation and system development so it's been set as a bolt-on strategy. But I can't remember if there has been one that ever looked at the whole. There was nothing 6 years ago that tells me that today that there would be a vendor portal but it has grown, so there is no strategy document.

What does it include?

- **initiatives/projects**
- **integration to existing systems**
- **level of financial commitment**
- **dedicated resources**
- **time-scales**

There is always the biggest consideration when they work with our systems, so I guess that's more in a technical department that they could work. They could currently not be related to e-procurement. We currently don't look at the contract systems, and we know it will have to work within ERP systems.

Are there any current initiatives or plans to be implemented within the next 12 months?

Well there is an ongoing program to put in a new ERP system. So what we have today is being long time light of how it worked with that. We are not really, there is nothing I can say. We are doing this right, except with the new portal we are transitioning to and the new ERP system will probably be better than if not do exactly the same as all these things, they will be under one umbrella. They will be from JD Edwards through SAP.

Are there any major obstacles (if applicable) to supplying your goods and services through an e-Procurement system?

I guess the biggest challenge has been balancing their need to have a consistent processing system but, at the

same time, making the user experience good, Because they are all buying different types of commodities and services, what works for one doesn't necessary work for the other. So, an exception would be in temporary workers contingent work forces we called where we have recruitment process and time sheets. We have actually come up with separate systems, now I know currently there is team in IT looking at whether it could work with the regular ordering system, but it is one of the exceptions. There is another exception, booking travel, which we class as procurement, so we have travel booking systems working with the Amex cards which seat outside and it's in different systems it not connected. But most things IT still goes to aviary the IT desk, but if you need something it generates a requisition for the same order; we call it ESPS. You can buy a life supply, you can buy services but it's typically equipment and stationary. But there are some exceptions.

Do you currently trade through any form of electronic procurement or marketplace?

We use the Ariba supply network but we also use Cyquest marketplace, which is a group of marketplaces.

Supervisor: How do you use them; are they used for different marketplaces; when will you use conquest basis?

Head of Global Resourcing and Procurement Technology: I think Cyquest 80-90 other suppliers' catalogues. It's more like Amazon, but because we can more control what's in it, we can let scientists see that it is full of suppliers. They can see lots of products from different companies but they are all within the agreements of procurement. So it's not out there in public domain; it's like giving them marketplaces and choice, while remaining under some commercial agreement with GSK.

What are the procurement processes in the organization?

Do you mean the types? We use purchase orders. We use procurement card; we use amax card. We use our travel system; we use our contingent work force system. We have another special one linked to legal services. Go to outside legal companies. It is a form of order and payment, but it is linked to our systems.

And how many admin people are involved in each?

Supervisor: Does anyone work on operational systems?

Head of Global Resourcing and Procurement Technology: Yes, we outsourced the day-to-day support. So, for the UK, we have I think six people. There is another team for the US. We also have one person in our outsource team maintaining the online catalogues and a team here, overseeing the day-to-day operation. We also have two part time IT roles that support backend of the systems.

Supervisor: What was it like when you first started e-procurement in terms of number of people? Was it more manual?

Head of Global Resourcing and Procurement Technology: Well, that was one of the difficult things to me, because I took over the team of 40 and I popped the transition to the system to some of these people. We actually managed to do that through tradition, but we did layoff temporaries. And there was further change when

we outsourced, but it was literally month-by-month the paper stack would go down, so there are empty seats, another paper stack going down other empty seats. So my job as manager was to try to motivate the ones that remained. But taking them from data, or piece of the paper doing this they were now on the phone helping people to choose goods and talking to suppliers, so their roles became more interesting. But it was a very significant change.

Which software vendors do you use to support the procurement process?

Ariba.

What are the elements/components of the procurement system/software you use?

In the UK, we have the requisition only, which interfaces with our back in finance system - JD Edwards. For some orders, we use the Ariba supply network to actually send the order to processing.

In the US, they are the same but they have also chosen Ariba for e-invoicing. Their e-invoicing program began much later than the UK. We don't have e-invoicing, but we do have Ariba requisitions; then it goes to JD when we do the payments.

Is your procurement system integrated with other systems of the company (with accounting system, database)?

Some suppliers are not integrated, but they can accept orders through the sales systems. But we are integrated with our own finance systems. And with things like our IT, we have an online need something in IT. If we need to buy something, it will go through our e-procurement systems. There is small chemical supply database used by R&D, so they can use it directly and see the chemicals. We have the cyquest catalogue.

How did you integrate the organizations' information systems with supplier systems?

I don't know the technical solution, because the systems team would do that.

Supervisor: When the customer wanted to do integration, would you just pass them on and let the systems teams sort it out?

Head of Global Resourcing and Procurement Technology: Normally, they need to come from the business. The other way to identify the need for technical improvement is by talking to the customer; we say you are not using the purchase order system and they say no this is what I need to do. It is difficult to use systems, which is why we might get the system paper to see the solution. The other way is by encouraging feedback, over the year, we have taken criticism from customer based and act it online. We don't do so much now because we make initial changes, but my team feed the systems team every month. For example, we take X number of calls or X number of emails and categorize them; say X number of people experience this problem or X number of people liked this program or X number of people have this failure. And then if they saw off the system team, release the enhancement and over of the years we have really improved, usually business need the triggers the

improvement. We measure performance all the time

What are the Electronic Procurement Tools the company adopted?

Our procurement system, like purchase ordering for requisitioning a little bit reporting. We have not gone for the reporting in a big way so we don't necessarily using it. In fact, we have to discourage use for fiasco reporting and we are waiting for the point from our finance system, because the way our procurement works it is only the one way to feed the requisition. It says I want to buy these goods worth £1000 and that goes to the finance systems if an invoice comes in and, actually, what happens is they got a price in a room and we call it out of tolerance. And rules around the tolerance whether they need to improve it or not, they say it's worth around 50 thousand tolerances that would not back into the procurement system, so it's purely ordering an element of reporting but we have got workflow in controlling thing like use it to control like we use it in R&D. So, we buy control drugs that have to be signed out by some people, so the workflow makes sure that those people sign it. They use it for compliance monitoring and control but, at the end of the day, it is used for buying things.

Have you implemented any sensor-based system? (e.g. RFID, EPC,ONS, Temperature, movement)

Our manufacturing groups, Logistics, know more.

Assess some security issues concerning procurement.

We have lots of IT orders apart from the financial. We had to abandon what we called single sign on, for internal security so people now have to log into the system. Normally, if I log on in the morning that will do me for the whole day for anything I use. But that's another sign system. Internally, we have to just control where it is we thought improvement might be single sign on, so we have to take that away because the order states it should be open. Also, we have to find a balance to make it easy for people not making it owners form type of stuffs with proper financial control. And we have limits, with which people don't need approval. And we have to open approval level. I never have known any problem with security outside the company. Even though we go to the supplier, we go to the ASN, I never been told of any security reach.

Do you measure the performance of your procurement system?

Yes. Apart from throughput, every month our technical system makes reports on our systems and we can see volumes and values, but there is also times for each activity. So, if we are looking for any particular order or requisition, we could obtain the history based on the time, and see if there is any delay in meeting an order.

In your opinion, what is the future of e-procurement in next 5-10 years?

(a) The company.

(b) In general.

Please indicate your future plans and approximate timescales for trading through electronic

procurement.

I think it will get better. We all have concerns about how we are going to integrate with the new SAP platform. We are currently using SAP in our manufacturing, and we get a lot of feedback that the flat ordering process in manufacturing is difficult. It's OK for manufacturing the way they buy material is based on scheduling. But for indirect, which have talking about is indirect people concerned system allow us as flexible with our process. And they might not be as easy so it would be shame because it would be backward step. I think I should have found the way to implement procurement in a new platform. I think having given it to business for several years, it is very difficult to take it away. From the customer/supplier side, I think there are few challenges: some customers/suppliers are very familiar with e-procurement and very comfortable with it, other still struggle with it, to go to the some of the process they little bit problem; however, we are finding more people have a lot more catalogues so it's becoming the norm. People are expecting to see online environment catalogues, which is good as their minds are changed for internal customer. I think people are familiar with it and come down and also we look forward to change. Managing the changes in organization infrastructure was very much fragmented with respect to supplier selection, different IT structure with no integration with supplier processing systems, lack of supplier's knowledge about the organisational infrastructure, transparency and visibility of procurement process prevailed.

Please indicate your future plans and approximate timescales for trading through electronic procurement.

As far as I can see in the feasible future, I guess we are just concerned with a cheaper way of improvement. We have gone to outsourcing, we outsourced the support, we got bolt on items, so currently as a team, we are looking to see if they could make contingent workforce system work with the areas pieces. Other countries have ideas that are starting to be adopted, like china, which has the same Ariba, and Egypt, the same with in the UK and US is the same businesses until we get the new system

Interview 3- Director Vendor Manager

Supervisor: Within 5-10 years, just get a sort of kind of right set of questions, so if you fail some of them, it's not really my area, say that I don't know the answer to them.

Head of Global Resourcing and Procurement Technology: Would it help if I explain what I am doing in GSK?

Supervisor: It's part of the research. Everything has to be recorded and transcribed as a whole cluster analysis; you go through every word that you say.

Head of Global Resourcing and Procurement Technology: I am head of group at GSK called Global Resourcing and Procurement Technology. So, I sit on the procurement leadership team at GSK, that's made up of areas representing the various business units within Glaxo, so area's that procurement lead for R&D organization one for commercial business in the U.S and in rest of world. There is also the procurement lead for cooperate services or core business services team. So people in IT, finance and HR are cooperate categories. And I am responsible for procurement technology that supports the procurement people, including the tools and technique to support the job as well as the externally facing application. It supports the user anywhere in the world purchasing a good or service. The third part of my role is e-sourcing. So the application is one of the biggest changes in how procurement is done, I guess since the first person bartered over a market store thousands of years ago, how applying technology to change some of the more traditional procurement dynamic so user develop electronic request for information through to auction and the bid optimization. So that's my role.

Chirstian or Denise, who you will meet later, are heads of the procurement operation center. So she is not responsible for the technology, but is responsible for the indirect requisition. Her team supports the more traditional procurement. If you go back 15-20 years, procurement was an organization with piece of paper you need fax to suppliers, so Denise spends a lot of time making sure that we have compliant processes in place and supporting GSK wide initiatives, like working capital. The result is often a crossover between Denise's work and my technology team. For obvious reasons, we can't do one without the other. So that's kind of worldwide of GSK.

With how many customers/suppliers (in total) do you currently use e-procurement to send/receive orders and payment? (Approx)

It's an interesting question, because we have the customer one and I am not going to guess. I'll get the right number for you. The supplier one is also interesting because you know we have got the whole parent-child across the globe. We are the company of merger and acquisition, so we have, if you could think of the finance system we have it somewhere across the globe so we are at the moment predominantly. We are transforming it into the SAP house in terms of core financial, but we have got Ariba and JDE today, so we have well in excess of 200,000 suppliers and whether or not that it the right number I would debate because we probably missing many. Well, there is the finance system in some of them. Many finance systems still use Excel and spreadsheets but, again, I will give you the right number. You know it's better to have the right number.

Can you receive orders via the following methods?

The predominant method will be email.

Sara: You mean you use email for both of them (sending and receiving)?

Head of Global Resourcing and Procurement Technology: Yes, email is predominant. The only caveat is invoice pieces where we are using companies for e-invoicing, which sometimes come through email.

Can you send invoices via the following methods?

Good question. It varies again dramatically across the globe. There is very good e-procurement process in terms of requisition, you know in terms of P2P, in the U.S and the UK, and it's getting better in Australia. And we have a large program call CERBS, which is the SAP role across the Europe used by the suppliers. As users of GSK, they go through the frontend system and the suppliers get a requisition. And then there is e-invoicing on the backend. But there is by now the globally deployed answered, because some of them remain on the market and for some mergers and acquisitions are made; so, if you look at the global with in US and the UK, absolutely, but again I can give you the flavour for how many suppliers and e-requisition verses now. There is also compliance factor making sure that a user anywhere in the globe using the right process and is not finding it easier to pick up the phone and call the next door neighbour and there are places where that's been more challenging than past. We have got along better over the last few years.

Are you able to accept payment through?

- **a purchasing card?**
- **a monthly-consolidated invoice?**

Again, this is something my team report through the content and catalogue, what is the right payment method?! Do we pay through travel and expenses card, do we use Pcard which is physical card guest card, or is it simply straight forward payment, directly to the supplier and typically we are do it through our sourcing group management process. It is part of our sourcing process we define and support from our organization what the right payment method would be for the catalogue, so there are lots of tiny transactions just lending itself to Pcard; 2-3 payments a year is better than we just get. We push them through invoicing.

Have you got a documented e-Business Strategy?

Another good question. I we are just talking about the later stages of the supplier interface, and the contract that we have, you are actually looking at the P2P, purchase order to the payment. That is largely driven through who we want to use from financial systems. So procurement 5-6 years ago late, the e-business strategy which was there was very basic finance system JDE finance system, we want to do was optimize standardize and improve the experience of the users and also suppliers too and we implement the Ariba. Because it sits on the JDE platform very easily and we did that in the US and the UK and that was a procurement laden initiative. And how technology I guess has changed is you get in these large companies that for they can do everything. So you know cradle of the grave you can do everything and SAP is one of those. And that's why the e-business solution becomes more in finance laden initiatives as it would be always possible for finance to use SAP on the backend and for procurement to be same. Now, we are using Ariba from the frontend. This is not just about cost; you have to think about how you can come up with the right simplified approach to do the day job, so it's not e-procurement purely our finance decision collaborative decision. So, there is procurement team within GSK and the things that full of that for you leading in procurement. So we will not rule out SAP to every single country at GSK. The thing that falls out of SAP is centrally laden initiatives that my group plugs in to, then fall in to procurement. There is not a typically formal finance system, there how the system procurement wants to

optimize in supplier side is Pcard or anything that should be over laden? Considering the fact that educating suppliers is the most time-consuming process, adopting the flexibility factors reduces the time spent on educating suppliers with the processing system, the cost of implementing IT structure for them and improvements in business process.

So, in the last 12 months we implemented the Ariba solution in Egypt and China because there will be a sizeable gap before they get SAP or they won't ever get SAP. Ariba is set nicely on top of the finance system for optimizing the way of working. This is a very complex answer but it is location driven by who owns and leads the strategy, so I have a five technology strategy and the markets to fall out of the company-driven strategy would be part of mine.

What does it include?

- **initiatives/projects**
- **integration to existing systems**
- **level of financial commitment**
- **dedicated resources**
- **time-scales**

Yes, absolutely. There is a major drive to integrate what we have today rather than re-invent them. This comes down to the cost of that company. We are not constricting whatever we have grown, we grow through acquisition. We will have the best solution from the system from the leverage.

When was the last time you updated?

Every 12 months, there is reason for that: one is technology moves so quickly and you can find yourself lagging behind, and the other is the budgeting technology, because some solutions are cheap and the others are not.

Who is responsible for the implementation of the e-Business Strategy?

Again, it would be myself and a collaboration between finance procurement and IT.

Are there any current initiatives or plans to be implemented within the next 12 months?

Our CERBS program is our role out of e-procurement across the European market, that's on the way in august. What I should say for all of our manufacturing facility so our direct material, purchase we have been for SAP house quite a long time now and what we moving to it is the same on indirect purchasing, so I am going for finishing good. We do have a couple of different strategies if you like; one that doesn't change much is manufacturing, and one that is more dynamic. Again, the other thing outside of the major program, 400 people work for that project team. So we reach the point where we have to decide on a market you know because our

business is evolving. You know the world is changing, you know China is not getting any smaller so there are no markets that come up in the Far East that emergent market organization that we are putting a lot of energy into as a result. The more you sell products in those countries the more you need a sophisticated purchase program, you know it's supporting their sales, those countries falling to my e-business strategies in terms of what I am going to replace, an older system and paper. Our system is not there at all, just an Excel spreadsheet or piece of paper at the moment.

Our e-procurement technology is a central part of the plan; it is core to some of the decisions. It is a very important capture of what the country does in the legislation but without a fairly robust IT or e-procurement technology to back that up is no way to run it. You can come up with e-business plan without knowledge.

Explain any major obstacles (if applicable) to supplying your goods and services through an e-Procurement system

The biggest one is the human factor. How does behaviour changed? They need for change management program internally to the company and externally, how do you change somebody's behaviour where all the focus on right I want to do the next drug and save somebody's life. And what are they focused on? They are not focused on the optimum way to purchase a good or material or for that the supplier them be paid so their actively working on this and they might easier for them to pick up that phone on the desk. I suppose to go in through what they may see as a long process and so there is big change in management factor that they understand by using this systems, they are less likely to create supply problems for manufacturing organization in 10 years, because they didn't do massive search in organization. I actually picked up the phone and picked the first name and then they got the pattern tip of the product rather than the generic one. That pattern supplier factory blows up in five years, and suddenly the product is out of stock and effectively the patient life service and that's one of the thing that little been different for GSK, because we will always be inpatient. If we run the maze buzz, you run the drug with the follow of new academic, so I blow up in Japan. Yes we are talking about people and their lives; that's why we are proud to work for the company. So big change management team both with our internal customers and also suppliers, suppliers may be very innovative. They might not have an email account. How do you support suppliers who they want to retain and board to e-procurement solution without your typical arrogant multinational organization? That's just how we are going to do it.

Do you currently trade through any form of electronic procurement or marketplace

(e.g. Ariba CSN, CommerceOne, MySAP.com, Oracle Exchange etc.)?

If so, state

- **names of customers involved**
- **names of marketplaces**

Yes, we utilize marketplace in certain category spend. So we have one got cyquest, that's for OLAP suppliers and R&D chemical and component that sits within our e-procurement solution. We have lots of different mini

Amazons if you like for different category spend. We have one for travel, for say somebody can go out, book hotel they want to stay in, a lot of seats inside the marketplace are pre-approved and prefer suppliers; in other cases, they are truly open markets so they use cyquest solution in some area is spend leverages just an open marketplaces

Others have closed marketplace or closed Amazon, and that really posed how effective it could be from negotiation start point to drive decisions.

What are the procurement processes in the organization?

We have a process called resource and group management, which is probably very similar to category management. This is a five-stage process from process initiation in terms of finding their need and doing general market analysis through continuing prove of what we are doing supplier management supplier relationship management. And we have the seats on top of that; these are resourcing program and our internal procurement technology program so what are the systems and tool they compare to support that process and again happy to send a quick sheet about it?

And how many admin people are involved in each?

So the admin of technology pushes the end user to requisition against the needs for an administrative procurement person. There are no central admin people to process in GSK across the globe you are not got procurement people that purely process the purchase order today. And that's global. What we do know is where the procurement operation center is compliant so you put an order through e-procurement solution, but have you make sure are in the same policies and one of the obvious policy is if you spending more than £100,000 worth of companies money through more competitive bids; hopefully, with the aid of a procurement organization, so that's one of the most obvious one. But there are also more checks, such as using preferred suppliers and approved vendors or what are the payment terms. But the reasons you are not talking about the organization is they are quite labour intensive and we are turning out of back of the fence. Massive sets of orders, you know people used to use Amazon at home so using technology solution at work is easier than identify an individual who is going to process that order.

Supervisor: So the operations of all the staffs are predominantly under control-led people?

Head of Global Resourcing and Procurement Technology: Yes, we do have operation centers, one in the UK one in the US. Those they are only market servicing in the US market and the UK market. The rest of the countries are more self-sufficient and they have some of the bigger markets. Like Jeremy, they have FTA; they are doing transaction procurement but largely it is an organization that commonly away with use of technology.

Which software vendors do you use to support the procurement process?

The large companies today use SAP, our biggest vender and our vendor of choice in the future. We utilize Ariba too at the moment for indirect spending in the US and UK. We have some home-grown system set up for pro-finance applications, some micro systems in places, and we have JD Edward. On the e-sourcing side, the

negotiation bits before we get to the kind of order phase we use for our outsourcing. So that's the decision we are using now and again.

How flexible they are?

Our software vendors: I think some of the larger one are less flexible now and probably for good reason. They get business stand point, they want to be supplying the product that is different for every single customer. So that's why they are not flexible; they are selling a vanilla, Microsoft is the good example. Richard's needs as a user and somebody else and GSK is fair because the more vanilla product the less risk there is. If we got very highly customized product the more chance there is that product somewhere out of the line eventually in the breaking or being actioned in a period of time. I think, on the other hand, that need sometimes slows how quickly you can implement the solution because of the country, and the process has to potentially tweak itself before being applied to the technology. And that's just I guess where other technology evolves. A lot of larger organizations are probably more customized in IT or solution in the past and have grown along with the IT vendors in question.

Which are the elements/components of the procurement system/software you use?

All of them.

Sara: Which one is more valuable than the others on the top?

I think the retinal investment is far easier to calculate for e-sourcing technology so the first auction, they are many companies run the software for five year. I think is far harder to ride a business case includes cost for e-procurement. Because you are on a journey and they are expensive, they definitely optimize it over the time providing you are not making lot of customization. You are not allowed to be more flexible if Ukraine standardization organization across multiple countries and processes that can obviously drive different synergies in terms of shared service centers dispread finance group. Obviously, there is some head count advantages in that or not larger service becomes. There is definitely some problem, the reason I said that is I think e-procurement value is added value. It is harder to find the softer side to it. Its synergies brings across the company. You know the data that froze to identify, they probably drive may be a procurement and saving or IT or finance saving. But it is not as obvious as easy running the first auction and did the 26 percent of saving.

Is your procurement system integrated with other systems of the company (with accounting system, database)?

Yes

How did you integrate the organization's information systems with supplier systems?

Head of Global Resourcing and Procurement Technology: Are you talking about people data?

Sara: Yes. It's quite wide as well; are you integrating with your new customer?

Head of Global Resourcing and Procurement Technology: By requirement, we just design the right way, we have single people database internal staff that obviously support the activity. We are trying to have a single vendor supplier file that's vendor master globally. We have companies that do parent-child tagging for use. Some of the smaller markets when you bring them to the large data look like an individual entities until they get classification done. You realize they are the part of IBM, because everybody is part of IBM. So there are a number of different initiatives, but there are many if you bring in new customers and your company is very much per customer.

Supervisor: That's quite challenging, because the organization is quite M&A based on the number of customer list they have.

Head of Global Resourcing and Procurement Technology: Yes, I mean there very few companies I have seen with perfect. Shell is and interesting one. But even they have simple, they are close to what utopia may be like.

What are the Electronic Procurement Tools the company adopted?

So that's the Mtoursim in terms of negotiation, the other tools that we have we obviously have contract management. We have number of tool s that we design and develop ourselves to project manage and capture our saving to manage risks. So we have mixture and I think, over time, if possible we have to reach SAP, because it's just SAP.

How flexible are these tools?

Very flexible as we build them ourselves whether or not and Mtourism. We have a smaller internal customer base; therefore, this drives flexibility so the system doesn't have to please, because SAP does this.

Have you implemented any sensor-based system? (e.g. RFID, EPC,ONS, temperature, movement)

(EPC: electronic product code, Sorting Item characteristics and movements)

(ONS: Object Name Service, Finding information within the network)

Assess some security issues concerning procurement.

There is a security issue. If we are just talking about somebody buying goods, we will make sure that we have ground authority to spend companies money; that's simply managed through the people system that I was talking about. We start talking about some of the, and also the finance systems depending on the category having approval group. So we have to buy certain things ourselves; other things, perhaps because they are radioactive, they would have to be. There is workflow within the tools which is why my manager needs to say yes. Also, the person globally responsible for being in radioactive needs to say yes. And then, obviously, outside of that where we are holding the contract, contract system that's not in our main file, requisition and finance systems. That's obviously a pass for protecting through central management.

Do you measure the performance of your procurement system?

Absolutely. When we started on this journey, we had a tennis player heading up the organization (Yan Yashly). We measure a lot of compliance and prefer supplier compliance to payment terms and users utilizing the system. We do the system on e-sourcing part. You know the negotiating side as well not action side so the strategic procurement warranty.

Supervisor: Does this flow back to regular meetings or its yearly check?

Head of Global Resourcing and Procurement Technology: It's daily. I can go know and see how it is going. Today most of our targets focus on top and are important to custom.

Supervisor: Do you have traffic light or dash boarding?

Head of Global Resourcing and Procurement Technology: Yes, we do something call smash board. We read green smile on face and we do gamble chart or word to further encourage looking at this. It's not just an industry report.

In your opinion, what is the future of e-procurement in next 5-10 years?

(a) The company.

(b) In general

I think you find the bigger technology houses, I do even more around the procurement and finance process there would be more and more module that bolt it, and a lot of companies will probably go down then so they have single, very much like Microsoft. When you create all documents you get a very large system that manages all of the data. With that comes transparency in everything. That's the journey GSK wants to take because of the nature of the GSK. It is impossible when we get there, because we have to stop acquiring companies, and we cannot do that.

Supervisor: So, I think standardization

I think we are and organization that is becoming thoroughly global. There is need for processes and systems to support globalization. That doesn't mean that just doing it in old traditional center, it means doing it everywhere. The voices across the world are coming pharma level rather than china, India, Japan or Australia you are actually doing is implementing. We have already done this within the UK and US. It is pharma collaboration across GSK globally in terms of what's the right answer so actually this take some stuff from Australia or Japan or China or India to ride or create the best process for GSK. And with that is you are not solving tiny little individual problems you are actually solving far wider for companywide problem rather than side issue. Some suppliers are not integrated, but they can't accept orders through their sales systems. The reason for considering flexible selecting process is that, according to the performance analysis, Pharma faces with more changes in future. So, we need to engage externally with more flexible suppliers.

Supervisor: Do you think the system will change to cope with countries like Peru, or will countries themselves change?

Head of Global Resourcing and Procurement Technology: I think it's a bit of both. Countries are more mature and I think there is less certainly in the market where we are. They were talking about growing populations or growing customer basis there becoming more mature so the gap is less, I think the technology is coming to need them. Are both wise? That's our technology roadmap where utopia would certainly be. You only have one hand and it does everything. Whether or not I believe that was happened is debatable and is only that good as when there is that can provide that utopia and at the moment their staffs are really good at, their staffs are also good at, that why we use other thing to outsourcing , and why we have got our own contract. But I think that brute culture start to move away because of the advantages of this signs systems, if you like.

Please indicate your future plans and approximate timescales for trading through electronic procurement.

I have a rolling three-year plan, anything on the plan is because the technology is moving so far, it is probably not worthy. So I am willing that what should we be looking at should be go more knish providers, should we go large provider, and then you are into the leveraging. And it's the transparency, well GSK is fairly mature on the e-sourcing and procurement side, so I think some of the other organizations you know be little be further back in the journey and that start to catch up become easier for GSK to start selling to supplier and customers too.

Interview 4- Procurement operation manager

With how many customers/suppliers (in total) do you currently use e-procurement to send/receive orders and payment?

I have to give you whole figure. At the last count I believe probably running out about 35,000 in total; there is very big spectrum there that our company may use very frequently, very high volumes right down to people that may only be use once annually, maybe not annually maybe per annually. So there is a mix and huge supply at the moment, 35,000 is probably around this figure for you. This is suppliers, the customers based in GSK, we had about 1200 different customers in the last quarter, so probably down to the thousand some will be the depict customers, probably about thousand customers in 3 months quarterly.

Can you receive orders via the following methods? Can you send invoices via the following methods?

We are currently in a transitional period. So we are actually using pretty much every method you could imagine at the moment. We have some suppliers that can only receive orders via post, which is very old-fashioned these days. And the majority still use faxes. We know also have the ability to e-delivery our POs as well. We are actually facilitating our e-invoicing platform. So we use an organization called OB10, in order to do our

invoicing, sort of additional benefit we got by going with them, we also starting deliver our purchase orders by that platform as well. Really, for the suppliers benefits cause the order filliping back straight to us. So it's easier to them to receive it in one platform to turning back to the same platform. So we are a bit of mix. Predominately I would say 95% of them via e-delivery. They go by auto-fax delivery. It's only by real hard quarter, still are paper based.

Are you able to accept payment through?

- **a purchasing card?**
- **a monthly-consolidated invoice?**

Yes, we use both types of purchasing cards. We use a physical card held by groups within the organization and they have got their own credit card details. We also use a version we call it guest card, where the card number is embedded in the order. We just go back again to e-procurement card. We also do some sort of purchasing on company credit card but they tend to be very specific section mostly travels accommodation to be honest with you. But the purchase of goods and service tends to be against either of any cards or purchase order.

Have you got a documented e-Business Strategy?

Yes, we probably do. We currently go to very transition to the entire organization globally. So that strategy there, I am not amazingly close to that at this time. The main reason is the UK roll out is quite further up the line yet. They currently rolling up the main to the east. They done very high level but I have not got any sort of detail strategy document of such.

It is very much a work in progress, but I think the overall business strategy procurement has probably is just re-updated within the last few months to be honest with you. We receive information from the top level of organization that actually changed our SAP roll out strategy. It was basically really, I mean digging the time line and the location where they are going to roll out to the UK was down sort of half way down the least to such. We actually move to the end of the list in order to get the roll up further in the future and it would be basically allow some of our market to come online a little bit faster and give them some level of a portal, e-commerce platform. The UK currently uses e-commerce and e-procurement, but it is not actually SAP, so it is a shuffle recently at the very top level. Consequently, we are waiting for the feed to come to us know and to understand the impact that actually make to us and what is going to change in our day-to-day, and how they move on strategy forward and dependably in future. Actually, we will be back in few months 18 months to be honest with depending on how they will roll out.

We have a number of levels so we actually have top level, which is obviously, be our board or our governments whereby they would make the high level decisions. This is beginning to cascade further down the organization to my direct line manager, Denise. She is actually roll out business planning, so we have business planning with each of procurement. So we are sort of working on cascade bases. So the strategy gets to divert from level of top down with each other and we are working down by strategy groups our own area over there, so you know we

are sorting out doing in bits and pieces and we also try to do it in conjunction our US colleagues as well, we work quite closely as an overall group so we try to keep strategy in line and try to do it in cemetery where we can do, here is no benefits that we are gain by, I am going to summarize the things we do to standardize the things we do to keep the delivery to the customer consistent, so we try to keep track of the supplier consistency as well.

What does it include?

- **initiatives/projects**
- **integration to existing systems**
- **level of financial commitment**
- **dedicated resources**
- **time-scales**

Are there any current initiatives or plans to be implemented within the next 12 months?

There are some, yes. We have really pushed our importing platform with being driving out 18 months now. But there should be push to finalize such and try to get up to 90% delivery of EPO's as well as to get those last few post EPO, so we actually target to end of this year in order to deliver that 90%. So that will be a bit of initiatives. There are also some other things that indirectly link us what we doing, things that can't work on capital program. This is the big deriving cost for GSK to reduce our working capital and deliver some benefits back in to the organization in catch. So we are currently deriving that. That's shaping little bit what we are doing, so again try to promote some of the suppliers to under professional payment terms, try to get people to use the approved suppliers little bit more because we know that's the best deal and best terms for GSK. So they are necessary strategies in such but they are just looping to what we do in day to day basis and direct impact on how we sort of approach are worked.

Are there any major obstacles (if applicable) to supplying your goods and services through an e-Procurement system

Hopefully not now. I think everything should be fine. There were no real major obstacles to be honest with you. Really some sort of transition, change, just educating our supplier about the changes which is going on to understand the reasons why have we done it, what also the benefits out of them, try to show the benefits in GSK is it the fact through having platform is benefit to them as well, or we can show them either reduction of the cost or speed up the time of the payments and orders and also the fact that they can also collect your orders in one place, you can get thing like feasibility doing , invoice payments date etc. it's really the whole package for the suppliers in order to give them multiple benefits, I mean trying to show them it's not going to gain if we are not moving to that e-platform. We have the suppliers that are not educated with the platforms, it's a nature of industry specially the one that we are work in, especially the fact that we are full of indirect space so its non-

production space and the turnover of the supplier is quit high specially at the low end of spend, so we find there are organization that did not heard an e-invoicing platform, they are quit small companies, just try to provide them the relevant information, educate them and show them what the benefits are. And they obviously getting to sign in and getting into the place that they can interact as efficiently as possible. I find sometimes it is an initial challenge; it tends to be wider on communication side of things rather than anything else. Normally, once we manage to get a conversation going, you can work out consistency reasonably easily, but we are not having any real big problem to be honest with you; very few people desist it completely.

Do you currently trade through any form of electronic procurement or marketplace?

We do indeed. Ariba is the platform we currently use. We also have the Ariba supply network attached to it. We currently use a purchasing tool and we are not using invoicing to anything else. What we have with regards to frontend procurement system which seat on core financial, so basically we utilize that in order again to try some of the platform and retake allergy so all of our credit card orders such the order that go down to that network because the suppliers have being attached to it for such a long time. And they all very familiar and also they had very good coverage of suppliers that we dealt with regularly on quit high volumes when we initiative roll it up. We use Ariba predominantly for 20% of our transactions and they will move on to the e-invoicing platform.

I would not say we don't have any issues. I think it's one of those situation where every company such the offer their sort of services does it owns unique away. So some of the suppliers for things like Ariba are quite happy to sign up if there were below, and very small volume because it's free. And as the volumes increase their charges increase as well. So we intend to find to get in to the end of sky, really big suppliers to happy to accept that based on the cost, because of the efficiency they get when they using the e-based platform. And then they get some of the smaller company who know they belong to hand reporting at the end of each year. There is not really being any cost involved. But it's some sort of middle ground I suppose where it could be a little bit advantage the fact that we are not big enough to lose the cost along the way but there could be big enough to cost associating with pushing at them with transaction along.

What are the procurement processes in the organization?

There are a few. Because of the multiple platform you end up having to run multiple processes as well. Predominantly, we ask that all goods and services are worldwide on the Ariba platform indirectly, so the majority will only come through one process. Basically, we work in what we regard as a self-servicing environment, so the customer is actually requesting to seat down the requisition itself. We have a number of tools within Ariba that help facilitate online catalogues etc. And basically customers put request for the thing they wish to order, if they order from one of the case approved suppliers we just let them go and go up to the door nobody looks at it. If they order against non-approved suppliers, it will actually stop with my team for review and will see whether we could source the item within the approved source. If there is lot of spend with this potential for negotiating discount or very set of terms, so we look at quit a lot of volumes of requisitions, trying to derive business down those derived loads to bit of the education that good for the customers, and we do let them do the majority of requisitioning, to be honest with you most of them go to the quite trouble through,

when you move away goods or services, we start to diverting to the different platform. We do have suppliers to provide things like travel, hotel accommodation, booking tools, to be use by other organization on that platform. So there were number of different way to get to the end and have an order, but predominantly should be ariba.

Supervisor: What does your typical customers look like?

One of the things within indirect space is within with anything which is not manufactured, within the company is biggest this, cover the huge manner of scopes so the guys who bumping here are all searching and developing scientist they are all biggest customer based. They tend to push out 80% of all the volume to our systems. And then we are going to other area such as corporate we have that consultant and financial planning, we had various other area as well, such as our consumer health division which may thing like looking to save our arena. So they are not regarded to our manufacturing plan types, but they still have manufacturing types of techniques, they need to sometimes they need to make sure that continuation of supply, and then we move on to other areas such as my pharmacy side of things again its very like our consumer. Whereby, they need to be on time and regular and good needs to be delivered, and things that come with them as well such as EDI, advertising pretty much everything comes through our process through our systems, and accommodating them are bit challenging, because people look at things pretty much in their own world, so it's a conversation that we have regularly, especially when we ask question about system improvement and development as soon as they put that up. What would you like to see? You know what scientist person would like to show you or corporate person would like to show you. So there would be a different end of the world. And they try to sort of accommodate that we can give sort of the platform that is user friendly but it's not tailored specifically to one group because its start to win favours to one group of customers then lose the other people on the other.

And how many admin people are involved in each?

When you say admin, do you mean admin in procurement perspectives? How many admin in procurement process we have to manage that?

I suppose if you count everybody including, myself the systems owner and the IT guys, I say it's around 20 who are responsible for the whole systems and all the processes within an interview systems.

We have a small group of IT guys to keep the system up and running. We also have a system owner and content owner, who deal with the physical system and make any improvements. The content owner is responsible for the catalogues and thing that help it in it. There is myself as the process owner that counterpart in the US we also process it we are going through it. We have few support staffs, my colleague is what in our terminology she is the buyer. Predominantly she negotiates deals, she is looking at thing in requisition basis, trying to get a better term for us. We also have a GSK-facing manager, so one of my colleague is one of what we called it P2P manager, so whatever from purchase to process he deals with customer base, what I do is sort of day to day requisition based, so we are sort of back-to-back organization; he looks after GSK and processes.

Which software vendors do you use to support the procurement process?

Which one don't we use? It's quite a lot to be honest with you. We tend to use some of the big ones, like most people do thoroughly those that set to this world. Our enhance IT guys are quite good, obviously the rate will be having place while purchasing software begin with the level of support there. So it's actually done by participant group within our space. But it's been moved out to SAP, which will change quite considerably when we start to move to level of support. We probably have number of people in organization that are familiar with that platform.

What are the elements/components of the procurement system/software you use?

I am not actually allowed to buy anything, so we facilitate these processes; we very rarely use them in procurement if I am honest with you. The majority of things we buy because we are bit of hybrid our organization the fact that I work for procurement but I work at R&D site so I benefit in working at R&D site. Somebody feels up our stationary covered, so we don't have any need to purchase that they contact local IT to get new screen new cable, where there are a lot of the other site that are not R&D, don't actually do that something which is help within R&D specific, you don't really need scientist to do some sort of things. So we are little bit lucky and little bit advantages to get little bit of both. But, if I was based somewhere like GSK house, some of those will be expected to do myself, so I do purchase my own stationary and IT accessories. And the other bits and pieces I will need consultancy, or various things like that.

Is your procurement system integrated with other systems of the company (with accounting system, database)?

Yes it is. It's integrated with our core financial systems, as well as I can be there is two different times, we work on JD Edwards core financial and so obviously still green screen system, still around for quite a long time. It is not as quite as leading system as something like Ariba, so we do have something like SAP. Ariba tends to be in our frontend and all of them feed the frontend our core financial system, its attached to our Ariba network as well in order to EPO and that better than far ago. This is not a lot of more within that try in to with the whole number of IT people so it's very straight forward at the moment. And again something that will change with implementing SAP.

How did you integrate the organizations' information systems with supplier systems?

A lot of them are integrated through third parties, so the good example is Ariba network where suppose whereby the suppliers have their own accounts, these sort of things and they can connecting it with their own SAP systems that tend to use, so most of our traffic is through them whether is the direct system the connection between two systems predominately needs to be very high volume very low value type of suppliers. There is not a huge amount on the other types of platforms, so I tend to use the invoicing platform; for example, we have not actually gone through an integrating solution, we are working on a web-based solution in that space. If I am honest with you, I don't think we will move towards an integrating solution until will see SAP. They will make decision when we are there. Integration was looked at that we weight it up as a possible solution to identify the potential suppliers for me. When we got into actual day-to-day intranet, the complexity got quite high some of

the supplier will be technologically-advanced enough to get actual integration of the money smoothly. So we felt the amount of benefit compare to the amount of work can't support what we need it for suppliers probably was not worthy in matter of time but it will be reviewed again probably in another year or 3months also.

What are the Electronic Procurement Tools the company adopted?

We have quite a few. We have a company platform; Ariba being the main one. We also use another organization called BTI for travel and hotel booking forms, so they basically provide our online environment. Whereby you can go on and pretty like price comparison sites and you can see different flight from different vendors, prices etc, then you can actually order flight from that platform, which supplier will go away and place those booking for us and we just see the e-ticket format of it. We do have a couple of others; we have an expense system. For example, any expenses you can claim for travel or expenditure or hotel or accommodation, you can order and claim through the system we call James. To be honest, I don't know who the provider is. They are actually multiple platforms within GSK, all of them predominantly electronic. We cannot use any paper based anymore depending on what you wants to order depending on platform you are going to use.

Assess some security issues concerning procurement.

No, it's one of the things that I never come across. I mean, I have been in this world for a reasonable amount of time, and I have never come across any security problem. Whenever we have a conversation with our suppliers, we are always pretty comfortable with the security. Not having problem that order have gone to the wrong supplier in e-platform, they have never un-encrypt the information we are supposed to have encrypted. So it's always very robust in that respect. I do not see anybody in supplier and customer sides, that had major challenges in that space.

Do you measure the performance of your procurement system?

When you say performance, do you mean volume and value perspectives rather than technology perspective? I can answer one part which is volume and value. Cause it take the logically probably outside my work, again that would probably be IT and our system owner as such, and I am sure they will order the performance that we have it on regular basis. I definitely keep track on the volume and value of orders, what is going through and the direct impact on my team. We always have couple of months when they start asking questions about what you have spent this year; how much those gone through from order; how much that is gone through against the credit card; and how much we sent out in the traditional way. We regularly capture the amount to spend the matter volume and what that sort of landscape look like in regard to how we issue those order how we receiving the payments back for those orders as well. Normally, we measure it quarterly, then we get to the end of the year item to provide a summary to my manager just for whole information and in case anybody else in the organization asks.

In your opinion, what is the future of e-procurement in next 5-10 years?

(a) The company.

(b) In general.

I think it's going to be in right direction to be honest with you. I think people are really waking up to e-procurement now; especially those who probably using it in their own lives rather than the office lives. It is much more regular now say to them the way we can buy it like Amazon or Ebay. I think people have become more comfortable with procurement as well. Where it will go is a good question as well. I think it's still little bit side loaded in some respect, it does not necessary integrate with some of those providers well its potentially could do. The Amazon itself doesn't need to integrate with the other one. They have such a lot customers anyway. So it should be looking at it in other way around if we could being attach to that getting something out of it even if necessarily through the network or e-procurement it's still web-based transactions. It still holds a lot of benefits and I think there is probably a little way to go for company it's starting to tapping some of those companies, we also suppliers have quite number of independent providers as well, and some of the integration between those I think are not existent or very difficult. There is still quit competitive with each other for some reasons. Being more friendly and overcoming fewer barriers

Please indicate your future plans and approximate timescales for trading through electronic procurement

I think our next step is to foresee our future with SAP. Hopefully, it will be a platform for GSK, which is obviously be a lot of changes for those who support this operations and also customer based as well, but will increase our leverage considerably. So we will have one place we could see all of our spending globally which, to be honest, would be varied from perspectives. It will help in contract and negotiations and deals so, again, it is going to be a huge jump forwards to actually start the real transparently and visibility what are procurement activities are on both strategic side and also the customer side as well, and also leverage information start to expend some of the deal that may not be in the UK. We may have somewhere else in the world whether they have deal overall and vise versa and become the whole global quickly it's a lot of benefit from that.

Flexibility issue?

I think they were some flexibilities there. I think some sort of due to our way of working. And the fact that we still have old core financial it does not really help It is not technologically-advanced enough to handle the platforms so I think again some challenges there regarding the different network that exist competition between those network. From the customer side, I think there are a few challenges some customers are very familiar with e-procurement and very comfortable with it, other customers still struggle with it, to go to the some of the process they have small problems. However, we are finding more people use a lot more catalogues so it is becoming the norm now. People are expecting to see online environment online catalogue, which is good. I think people are familiar with it and come down and also we look forward to the change. What we do internally as well, those who want to come down will get the move as well, we are currently doing some work whereby we are looking to go to one content aggregator so we got a bit slit in our catalogue whereby using punch out catalogue to supplier websites or a third-party contract aggregator. We also have an internal catalogue, and we are moving to our third-party aggregator. Again, this will encourage people a little more for one place to go, you just need to punch in the one search engine. Again, it makes the whole user interface experience easier. When

the people see it takes less than 10 minutes, when it was taking half an hour in the old-fashioned way, they start to become more engaged and use those platforms more.

Appendix F- Interview question (2)

The repertory grid technique was originally developed by George Kelly (1955), progenitor of personal construct theory. Rep Grid is designed to help explore experiences, events, processes, persons and objects in one's life world. Respondents are asked to elicit a set of processes in selecting suppliers. Note that the two options highlighted must be included as part of the element set. The process consists of identifying:

- **Elements** or various dimensions of similarity and distinction among specific examples of a given phenomenon – in this case '*supplier selection processes*'.
- One compares the elements according to where each fits along various **constructs** or continua between contrasting elements. The process of positioning elements along construct scales generates a single matrix known as a **repertory grid**, from which the term Rep Grid was derived.
- Collectively, the interrelationships among all constructs and elements represent a construction, a composite structure expressing the relative salience/significance, alignment, and covariance among the core dimensions of the phenomenon being explored" (Abrams & Meadows (2007) Microanalysis p. 94f).
- This process ends with the formulation of a construct, a polarity or continuum that should express experienced qualities rather than descriptive characteristics. Then all elements are ranked as related to the poles. Here on a scale from one to five, as related to the construct *affirmation vs. consolation*. (You may not know all elements, but I think you'll get the idea).

Step 1: Open Question- What processes do you go through when selecting and integrating new suppliers?
[Making sure this focuses also covers their EPM as well as generic suppliers]

Step 2: Rep Grid- Tell me the characteristics that make these process more flexible?

Step 3: In the next step, the elements (supplier selection process) are compared in triads (random set of three cards)

Step 4: Please rate all factors on a scale of 1 to 5 against the elicited construct.

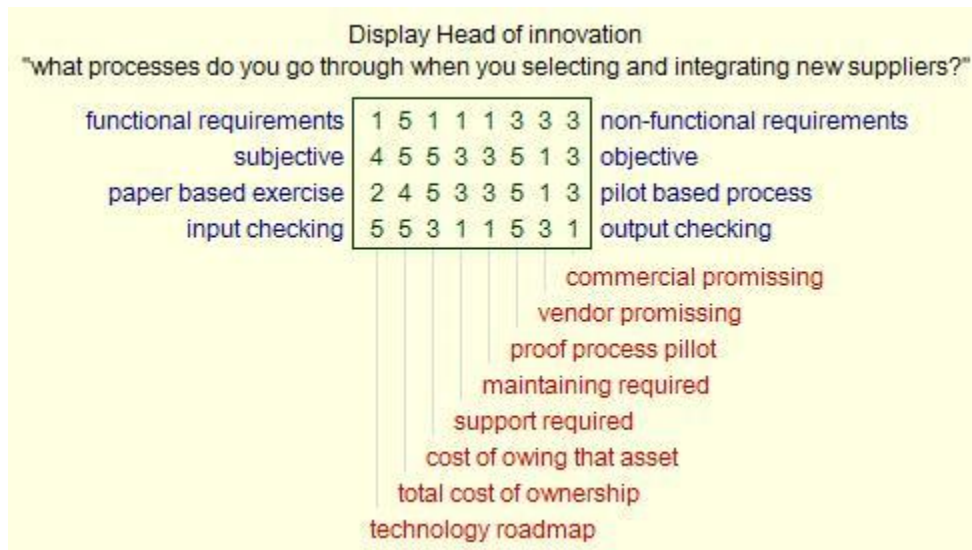
Appendix G- Interview transcription (Second set of interview- section 5.5)

Interview 1- Head of procurement (Pharma 1)		
Display Head of Procurement		
"What are the processes do you go through when selecting and integrating new suppliers?"		
Small amount of spend	4 4 3 3 5 3 3 3 4 5 4 3 2 3 2 4 4 3 3 4	Large amount of spend
Internal Risk	4 3 3 2 4 3 3 3 4 3 4 4 2 2 3 4 4 3 3 3	External Risk
Service providing	4 4 4 3 4 4 3 3 3 3 3 3 1 4 3 5 2 2 2 3	not providing service
Existing supplier	2 1 1 2 3 4 3 3 3 4 3 3 2 3 3 4 3 3 3 2	new supplier
Functional process	3 3 3 4 3 2 4 4 4 2 3 4 1 3 2 3 2 2 2 2	non-functional process
functional tool	4 3 2 4 4 4 1 1 4 3 3 2 1 1 2 2 2 2 2 2	Research based
external influence in Market	3 2 3 3 4 3 3 3 3 3 3 3 3 3 2 2 3 3 4 3	Broad influence on market
Influence factors	1 1 1 2 1 1 2 1 1 1 2 2 4 1 4 4 4 1 1 2	not deciding factor
external factors	4 1 1 1 1 1 3 3 1 1 2 1 1 2 1 1 3 1 1 1	internal view of organization
internal management	1 1 1 1 1 1 2 1 1 1 3 2 1 1 1 2 2 1 1 1	external management
internal negotiation	1 1 3 1 1 1 2 3 1 1 3 3 1 4 3 3 2 3 3 3	commercial negotiation
		Broad level spend
		Supplier ability to provide service
		Consistant service
		Trade process search
		Impact on organization
		Internet Search
		Negotiating with suppliers
		E-auction
		market evaluation
		Influence on market
		Value of stakeholder
		Short list suppliers
		Managing Risks
		Risk analysis
		negotiating with suppliers
		Long list suppliers
		Internal organization research
		Checking existing suppliers
		pre-experience with suppliers
		Understanding organization requirements

Interview 2- Head of procurement operations manager (Pharma 1)

Display Head of operation manager		
"what processes do you go through when selecting and integrating new supplier?"		
ESTABLISHING FINISHED PRODUCTS	5 3 2 4 3 5 5	FINISHED PRODUCTS
INFORMAL HAPPENING	5 2 2 4 3 2 3	FORMAL
EXTERNAL SUPPLIERS	3 3 2 2 2 1 1	NOT-HAPPENING
EXTERNAL INFO-UNDERSTANDING OF MARKET	1 3 3 2 2 3 2	INTERNAL SUPPLIERS
ENOUGH INFO	4 5 2 1 1 1 3	INTERNAL INFO
UNDERSTANDING OF INFO	1 3 2 1 1 2 3	NOT THAT MUCH INFO
PROCEEDING INFO	3 2 3 4 3 5 5	END RESULT INFO
EXTERNAL DETAIL INFO	3 1 1 1 2 5 5	DELIVERING INFO
SUPPLIER INPUT	2 4 2 1 2 2 1	HIGH LEVEL INFO
	4 5 2 1 1 1 3	REGARDING STAKEHOLDER
		NEGOTIATING FOR CONTRACT
		E-AUCTION
		RFI
		RFQ
		INVESTIGATING MARKET
		INTERNAL BUSINESS CUSTOMER
		SOURCING STRATEGY

Interview 3- Global director of innovation (Pharma 1)



Interview 5- Director, Head of Hub Northern Europe (Pharma 2)

Display Director, Head of Hub Northern Europe	
External	5 5 5 4 5 2 1 1 4 4 5 5 1 1 1 5 1 3 3 5 5 4 4
Balance project team	4 5 5 5 3 3 3 4 4 4 4 4 3 4 4 1 4 4 4 3 4 4
Demand management-outcome of discussion	1 1 1 1 1 3 3 3 3 3 1 1 3 1 3 3 3 1 3 3 1 1 1
Emotional evaluation	2 2 2 2 5 3 3 2 5 5 5 5 4 4 2 3 4 4 4 3 4 2 3
interpreting internal requirements	2 2 2 2 1 3 3 3 1 1 2 1 3 4 3 3 3 2 5 4 2 5 5
Managing demand	2 2 2 2 1 3 3 3 1 2 1 2 5 5 5 5 3 1 5 4 5 1 1
Evaluating suppliers	1 1 1 1 1 4 4 5 1 1 1 3 2 2 5 5 1 5 1 3 1 1 1
Scope of project	? 1 1 1 1 2 5 5 5 2 2 5 5 5 5 4 4 4 4 4 4 4 4
evaluating not potential	1 1 1 1 1 1 5 5 3 1 1 5 5 5 4 1 5 3 5 5 3 5 5
Internal	
Compliment project scope	
external outcome	
Logical evaluation	
interpreting external requirements	
Managing offers	
RFQ getting answers	
Not have any scope	
evaluating potential	
Capacity of suppliers	
Quality of service of suppliers	
Route based Info	
evaluating suppliers	
price and service evaluation	
RFQ	
Supplier Financial assessment	
Project Team	
Professional References	
comparing business models	
Comparing price	
Comparing criteria	
Identifying goal	
Identifying driver	
Decision Making	
Comparison (web, newspaper)	
Market Research	
Type of suppliers looking at	
Managing demand	
Type of service looking for	
Create charter of project	
Scope of process	
Understanding of business process	

Interview 6- Procurement Manager (Pharma 2)

Display Procurement Manager

Identifying potential supplier	2	2	1	2	2	3	3	2	1	1	2	2	1	1	1	2	3	2	2	not potential suppliers
Identifying realistic price	3	2	4	2	1	3	3	2	3	2	2	2	2	3	2	1	1	3	2	not actual price
Initial supplier selection process	2	2	2	1	1	4	4	2	1	2	3	1	1	1	1	3	3	1	4	End of supplier selection process
Checking number of supplier	2	2	2	1	2	4	3	2	2	4	2	2	4	2	2	5	4	2	4	Inviting for proposal
Pre-experience in market evaluation	2	2	3	2	4	5	4	1	2	3	3	3	4	2	2	3	3	2	4	Risk evaluation supplier
Process of engaging with requirements	1	4	3	3	3	2	3	3	3	4	2	4	4	1	2	3	4	2	4	Process of selecting criteria
Core competencies-deliverables and services	1	1	1	2	3	3	4	1	2	3	2	2	1	2	3	3	3	3	1	adds on process
checking Similar value	3	4	3	2	3	2	4	2	3	3	3	4	2	2	2	3	3	3	1	Different value
Understand inital knowledge of supplier	2	4	2	2	4	4	4	3	1	3	5	3	5	5	2	3	3	2	5	Final selection of suppliers

- Deliverables
- Marketplace search
- Quote from suppliers
- Price checking
- Market search
- Work with stakeholders define requirements
- Supplier selection
- Requirement checking
- Uniqueness
- RFQ
- Checking available suppliers
- Experience and previous work
- Effect on organization
- Off-set risks
- Tender Process
- Criteria They set for that requirements
- Evaluate suppliers
- Core competencies
- Initial Requirements

Appendix H- Tweetcatcher 2 software structure

Over the web: Tweetcatcher 2

Download collected Tweets with SentiStrength

Next scheduled run time

Currently running query (Green)

Historic queries (Red)

Halt running query (in green)

Enter the search term(s) Users can build up to 5 search terms and 4 operators

Click to see IE9 RSS Feed

Other activated queries for user

Advanced queries are also supported

Query	Start Date	End Date	Tweets Filename	Tweets Filename with Senti-Strength	Status	Efficient in Bytes	Tweets Collected
mrna AND (lung OR sarcoma)	2012-09-07 10:40:14	---	---	---	Running at 12:00:00	114872	893
mrna AND (lung OR sarcoma)	2012-09-10 10:40:14	---	---	---	Completed	0	0
mrna AND ecoli	2012-09-07 16:03:40	2012-09-07 16:03:40	---	---	Completed	0	0
mrna	2012-09-07 13:34:26	2012-09-07 16:03:40	---	---	Completed	0	0

Other Activated TC2 Queries for user: huan.bonaydke@gmail.com

- Running "local government"
- Running parkinson AND disease job jobs

Passed parameters are: QT 159 mrna AND ecoli

The query to search for **mrna AND ecoli** has been successfully scheduled.

Want to see a sample Twitter output using an RSS Reader?
 If you are using IE 9.8 you can see a sample Twitter output by following this link.
 Alternatively, copy and paste the RAW link into your RSS Reader:
<http://search.twitter.com/search.atom?pp=100&lang=en&page=1&q=mrna+AND+ecoli+since%3A2012-09-06+until%3A2012-09-07>

TC 2 acknowledges a successful scheduled search

Query Preview? See what you will get from Twitter, if using IE 9

Cut and paste into popular Google Reader to view feed

Brunel UNIVERSITY LONDON

Over the web: Tweetcatcher 2



- 1) Timestamp
- 2) User Handle
- 3) Tweet
- 4) Unique ID
- 5) Users Name
- 6) Followers
- 7) Following
- 8) Public Lists
- 9) Time Zone
- 10) Geo Coordinates
- 11) User Tweets
- 12) Retweet Count
- 13) Expanded Links
- 14) Senti_Positive
- 15) Senti_Negative
- 16) Senti_Scale 14) – 15)

Only available in
SentiStrength DOWNLOAD

TheIwall et al. (2010)