FACTORS AFFECTING THE EXTENT OF E-PROCUREMENT USE IN SMALL AND MEDIUM ENTERPRISES IN NEW ZEALAND

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ABSTRACT

Organisations practicing e-procurement rely on a range of information technologies to facilitate contracting and purchasing. Even though e-procurement is widely in use, factors shaping the use of e-procurement are poorly understood, because the existing studies relied on limited models of e-procurement practice. In particular, none of the studies took into account both the range of e-procurement functionalities used (breadth of e-procurement use) and the extent to which an organisation relies on e-procurement (depth of e-procurement use). Therefore, the purpose of my study was (a) to extend the existing measures of the extent of e-procurement use to better account for the richness of the existing practice, and (b) to examine the main factors affecting the extent of e-procurement use.

An explanatory model of the extent of e-procurement use was formulated by conceptualising the extent of use as a two-dimensional construct comprising the dimensions of breadth and depth. The factors hypothesised to affect the breadth and the depth of e-procurement use were derived based on technology-organisation-environment (TOE) framework and diffusion of innovation (DOI) theory as well as on prior empirical studies of e-procurement adoption and use within an organisation. The factors from the technological context were relative advantage, compatibility, and complexity; from the organisational context, top management support and employee knowledge; and from the environmental context, partner readiness and external pressure.

The model was tested against quantitative data obtained in a survey of 1,000 small and medium enterprises (SMEs) in the manufacturing industry in New Zealand. The response rate was 15%. Structural equation modelling was used to test the model. Qualitative data obtained in a series of follow-up interviews and in the survey were analysed via constant comparative method. Qualitative results were used to help interpret the quantitative findings.

The model explained 39% of variance in the breadth of e-procurement use and 32% of variance in the depth of e-procurement use. Of the technological factors, relative advantage affected the breadth of e-procurement use (β = .26) and compatibility affected the depth of e-procurement use (β = .33). An environmental factor, external pressure, affected the breadth of e-procurement use (β = .37). None of the factors from the organisational context of TOE framework had effect.

Findings suggest that the breadth and the depth of e-procurement use are affected by different factors and, thus, lend support to conceptualising the extent of e-procurement use as a two-dimensional construct. However, the support for using DOI theory in context of explaining e-procurement use was mixed; of the three factors derived from DOI theory, relative advantage, compatibility, and complexity, only relative advantage and compatibility had effect.

Keywords: *E-Procurement, TOE Framework, DOI Theory, SMEs, New Zealand.*

DEDICATION

I dedicate this thesis to my late father, Hassan Saad, 1932–2010, who gave me his continuous support until his last breath but had no opportunity to see me complete this study.

I dedicate this thesis to my mother, Mariam Ismail, for her support, prayers, patience, and encouragement.

This journey would not have been possible without you both.

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LIST OF ABBREVIATIONS

AVE	:	Average variance extracted
B2B	:	Business-to-business
CFA	:	Confirmatory factor analysis
CFI	:	Comparative fit index
DOI	:	Diffusion of innovation
EDI	:	Electronic data interchange
EFA	:	Exploratory factor analysis
ERP	:	Enterprise resource planning
ICT	:	Information and communication technology
InterOS	:	Inter-organisational information systems
IntraOS	:	Intra-organisational information systems
MIS	:	Management information systems
MRO	:	Maintenance, repair, and operating
NAPM	:	National Association of Purchasing Management
PLS	:	Partial least squares
RBV	:	Resource-based view
RMSEA	:	Root mean square error of approximation
SEM	:	Structural equation modelling
SME	:	Small and medium enterprise
SRMR	:	Standardised root mean square residual
TLI	:	Tucker-Lewis index
TOE	:	Technology-organisation-environment
WWW	:	World Wide Web

LIST OF PUBLICATIONS

Conference abstracts and conference proceedings papers published in conjunction with my study.

Conference Abstracts

Hassan, H., Tretiakov, A., & Whiddett, D. (2010). *The extent of e-procurement adoption in New Zealand: An integrated model.* Paper presented at The Inaugural New Zealand Information Systems Doctoral Conference (NZISDC), Auckland, New Zealand.

Hassan, H., Tretiakov, A., & Whiddett, D. (2011). *Extent of e-procurement usage: An empirical study of small and medium sized New Zealand businesses.* Paper presented at the 2011 New Zealand Information Systems Doctoral Conference (NZISDC 2011), Wellington, New Zealand.

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Conference Proceedings Papers

Hassan, H., Tretiakov, A., & Whiddett, D. (2010). Extent of adoption as opposed to adoption: Case of e-procurement. *Proceedings of the 21st Australasian Conference on Information Systems (ACIS 2010)*, Brisbane, Australia.

Hassan, H., Whiddett, D., & Tretiakov, A. (2010). Public B2B e-marketplaces: Functions, trends, and participation by New Zealand organisations. *Proceedings of the 24th Annual Australian and New Zealand Academy of Management (ANZAM 2010)*, Adelaide, Australia.

Hassan, H., Tretiakov, A., & Whiddett, D. (2011). Extent of e-procurement usage: An empirical study of small and medium sized New Zealand manufacturing businesses. *Proceedings of the 22nd Australasian Conference on Information Systems (ACIS 2011)*, Sydney, Australia.

CHAPTER 1 INTRODUCTION

This is a study of the extent of e-procurement use at small and medium enterprises (SMEs) in New Zealand. The purpose of the study is (a) to extend the existing measures of the extent of e-procurement use to better account for the richness of the existing practice, and (b) to examine the main factors affecting the extent of e-procurement use.

1.1 Background of the Study

Procurement is a process in which organisations establish agreements for the acquisition of goods or services (contracting) or purchase goods or services in exchange for payment (purchasing) (Robinson, Wale, & Dickson, 2010; Rolstadas, Hetland, Jergeas, & Westney, 2011). E-procurement is the use of information technology in the procurement process (Abu-Elsamen, Chakraborty, & Warren, 2010; Garrido, Gutierrez, & Jose, 2008; Gunasekaran & Ngai, 2008; Muffato & Payaro, 2004). E-procurement enables companies to reduce business costs (Gunasekaran & Ngai, 2008), to reduce purchasing time (Lefebvre, Lefebvre, Elia, & Boeck, 2005), to streamline purchasing processes (Teo, Lin, & Lai, 2009), and to access wider markets (Gunasekaran, McGaughey, Ngai, & Rai, 2009) (see section 2.4.2 for a more detailed discussion of e-procurement benefits).

The technologies enabling e-procurement range from commonly available communication tools, such as e-mail, to complex systems, such as e-marketplaces or enterprise resource planning (ERP) systems (Abu-Elsamen et al., 2010; Gunasekaran et al., 2009; Teo et al., 2009; Trkman & McCormack, 2010). E-procurement may involve a diverse range of functionalities, such as searching for suppliers of goods and services by using general or specialised search engines (Teo et al., 2009), communicating with sellers via e-mail (Teo et al., 2009), providing online information about product specifications that suppliers must meet (Wu, Zsidisin, & Ross, 2007), placing orders via e-catalogues (Lefebvre et al., 2005), and making payments to suppliers electronically (Lefebvre et al., 2005) (see section 4.3.6.1 for a more detailed discussion of e-procurement functionalities).

Organisations differ in the extent to which they use e-procurement, both in terms of the range of the functionalities used (the breadth of e-procurement use) and in terms of how much the organisation relies on e-procurement (the depth of e-procurement use). By conceptualising the practice of technology use in terms of breadth and depth, one can parsimoniously represent the state of the practice and define measures that can be used to test hypotheses relating to factors affecting the practice (Zhu & Kraemer, 2005).

Most of the e-procurement functionalities can be seen either as primarily facilitating information or as primarily facilitating transactions (Beldona, Morrison, & O'Leary, 2005). Thus, e-procurement can be viewed from two main perspectives: facilitating information and facilitating transactions. It is common to describe e-procurement functionalities in terms of supporting different forms of e-procurement, such as e-informing (Boer, Harink, & Heijboer, 2002) or e-catalogues (Schoenherr & Tummala, 2007). In section 2.3, I summarise the literature by listing the main forms of e-procurement and by relating them to different perspectives of e-procurement. The information perspective is represented by e-sourcing (searching for suppliers), e-collaboration (communicating with suppliers), and e-informing (informing suppliers about the requirements). The transaction perspective is represented by e-catalogues (purchasing online), e-tenders (inviting offers from suppliers), e-auctions (bidding online), intra-organisational information systems (IntraOS) (information systems offering access to a centrally controlled procurement process throughout an organisation), and inter-organisational information systems (InterOS) (integration with the suppliers via inter-organisational information systems) (see Figure 2-1 in section 2.3 for a descriptive model of forms of e-procurement).

1.2 Problem Statement

Even though e-procurement is a complex practice, a number of studies simplified the representation of the state of e-procurement in an organisation to a binary measure (in the narrow meaning of the term *adoption*, as existence of e-procurement use, rather than as the process leading to use). For example, in their survey of large organisations in multiple industries in Portugal, Soares-Aguiar and Palma-dos-Reis

(2008) asked the respondents to indicate whether they used e-procurement or not within their organisation. In my view, different respondents are likely to have a different concept of what constitutes e-procurement and, thus, the validity of research relying on such a binary measure is in question. The binary measure does not capture salient variations in organisational behaviour with respect to information technology (Ramamurthy, Premkumar, & Crum, 1999; Tornatzky & Klein, 1982; Zhu, Dong, Xu, & Kraemer, 2006). Conversely, descriptive studies of e-procurement practice (such as the study by Lefebvre et al., 2005) presented the practice of e-procurement in much detail.

Even though some of the studies attempting to explain the extent of e-procurement use by organisations used representations of e-procurement practice that are more detailed than a binary measure (see, for example, Pearcy, Parker, & Giunipero, 2008; Wu et al., 2007), these studies covered only a subset of the e-procurement functionalities covered by Lefebvre et al. (2005). For example, Wu et al. (2007) covered some of the functionalities relating to e-sourcing, e-informing, and InterOS, but did not include any functionalities specific to e-collaboration, e-catalogue, e-tender, e-auction, or IntraOS (the study by Wu et al., 2007, is reviewed in detail in section 2.7.4). Pearcy et al. (2008) included some of the functionalities relating to e-sourcing, e-collaboration, e-catalogue, and InterOS, but did not include any functionalities specific to e-informing, e-tender, e-auction, and IntraOS (the study by Pearcy et al. is reviewed in detail in section 2.7.4).

Thus, the existing explanatory studies of e-procurement use relied on limited models of e-procurement practice. In particular (according to the literature review, see Chapter 2), the main forms of e-procurement relating to information and transaction perspectives were never covered together, in a single study (see the discussion in section 2.4.1).

The only study that considered both the use of e-procurement functionalities and the depth of e-procurement use (according to the literature review presented in Chapter 2), the study by Batenburg (2007), did not conceptualise the breadth of e-procurement use as a single construct, but treated the use of individual functionalities

as separate variables (an approach leading to results that are difficult to interpret, particularly when a broad range of functionalities is covered, see the criticism in section 2.7.3). None of the explanatory studies that included the construct of breadth of e-procurement use also included the construct of depth of e-procurement use (see Table 2-9 in section 2.7 for details of the explanatory studies). Thus, prior research provides no evidence whether breadth of e-procurement use and depth of e-procurement use are affected by the same factors in the same way, are affected by the same factors in different ways, or are affected by different factors.

E-procurement differs from most other uses of information technology by organisations in that it occurs in a particularly complex context: e-procurement practice is shaped not only by the technological and organisational aspects but also by the inter-organisational environment (see Figure 1-1 for a diagram depicting the contexts of e-procurement). E-procurement is the use of information technology by an organisation to facilitate the acquisition of goods or services. Thus, the suppliers of goods and services (part of the organisation's external environment) contribute to shaping the e-procurement practice within the organisation. However, none of the existing explanatory studies of e-procurement functionalities used by organisations covered all of the three aspects of e-procurement context: technology, organisation, and external environment (see Table 2-9 in section 2.7 for details of the explanatory studies). For example, Wu et al. (2007), in a survey of companies in multiple industries in the US, considered factors from the organisational (top management support and organisational learning ability) and environmental (normative pressures) contexts only (the study by Wu et al., 2007, is reviewed in detail in section 2.7.4). Likewise, Pearcy et al. (2008), in a survey of companies in multiple industries in the US, considered the organisational context only (the study by Pearcy et al. is reviewed in detail in section 2.7.4). Thus, the existing explanatory studies relied on limited models of e-procurement context. In particular, none of the studies considered all three main e-procurement contexts (technology, organisation, and environment) at the same time.

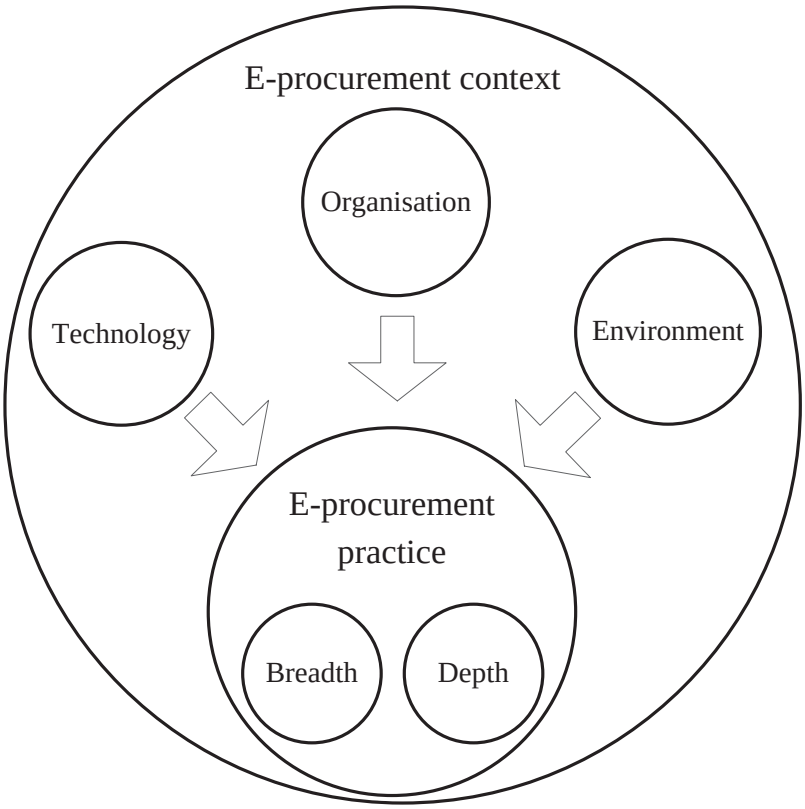

Figure 1-1. Main contexts of e-procurement.

To understand how the extent of e-procurement use is shaped by e-procurement context, one has to consider all of the essential aspects of e-procurement practice and all of the essential aspects of e-procurement context in a single model. In particular, to compare the effects of the main factors affecting the extent of e-procurement use, one has to include the factors in the same model. Moreover, one has to capture in the model all of the essential aspects of e-procurement practice.

1.3 Research Questions

Based on the problem definition introduced in section 1.2, the research questions for my study are stated as follows:

1. How can the existing measures of the extent of e-procurement use be extended to better account for the richness of the existing practice?

2. What are the main factors affecting the breadth and the depth of e-procurement use?

To address the first research question, I conceptualised the extent of e-procurement use as a two-dimensional construct, with the dimensions of breadth of e-procurement use and depth of e-procurement use. I extended the existing measures of breadth of e-procurement use to include a broader range of functionalities, to achieve a better coverage of both information and transaction perspectives of e-procurement.

To address the second research question, I formulated a structural model involving technological, organisational, and environmental factors affecting the extent of e-procurement use.

To test the structural model (along with the extended measure of breadth of e-procurement use), I conducted a survey of SMEs in manufacturing industry in New Zealand and analysed the data via structural equation modelling (SEM). Further, to gain insights into how the factors found to have effect manifest in practice, I analysed qualitative data obtained in the survey and in a series of follow-up interviews with SME managers. A summary of the research procedures is presented in section 1.5.

1.4 Theoretical Foundation of the Study

Following the work by Zhu and Kraemer (2005) on the extent of use of e-business, I conceptualised the extent of e-procurement use as breadth (reflecting the range of e-procurement functionalities used) and depth (the extent to which an organisation relies on e-procurement).

The factors in the research model (the independent variables hypothesised to affect breadth and depth of e-procurement use) were derived based on technology-organisation-environment (TOE) framework and diffusion of innovation (DOI) theory, as well as on the existing empirical studies of e-procurement adoption and use. TOE framework and DOI theory are discussed in detail in section 2.6.

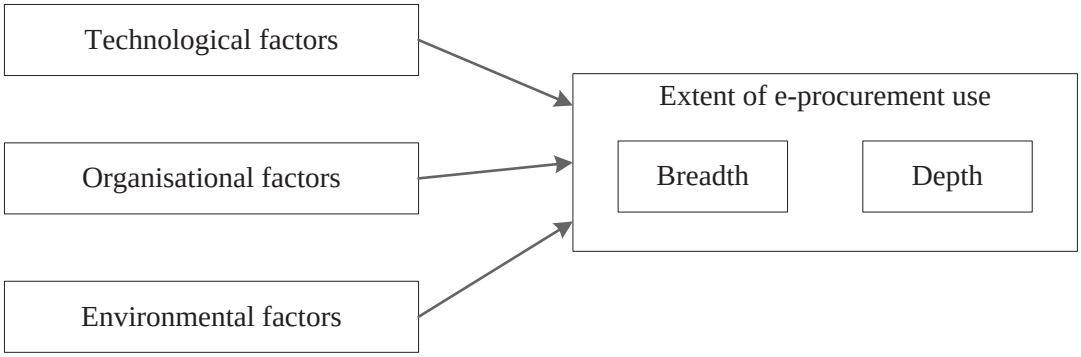

Figure 1-2. High-level research model. The detailed research model is given in Figure 3-1.

An outline of the research model is given in Figure 1-2, and the detailed, full research model is given in Figure 3-1 in Chapter 3. The division of factors into technological, organisational, and environmental contexts was motivated by TOE framework; the technological factors were relative advantage, compatibility, and complexity, motivated by DOI theory. Factors from all of the three contexts of TOE framework that were used in my study are introduced in detail in section 3.4.

1.5 Summary of the Research Method

To measure the extent of e-procurement use, I relied on the measure formulated by Zhu and Kraemer (2005) for e-business, and adapted it for e-procurement based on the prior studies of e-procurement practice, such as the study by Lefebvre et al. (2005).

To measure the factors hypothesised to affect the extent of e-procurement use (see the research model in Figure 1-2), I adopted measures from prior empirical research of technology adoption and use, slightly rewording some of the items to fit the context of e-procurement use.

To test the research model, I collected data from the managers of SMEs in manufacturing industry in New Zealand. Along with the items measuring the extent of e-procurement use and items measuring the factors hypothesised to affect the extent of e-procurement use, the questionnaire included open-ended questions asking

the respondents to comment on their responses. The questionnaire also asked the respondents if they might be available to participate in in-depth follow-up interviews.

The model was tested against the data by using SEM. To understand better the reasons behind the relationships found to be statistically significant, I conducted a series of in-depth follow-up semi-structured interviews with the survey respondents who indicated that they agreed to be interviewed. The interview transcripts, along with the free-form comments provided by the respondents, were treated as qualitative data, and constant comparative method was used to obtain further insights.

The research methods and procedures are discussed in detail in Chapter 4.

1.6 Definitions of Key Terms

The definitions of the key terms used in my study, including terms relating to e-procurement technology, dimensions of the extent of e-procurement use, factors potentially affecting the extent of e-procurement use, the population of the study, and the research methods used are presented in this section.

Breadth of e-procurement use. The extent to which an organisation takes advantage of the variety of e-procurement functionalities available (Zhu & Kraemer, 2005).

Compatibility. The extent to which e-procurement is perceived by the organisation as being consistent with the organisation's preferred work style, existing work practices, prior experience, and values (Karahanna, Agarwal, & Angst, 2006).

Complexity. The extent to which e-procurement is perceived by the organisation as being difficult to understand and use (Rogers, 2003).

Depth of e-procurement use. The extent to which an organisation relies on e-procurement (Zhu & Kraemer, 2005).

E-procurement. The use of information technology in the procurement process (Abu-Elsamen et al., 2010; Garrido et al., 2008; Gunasekaran & Ngai, 2008; Muffato & Payaro, 2004).

Employee knowledge. Employees' knowledge relevant to e-procurement (Soares-Aguiar & Palma-dos-Reis, 2008).

Environmental context. The external environment in which the organisation conducts its business, including other organisations it interacts with and the relevant standards and regulations (Teo et al., 2009; Tornatzky & Fleischer, 1990).

Extent of e-procurement use. The extent to which the organisation uses e-procurement (Teo et al., 2009). In my study, the extent of e-procurement use is represented by two dimensions: breadth of e-procurement use and depth of e-procurement use.

External pressure. Pressure to use e-procurement exerted by other organisations in the organisation's external environment that already use e-procurement (Joo & Kim, 2004).

Factor. This term is used in two unrelated meanings: (a) an independent variable hypothesised to affect a target dependent variable (synonymous with *independent variable* or *determiner*) and (b) a statistical term, factor in exploratory or confirmatory factor analysis. To avoid confusion, when discussing factor analysis I use the terms *independent variable* or *determiner* to denote the meaning (a).

Mixed-method. Research method integrating both quantitative and qualitative research techniques into a single study (Johnson & Onwuegbuzie, 2004).

Organisational context. Organisation's scope, size, amount of slack resources available internally, or other internal aspects of the organisation (Tornatzky & Fleischer, 1990; Zhu & Kraemer, 2005).

Partner readiness. The degree to which the customers and suppliers of the organisation are willing and ready to conduct their business with the organisation electronically (Barua, Konana, Whinston, & Yin, 2004) and have the systems in place to conduct transactions on the Internet platform (Zhu, Dong, Xu, et al., 2006).

Procurement. A process in which organisations establish agreements for the acquisition of goods or services (contracting) or purchase goods or services in exchange for payment (purchasing) (Robinson et al., 2010; Rolstadas et al., 2011).

Relative advantage. The extent to which the use of e-procurement is perceived by the organisation to offer advantages (Rogers, 2003).

SME. Business that employs from 6 to 99 full-time equivalents (New Zealand Centre for SME Research, 2010).

Technology adoption. I follow the common practice (pointed out by Greenhalgh, Robert, MacFarlane, Bate, & Kyriakidou, 2004) of using the term adoption in two related meanings, as a process leading to technology use and as the existence of use (and thus, as a binary variable describing the status of use in the simplest possible way). The exact meaning implied is clear from the context.

Technological context. The perceptions at the organisation of the existing technologies in use within the organisation and of new technologies relevant to the organisation (Tornatzky & Fleischer, 1990; Zhu, Kraemer, & Xu, 2006).

Top management support. The extent of commitment and resource support given by the top management (Premkumar, 2003).

1.7 Significance of the Study

My study contributes to theory by conceptualising the extent of e-procurement use as a two-dimensional construct with the dimensions of breadth and depth of e-procurement use. The new conceptualisation is used as a basis for formulating a structural model that explains the extent of e-procurement use, and the structural

model is tested against empirical data. The two-dimensional conceptualisation offers a richer (and yet, still parsimonious) representation of e-procurement practice. My study results in better understanding of factors shaping e-procurement practice because factors affecting breadth of e-procurement use are differentiated from factors affecting depth of e-procurement use.

Better understanding of factors shaping e-procurement practice is of relevance to SME managers (as it contributes to better understanding of their competitive environment), to e-procurement software vendors (as it offers insights into the extent and the nature of potential demand for their services), and to the relevant regulatory bodies (as it informs their understanding of how one can influence the state of e-procurement use).

1.8 Delimitations of the Study

My study followed the studies by Batenburg (2007), Min and Galle (2003), Pearcy et al. (2008), Soares-Aguiar and Palma-dos-Reis (2008), Teo et al. (2009), and Wu et al. (2007) in relying on a broad interpretation of e-procurement, inclusive of the uses of commonly available technology to facilitate procurement. Moreover, the data used to test the research model were collected from SMEs; large organisations (with sufficient resources to implement sophisticated dedicated e-procurement systems) were not covered. Dedicated e-procurement systems involving direct technology integration between organisations (InterOS) and dedicated e-procurement systems offering access to a centrally controlled procurement process throughout an organisation (IntraOS) were covered by the study but were not in widespread use by the participants; my study did not explicitly focus on such systems.

1.9 Structure of the Dissertation

The thesis is structured as follows. Chapter 1 presents the background of the study, the problem to be addressed, and the overall theoretical framework. Chapter 2 presents a literature review covering descriptive and explanatory studies of e-procurement adoption and use, as well as theories relevant to explaining technology adoption and use by organisations. Chapter 3 introduces the research model, which

was based on TOE framework, DOI theory, and on the results of prior explanatory studies of e-procurement adoption and use. The research model explains breadth and depth of e-procurement use. Chapter 4 introduces the research method. The research method involved analysing quantitative and qualitative data obtained from manufacturing SMEs in New Zealand using a cross-sectional survey and a series of interviews. Chapter 5 presents the findings, including the outcomes of hypotheses testing (based on quantitative data) and the interpretation of qualitative data. Chapter 6 concludes the thesis by discussing the implications of the findings and by explicitly stating the contributions of the study.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review. First, alternative definitions of e-procurement are presented, and the definition used in my study is introduced and justified. Then, the forms of e-procurement suggested by the literature are summarised as a descriptive model; descriptive studies of e-procurement use by organisations are presented in terms of the model. To detail the theoretical foundation of my study (introduced in section 1.4), theories and theoretical frameworks explaining information systems adoption and use are presented, along with examples of their use. The chapter concludes by introducing the existing studies of factors determining e-procurement (and related technologies) adoption and extent use and by briefly discussing the specifics of SMEs.

2.2 Definitions of E-Procurement

As introduced in section 1.1, procurement refers to a process in which organisations establish agreements for the acquisition of goods or services (contracting) or purchase goods or services in exchange for payment (purchasing) (Robinson et al., 2010; Rolstadas et al., 2011). E-procurement refers to the use of information technology in the procurement process (Abu-Elsamen et al., 2010; Garrido et al., 2008; Gunasekaran & Ngai, 2008; Muffato & Payaro, 2004). A review of e-procurement literature by Schoenherr and Tummala (2007) found that there was no generally accepted definition of e-procurement.

Harrigan, Boyd, Ramsey, and Ibbotson (2008) and Min and Galle (2003) defined e-procurement as a business-to-business (B2B) purchasing practice that utilises e-commerce or Internet-based technologies to identify potential sources of supply, purchase goods and services, transfer payments, and interact with suppliers. Gunasekaran et al. (2009) defined e-procurement as the use of integrated information technology systems for procurement functions, including sourcing, negotiation, ordering, receipt, and post-purchase review. A number of other researchers (see, for

example, Batenburg, 2007; Boer et al., 2002; Davila, Gupta, & Palmer, 2003; Garrido-Samaniego, Gutierrez-Arranz, & Jose-Cabezudo, 2009; Kothari, Hu, & Roehl, 2005; Reunis, Van Raaij, & Santema, 2004; Teo et al., 2009; Wu et al., 2007), provided definitions of e-procurement, with most of the definitions including the use of Internet technology in purchasing as an essential aspect.

My study defines e-procurement as an organisational use of information technology in establishing contracts and purchasing goods or services, which is consistent with the definitions of e-procurement used by Abu-Elsamen et al. (2010), Garrido et al. (2008), Gunasekaran and Ngai (2008), and Muffato and Payaro (2004). Abu-Elsamen et al. defined e-procurement as "a comprehensive process of establishing agreements for the acquisition of products or services (contracting) or purchase products or services in exchange for payment (purchase) electronically" (p. 144); Garrido et al. as "using Internet technology in the purchasing process; it involves using network communications technology to engage in a wide range of activities up and down the value-added chain both within and outside the organisation" (p. 616); Gunasekaran and Ngai as "a comprehensive process in which organisations use information technology systems to establish agreements for the acquisition of products or services (contracting) or purchase products or services in exchange for payment (purchasing)" (p. 161); and Muffato and Payaro as "activities required for the procurement of goods or services which are supported by the Internet, or in general by information and communications technologies" (p. 341).

The definition of e-procurement used in my study does not limit the term to the use of integrated systems explicitly purchased, implemented, and labelled as "e-procurement systems," but also includes less visible uses of information technology to facilitate procurement, such as the uses of e-mail or Internet browsing. The definition is consistent with most of the prior studies using the term *e-procurement*. In particular, the specific forms of e-procurement (see section 2.3 for an in-depth discussion of e-procurement forms) and the functionalities of e-procurement described in the literature (listed in Table 4-3 in section 4.3.6.1) are, overall, covered by this definition.

2.3 Forms of E-Procurement

The aim of this section is to present the forms of e-procurement documented in the literature. A form of e-procurement is a set of related information technology functionalities used to support procurement activities. In the literature, some of the authors (see, for example, Teo et al., 2009) used the term "e-procurement technology" to denote a similar meaning.

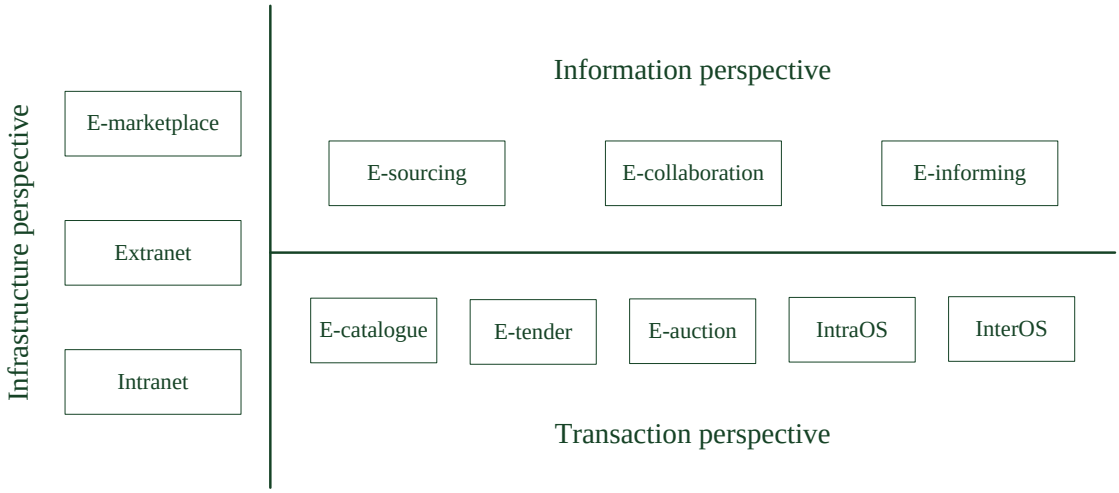

Figure 2-1. Forms of e-procurement.

The diagram in Figure 2-1 is a descriptive model describing the most common forms of e-procurement. I formulated the descriptive model based on reviewing the literature. The model presents the forms of e-procurement from three main perspectives: information, transaction, and infrastructure. The information perspective focuses on the use of e-procurement in facilitating information flows (e.g., informing suppliers regarding the next reverse auction date via e-mail). The transaction perspective focuses on the use of e-procurement in facilitating transactions (facilitating cash flow, e.g., when purchasing goods or services at an e-auction). Finally, the infrastructure perspective refers to packaging and securing e-procurement functionalities (e.g., an e-marketplace secures access to e-auctions and ensures that they are easy to find). The information, transaction, and infrastructure perspectives are discussed in more detail (with examples) in sections 2.3.1, 2.3.2, and 2.3.3, respectively.

The model in Figure 2-1 is a conceptual model summarizing the body of the literature and was used to ensure that the measure of the breadth of e-procurement use covers all of the relevant content (see section 4.3.6.1). The model was not intended to suggest that there is a clear separation between the perspectives (e.g., that the perspectives can be extracted as separate factors in exploratory factor analysis of data describing the use of different functionalities). Nonetheless, this possibility is explored in section 5.6.

2.3.1 Information Perspective

From the information perspective, the forms of e-procurement are e-sourcing, e-collaboration, and e-informing (Boer et al., 2002; Knudsen, 2003; Reunis et al., 2004; Schoenherr & Tummala, 2007).

E-sourcing involves buyers searching for suppliers using Internet technology (Boer et al., 2002; Knudsen, 2003). Examples of e-sourcing functionality are searching for suppliers via an e-marketplace or just by searching the Internet.

E-collaboration involves people (within or across organisations) interacting to accomplish procurement using Internet technology (Bajwa et al., 2008). Examples of e-collaboration functionality are communicating with suppliers to negotiate contracts or to resolve supply issues via e-mail, instant messaging, or video conferencing (Bartezzaghi & Ronchi, 2005; Teo et al., 2009).

E-informing involves buyers using Internet technology to make information about their needs available to potential suppliers (Essig & Arnold, 2001). An example of e-informing functionality is publishing product requirements specifications on an extranet that can be accessed by both internal buyers and suppliers (Boer et al., 2002). A more sophisticated example of e-informing involves a buyer offering suppliers limited access to the buyer's ERP system over the Internet, enabling them to view information relevant to predicting the buyer's future needs (Wu et al., 2007).

2.3.2 Transaction Perspective

From the transaction perspective, the main forms of e-procurement are e-catalogue, e-tender, e-auction, IntraOS, and InterOS (Boer et al., 2002; Knudsen, 2003; Reunis et al., 2004; Schoenherr & Tummala, 2007; Teo et al., 2009).

E-catalogue refers to purchasing goods and services online, via online catalogues provided by suppliers (Krishnaswamy, Zaslavsky, & Loke, 2000). An example of using e-catalogue functionality is placing orders for packaging products at the General Fasteners website (http://www.generalfasteners.ca).

E-tender refers to a structured invitation by buyers to suppliers for the supply of goods or services. Examples of using e-tender functionality are creating electronic contract notices, evaluating tenders, and keeping track of contract awards using a web based tool at Visma TendSign (http://www.opic.com/en/tendsign).

There are two types of e-auction: direct (forward) and reverse. In a direct auction, buyers compete online for goods or services offered by a supplier (Knudsen, 2003). In contrast, in a reverse auction, suppliers compete online to provide goods or services requested by a buyer (Tassabehji, Taylor, Beach, & Wood, 2006). An example of direct auction functionality is placing orders for computers at the uBid.com website (http://www.ubid.com). An example of reverse auction functionality is placing orders for machinery at the India Markets website (http://www.indiamarkets.com).

IntraOS refers to a system using information technology to allow access to a centrally controlled procurement process throughout an organisation. In the literature, systems of this type have been described as “Web-based ERP” when the focus is on procuring direct goods and as “e-MRO” (maintenance, repair, and operating) when the focus is on procuring indirect goods (Boer et al., 2002; Knudsen, 2003).

InterOS refers to integrating the company’s information systems with the supplier’s systems to enable fast processing of transactions. This can be achieved by integrating internal systems (such as ERP systems) belonging to different organisations (e.g., by

using electronic data interchange, EDI, standards). An example of InterOS functionality is using EDI to transfer electronic documents, such as purchase orders, from a buyer's computer system to a seller's computer system without human intervention (Monczka, Trent, & Handfield, 2002).

2.3.3 Infrastructure Perspective

Common infrastructure environments used to enable and to control access to e-procurement functionalities are e-marketplace, intranet, and extranet (Boer et al., 2002).

E-marketplace refers to an Internet website allowing multiple buyers and suppliers to communicate and exchange goods and services (Cheng, Chan, & Lin, 2006; Stockdale & Standing, 2004). There are three ownership models for e-marketplaces: ownership by a major player in the industry, ownership by an independent third party, and ownership by several major players within the industry (a consortium) (Murtaza, Gupta, & Carroll, 2004). The most common forms of e-procurement supported by e-marketplaces are e-sourcing, e-catalogue (Harrigan et al., 2008), and e-auction (direct or reverse) (Carr, 2000). Examples of using e-marketplace functionality are searching for trading partners by using the relevant information published at an e-marketplace and making purchases at a direct e-auction. In terms of the model in Figure 2-1, these are examples of an e-marketplace enabling e-sourcing and e-auction, respectively.

Intranet refers to a private computer network using Internet technology to enable connectivity inside an organisation (Edenius & Borgerson, 2003; Wagner, Chung, & Baratz, 2002). An intranet can be accessed by the employees of the organisation only. An example of using an intranet to enable e-procurement is when Siemens' employees place orders via the SIS Supplier Information System running on Siemens' intranet (Boer et al., 2002). In terms of the model in Figure 2-1, this is an example of an intranet enabling an IntraOS.

Extranet refers to a private computer network using Internet technology to enable access to an organisation's information technology resources by carefully selected

external parties, such as suppliers and buyers (Ling & Yen, 2001). An example of using an extranet to facilitate e-procurement is placing manufacturing schedules on an extranet to enable raw materials suppliers to better plan raw materials production (Tan, Shaw, & Fulkerson, 2000). In terms of the model in Figure 2-1, this is an example of an extranet enabling e-informing.

2.4 Descriptive Studies of E-Procurement Use

The aim of this section (along with section 2.7) is to present prior studies of e-procurement use. E-procurement can be studied at the individual level or at the organisational level. Therefore, e-procurement use can be measured at either of these levels. However, as my study examines the factors affecting the breadth and depth of e-procurement use at an organisational level rather than at an individual level, prior studies of e-procurement adoption and use at an individual level are, therefore, mostly excluded from discussion.

Studies are classified into two types: descriptive and explanatory. A descriptive study describes the state of affairs without emphasising hypothesis testing or inferences regarding cause-effect relationships (Kothari, 1990; Saunders, Lewis, & Thornhill, 2007). In contrast, the aim of an explanatory study is hypothesis testing or making inferences regarding cause-effect relationships (Kothari, 1990; Saunders et al., 2007). Correspondingly, descriptive studies data are often collected to present a broad picture of the target domain; explanatory studies often limit data collection to the data that is needed to test the target hypotheses.

In the rest of this section, subsections 2.4.1, 2.4.2, and 2.4.3 discuss the prior descriptive studies of e-procurement use from the perspectives of the forms and functionalities of e-procurement, benefits of e-procurement, and barriers to e-procurement, respectively. Explanatory studies are discussed in section 2.7.

Studies were identified as follows. First, the Google scholar database (http://scholar.google.com) was searched using combinations of keywords “e-procurement” and “electronic procurement” with “adoption” and “use”. In the resulting output, studies testing hypotheses regarding factors affecting e-procurement

adoption or use were classified as explanatory studies of e-procurement adoption and use, whereas studies presenting data describing how e-procurement is used by organisations as well as studies summarising the opinions of practitioners regarding benefits of e-procurement and regarding barriers to e-procurement adoption and use were classified as descriptive. The citation tree was followed. Articles cited in the articles identified, as well as articles citing the articles identified, were also considered. Moreover, a broad, unstructured search was also conducted.

Descriptive studies of e-procurement use are summarised in Table 2-1 and discussed in detail in the rest of this section.

The studies were conducted in several regions including Asia (Gunasekaran & Ngai, 2008; Kheng & Al-Hawamdeh, 2002), Australasia (Hawking & Stein, 2004), Europe (Gunasekaran et al., 2009; Harrigan et al., 2008; Tanner, Wolfle, Schubert, & Quade, 2008), and North America (Davila et al., 2003; Lefebvre et al., 2005). Thus, the geographical coverage was very broad.

The studies covered businesses of all sizes, with most of them covering both SMEs and large companies (Davila et al., 2003; Gunasekaran & Ngai, 2008; Harrigan et al., 2008; Hawking & Stein, 2004; Kheng & Al-Hawamdeh, 2002). The study by Davila et al. (2003) differed from the rest by explicitly focusing on universities and government departments, along with companies in various industries. Two of the studies (Gunasekaran et al., 2009; Lefebvre et al., 2005) covered SMEs only; one of the studies (Tanner et al., 2008) covered large companies only.

Most of the studies covered companies from multiple industries, with manufacturing included most consistently. Two of the studies (Harrigan et al., 2008; Lefebvre et al., 2005) focused on a single industry, the manufacturing industry. Harrigan et al. (2008) limited their study to manufacturing companies within the information and communication technology (ICT) sector only, on the premise that ICT manufacturing companies are more likely to adopt technologies like e-procurement. One of the studies (Hawking & Stein, 2004), however, did not report the industries covered.

Table 2-1 *Descriptive Studies of E-Procurement Adoption and Use*

Study	Country	Organisation size	Industry	Key informant	N[d]	Aspects covered		
						Forms and functionalities	Benefits	Barriers
Kheng & Al-Hawamdeh (2002)	Singapore	All	Multiple industries	—[c]	150		√	√
Davila et al. (2003)	US	All	Multiple industries	—[c]	168	√	√	√
Hawking & Stein (2004)	Australia	All	—[b]	Information system professional	38	√	√	√
Lefebvre et al. (2005)	Canada	SME[a]	Manufacturing	Chief executive officer	192	√	√	
Gunasekaran & Ngai (2008)	Hong Kong	All	Multiple industries	Top or middle manager	74	√	√	√
Harrigan et al. (2008)	Ireland	All	ICT Manufacturing	—[c]	12	√	√	√
Tanner et al. (2008)	Switzerland	Large[a]	Multiple industries	E-procurement officer	68	√	√	√
Gunasekaran et al. (2009)	Portugal	SME[a]	Multiple industries	Procurement professional	39		√	√

Note. In all of the studies, the unit of analysis was an organisation, with a key informant responding on behalf of the organisation.

[a]Lefebvre et al. did not report the definition of SME they used. Tanner et al. and Gunasekaran et al. classified companies with more than 500 employees as large. [b]Industries not reported. [c]Key informant not reported. [d]N is the number of companies that participated in the study.

The unit of analysis in all of the studies was an organisation. In most of the studies, a single respondent, such as an information system professional, a chief executive officer, an e-procurement officer, or a procurement professional, was used to fill in the questionnaire on behalf of the whole organisation. In one of the studies (Gunasekaran & Ngai, 2008), the respondents (one per company) were drawn from top or middle management, not limited to a particular position. Three of the studies (Davila et al., 2003; Harrigan et al., 2008; Kheng & Al-Hawamdeh, 2002) did not report any details about the key informants they used.

All of the studies used cross-sectional surveys for data collection. One of the studies (Lefebvre et al., 2005) combined data collection via a survey with follow-up in-depth interviews involving some of the survey participants (with interview participants selected to represent different extents of e-procurement adoption). In most of the studies, the potential respondents were reached by means of a self-administered questionnaire posted to them by regular mail (see, for example, Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009); in some of the studies (see, for example, Lefebvre et al., 2005; Tanner et al., 2008), the participants were contacted via e-mail, with the self-administered questionnaire provided online. The response rates ranged from 8% (Lefebvre et al., 2005) to 38% (Harrigan et al., 2008). The reasons behind low or high response rates in different studies were not clear from what was reported.

Harrigan et al. (2008) included in their sample only companies with websites. Hawking and Stein (2004) restricted the sample to companies that used large scale information systems. The choice of the sample employed in the studies by Harrigan et al. and Hawking and Stein increased the chances that the companies surveyed had used e-procurement.

In most of the studies (see, for example, Gunasekaran & Ngai, 2008; Harrigan et al., 2008), the forms and functionalities of e-procurement, the benefits of e-procurement, and the barriers to e-procurement were covered (thus, respondents reported the extent of use of e-procurement forms and functionalities within their organisations, as well as their opinion regarding the possible benefits of e-procurement use to their organisation and regarding the possible barriers to e-procurement use within their

organisation). The forms of e-procurement ranged from the most basic and simple use of web browsers (see, for example, Davila et al., 2003; Hawking & Stein, 2004) to integrated e-procurement systems (see, for example, Gunasekaran & Ngai, 2008; Hawking & Stein, 2004).

In most of the studies, the potential benefits of e-procurement covered were internal benefits (e.g., reducing business cost and purchasing time) rather than external benefits (e.g., preserving the natural environment). Likewise, in most of the studies, the potential barriers to e-procurement covered were internal (e.g., implementation costs and technical issues) rather than external barriers (e.g., regulatory and legal issues).

The results relating to the forms and functionalities of e-procurement, the benefits of e-procurement, and the barriers to e-procurement are discussed in more detail in sections 2.4.1, 2.4.2, and 2.4.3, respectively. Section 2.4.1 provides support for the descriptive model of forms of e-procurement presented in section 2.3; the descriptive model is used as a basis for the operationalisation of breadth of e-procurement use formulated in my study (operationalisation is discussed in detail in section 4.3.6.1). The discussion of e-procurement benefits and barriers presented in sections 2.4.2 and 2.4.3 provides background information and support for some of the hypotheses included in the research model (see Chapter 3).

2.4.1 Forms and Functionalities of E-Procurement

The forms of e-procurement covered in prior descriptive studies of e-procurement use (see Table 2-1 for the list of the studies) are listed in Table 2-2.

Only two studies (Gunasekaran & Ngai, 2008; Lefebvre et al., 2005) covered the forms of e-procurement from an information perspective. All of the studies covered one or more forms of e-procurement from the transaction perspective, but only Davila et al. (2003), Harrigan et al. (2008), and Lefebvre et al. (2005) covered a range of e-procurement forms, with the rest focusing on just one e-procurement form. None of the studies covered IntraOS. Overall, the existing descriptive studies of e-

procurement adoption and use focused on e-procurement functionalities facilitating interactions between companies, rather than on e-procurement inside an organisation.

Table 2-2 *Percentages of Companies Using Different Forms of E-Procurement*

Form (see Figure 2-1)	Study					
	Davila et al. (2003)	Hawking & Stein (2004)	Lefebvre et al. (2005)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)	Tanner et al. (2008)
			Information perspective			
E-sourcing			43%	12%		
E-collaboration			16%	16%		
E-informing			32%			
			Transaction perspective			
E-catalogue	25%		34%		92%	
E-tender			2%		92%	
E-auction	—[a]		6%		75%[c]	
InterOS		8% direct, 2% MRO[b]		18%	92%	53%

Note. For details on how each study was conducted, including the companies covered, the industry, and the country, refer to Table 2-1.

[a]The percentage of companies using e-auctions was not clear from what was reported in the study, even though e-auctions were covered. [b]Hawking and Stein reported the use of EDI for direct and for MRO materials separately. [c]The percentage for direct auctions; for reverse auctions, the percentage of companies using them was characterised as "less than half" and no specific number was given.

The study by Lefebvre et al. (2005) covered a broader range of e-procurement forms and functionalities than the rest of the studies, and considered the functionalities in more detail. Nonetheless, Lefebvre et al. did not cover InterOS, which was represented in the studies by Gunasekaran and Ngai (2008), Harrigan et al. (2008), Hawking and Stein (2004), and Tanner et al. (2008) as purchasing via EDI.

Both Gunasekaran and Ngai (2008) and Lefebvre et al. (2005) covered e-sourcing and e-collaboration. Lefebvre et al. found that almost half of the companies (43%) searched for suppliers electronically. In contrast, in the study by Gunasekaran and Ngai, only 12% of the companies searched for suppliers electronically. The difference may have been because of company size, with the smaller companies covered in the study by Lefebvre et al. relying more on opportunistic ways to cut

business costs, and with the larger companies in the study by Gunasekaran and Ngai relying more on established relationships. In both studies, 16% of the companies collaborated online with their suppliers.

Two of the studies (Harrigan et al., 2008; Lefebvre et al., 2005) covered e-catalogue, e-tender, and e-auction. One of the studies (Davila et al., 2003) covered e-catalogue and e-auction, but did not cover e-tender. Lefebvre et al. (2005) found that the companies they covered purchased goods and services via e-catalogue (34%) more than via e-tender (2%) and e-auction (6%) (the specific types of auction were not distinguished). In contrast, Harrigan et al. (2008) found that more than half of the companies used e-catalogue (92%), e-tender (92%), and direct auction (75%). Thus, larger and more knowledgeable about information technology companies covered in the survey by Harrigan et al. relied more on sophisticated forms of e-procurement. Nonetheless, the results from the study by Harrigan et al. may be not reliable, as only 12 companies participated in the study. Davila et al. (2003) found that 25% of the companies used e-catalogue; however, the percentage of companies that used e-auction was not clear from the information reported. The use of e-catalogue in the study by Davila et al. was similar to the study by Lefebvre et al., even though the study by Davila et al. covered larger companies. This suggests that the difference in the use of more sophisticated forms of e-procurement between Harrigan et al. and Lefebvre et al. was because the companies covered by Harrigan et al. had experience in using information technology, rather than because of the difference in size.

Four of the studies (Gunasekaran & Ngai, 2008; Harrigan et al., 2008; Hawking & Stein, 2004; Tanner et al., 2008) covered InterOS; two of these studies (Gunasekaran & Ngai, 2008; Hawking & Stein, 2004) found that only a small percentage of the companies used EDI. In Gunasekaran and Ngai (2008), 18% of the companies used EDI. Hawking and Stein (2004) found that only 8% and 2% of the companies used EDI to procure direct materials and MRO, respectively. Both Gunasekaran and Ngai and Hawking and Stein covered companies of all sizes, and the results were, overall, consistent. Conversely, Tanner et al. (2008) found that more than half of the companies (53%) used EDI. Likewise, Harrigan et al. (2008) found that almost all of the companies (92%) used EDI. The companies covered in Tanner et al. were large

companies; thus, it was easier for them to make the necessary investment to establish an EDI infrastructure. Harrigan et al. covered companies of all sizes, but focused on information technology-savvy companies (companies with expertise in using information technology). Information technology-savvy companies have the relevant expertise; therefore, it is easier for such companies both to understand the benefits of InterOS and to implement InterOS. Nonetheless, as mentioned in the preceding paragraph, the results from the study by Harrigan et al. may be not reliable, as only 12 companies participated in the study.

Lefebvre et al. (2005) was the only study (out of the descriptive studies identified in this literature review) that explicitly focused on SMEs; SMEs are also the focus of my study. The results by Lefebvre et al. suggest that SMEs are roughly equally likely to be involved in e-sourcing, e-informing, and into purchasing via e-catalogue. E-collaboration is less common, and the use of e-tender and e-auction, even less common. Lefebvre et al. did not cover InterOS. By comparing the use of InterOS reported for large companies by Tanner et al. (2008) with the use of InterOS reported in the studies covering companies of all sizes (Gunasekaran & Ngai, 2008; Harrigan et al., 2008; Hawking & Stein, 2004), one would expect that smaller companies use InterOS less than larger companies. As discussed earlier in this section, this is not surprising in view of the investment required. Thus, it is likely that the percentage of SMEs relying on the use of InterOS is smaller than the percentages reported for companies of all sizes in studies that did not explicitly focus on information technology-savvy companies (Gunasekaran & Ngai, 2008; Hawking & Stein, 2004); hence, the number is likely to be around 5% or less.

Even though the studies covered in Table 2-2 were conducted in different developed countries, overall, the results were consistent. Thus, it appears that the patterns of use of different forms of e-procurement do not differ drastically from country to country.

As suggested by Table 2-2, all of the forms of e-procurement from information and transaction perspectives suggested by the model in Figure 2-1 were never covered in a single study. Nonetheless, the data summarised in the table provides further support for the descriptive model of forms of e-procurement; the table demonstrates that the

descriptive model enables making sense of empirical data on e-procurement use and that most of the forms of e-procurement suggested by the descriptive model are in use in practice (with the exception of IntraOS, as mentioned earlier in this section).

The following discussion focuses on the individual studies that covered the forms and functionalities of e-procurement in more detail.

Davila et al. (2003), in a survey of companies in multiple industries in the US, found that most of the companies were relatively new to e-procurement. Only 34% of the companies had been using e-procurement for a year or more. The goods were acquired over the Internet for only 15% of their supply base. The most common form of e-procurement was e-catalogue (25% of the companies); software such as Internet browsers was used to make purchases directly from the suppliers. The most commonly used functionalities were placing orders and tracking orders. Most of the companies relied on e-procurement to acquire indirect goods more than to acquire direct goods and services. Larger companies were earlier adopters of e-procurement than smaller companies. The majority of the companies were conservative adopters ("late majority" category according to DOI theory, see section 2.6.1 for a discussion of DOI categories of adopters), as they were taking a "wait and see" approach rather than adopting aggressively. The companies were either aware of e-procurement potentials and possibilities but were not committing resources towards e-procurement, or were investing selectively until the best e-procurement model was identified. However, according to the respondents, the companies were ready to move fast once technology and business uncertainties are resolved. A number of companies (27%) were aggressive in setting strategy on e-procurement use and were investing heavily to gain competitive advantage via e-procurement.

Hawking and Stein (2004), based on a survey of companies in Australia, concluded that the uptake of e-procurement by Australian companies was low. Most of the companies relied more on the traditional practices of procurement, including fax, paper-based mail, and telephone, rather than e-procurement. For both direct and indirect procurement, the use of fax and paper-based mail was higher among medium-large companies (companies with revenue of more than $AUD 250 million)

than among small-medium companies (companies with revenue of less than $AUD 250 million). In contrast, small-medium companies relied more on telephone and Internet for both direct and indirect procurement than medium-large companies. For direct procurement, small-medium companies were heavier users of EDI than medium-large companies. Conversely, for indirect procurement, medium-large companies used EDI more than small-medium companies. However, e-mail was used by both small-medium and medium-large companies at similar levels. Nonetheless, the results of the study are not necessarily generalisable, as only 38 companies participated.

Lefebvre et al. (2005) classified e-procurement functionalities as a part of a broader B2B e-commerce study. Based on a Delphi study involving 12 experts, Lefebvre et al. distinguished searching for new suppliers and searching for goods and services as "electronic information search"; purchasing via e-catalogues, placing and managing orders with suppliers, and accessing suppliers' goods or services database as "simple electronic transactions"; purchasing via e-auctions, purchasing via e-tenders, negotiating contracts with suppliers, making payments to suppliers, accessing suppliers' inventories, and allowing suppliers to access the buyer's inventories as "complex electronic transactions"; and sending documents to suppliers, doing collaborative online engineering with suppliers, and tracking goods purchased during transportation as "electronic collaboration". (It should be noted that the use of the term "transaction" in the work by Lefebvre et al. is not entirely consistent with the use of the term in the descriptive model of forms of e-procurement in Figure 2-1.) Lefebvre et al. conducted a survey of SME companies in the manufacturing industry in Canada using a questionnaire based on the classification they established. Almost half of the SMEs (43%) searched for suppliers electronically. More than quarter of the companies (34%) purchased goods and services via e-catalogues. Only 6% and 2% of the companies purchased goods and services via e-auctions and e-tenders, respectively.

In the study by Lefebvre et al. (2005), of the 192 SMEs that responded to the survey, 12 opted to participate in in-depth interviews. The CEOs interviewed ranged in their approaches from assessing the situation without taking any action to plan to use e-

commerce technology in the near future, to using e-commerce technology provided by their partners, and to implementing sophisticated e-commerce technology within their own organisations.

Gunasekaran and Ngai (2008), in a survey of companies in multiple industries in Hong Kong, found that most of the companies (79%) did not use e-procurement. The rest of the companies had used e-procurement for one to four years. Most of the companies that used e-procurement relied on suppliers' websites and EDI networks. The most commonly used functionalities were gathering information electronically, providing information regarding order status control, ordering goods or services electronically, communicating with suppliers electronically, and searching for suppliers electronically. Similar to the results of Davila et al. (2003), most of the companies used e-procurement primarily for purchasing office products and maintenance items, rather than raw materials. Most of the respondents (77%) believed that e-procurement was important, while 23% of them considered e-procurement not important. Gunasekaran and Ngai suggested that educating companies in both long- and short-term benefits of e-procurement would encourage e-procurement use in future.

Harrigan et al. (2008), in a survey of companies in ICT manufacturing industry in Ireland, found that most of the companies (92%) used e-catalogues and e-tenders. More than half of the companies (75%) used direct e-auctions, while less than half of the companies used e-reverse auctions. Almost all of the companies (92%) used traditional EDI systems, and most of these systems were used to submit requests for tenders (RFTs) and were controlled by the seller. In contrast to Davila et al. (2003) and Gunasekaran and Ngai (2008), most of the companies relied on e-procurement to acquire direct materials (56% in terms of the overall amount spent of direct materials) more than to acquire indirect materials (36% in terms of the overall amount spent on indirect materials). Nonetheless, the results of the study are not necessarily generalisable, as only 12 companies participated.

Tanner et al. (2008), in a survey of large companies in Switzerland, found that more than half of the companies (53%) exchanged business documents with their suppliers

electronically. The majority of the companies exchanged less than 20% of business documents electronically with their suppliers. The most common type of documents exchanged online were purchase orders (85%). Other types of documents were invoices (58%), order confirmation documents (58%), request for quotes and bids documents (58%), and dispatch advices (49%).

2.4.2 Benefits of E-Procurement

The benefits of e-procurement use reported in the literature are summarised in Table 2-3 and discussed in detail in this section. The benefits of e-procurement are listed in descending order, starting from more commonly reported.

To rate benefits, most of the studies reported average scores obtained via Likert scales, either directly for the benefits listed in Table 2-3 or for multiple aspects of each benefit (such as separately for reducing purchasing costs and reducing administration costs, both aspects of reducing business costs). Ranges of Likert scales and the aspects of benefits differed between studies. To enable comparisons, average scores reported in the literature were normalised and aggregated to obtain a normalised benefit score s_i for each benefit i, calculated by using the following formula:

$$s_i = \frac{x_{i1} + x_{i2} + \cdots x_{in}}{n x_{max}}, \quad (1)$$

where x_{i1} to x_{in} are average scores for the benefit i obtained via Likert scales (adjusted when necessary for the scale to start from zero), and x_{max} is the maximum value in the Likert scale used (after the adjustment, if any). In all studies, Likert scale ranges were consistent across items used in the study; nominal scales reflecting if the aspect of a benefit exists or not, used in some of the studies, were treated as Likert scales ranging from 0 to 1. The resulting normalised benefit scores are listed in Table 2-3.

Table 2-3 *E-Procurement Benefit Scores*

Benefit	Study							
	Kheng & Al-Hawamdeh (2002)	Davila et al. (2003)	Hawking & Stein (2004)	Lefebvre et al. (2005)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)[c]	Tanner et al. (2008)	Gunasekaran et al. (2009)
Reduce business costs	.60	—[a]	.57	.34	.60	.75[b]	.41[b]	.35
Reduce purchasing time		—[a]	.43		.65			.33
Streamline purchasing processes		—[a]	.45			.83[b]	.34[b]	
Access wider markets		—[a]			.56	.33[b]		.33
Improve relationships with trading partners					.58	.58[b]		.43
Reduce the use of resources		—[a]			.55		.15[b]	.33
Increase competitiveness	.60					.50[b]		
Increase revenue				.34		.33[b]		
Reduce environmental footprint					.55			.23
Enhance decision making			.44					
Secure supplies							.45[b]	
Increase business cost transparency							.25[b]	

Note. Most of the studies used 5 or 7-point Likert scales; Kheng and Al-Hawamdeh, Harrigan et al., and Tanner et al. used nominal scales. The details of how the studies were conducted are summarised in Table 2-1.

[a]Benefits characterised based on qualitative data; hence, no numeric scores available. [b]I estimated these numbers based on a graph given in the paper. [c]The study by Harrigan et al. involved a very small number of selectively chosen respondents (see Table 2-1); therefore, the scores obtained in the study should be interpreted with care.

The end benefits with broad support across studies and with relatively high scores were “reduce business costs,” “improve relationships with trading partners,” “reduce purchasing time,” and “access wider markets”. “Streamline purchasing processes” was also highly rated and had broad support, even though it is, arguably, not an end benefit in itself, but a desired outcome enabling reducing business costs, reducing purchasing time, and reducing environmental imprint.

It is notable that for the study by Gunasekaran et al. (2009), the ratings were consistently lower than for the study by Gunasekaran and Ngai (2008). The main difference between the two studies was that Gunasekaran et al. covered specifically SMEs, while Gunasekaran and Ngai covered companies of all sizes, suggesting that larger companies had a more positive view of e-procurement benefits.

In the following, the benefits of e-procurement reported in the literature are discussed in more detail.

Reducing business costs. The most commonly reported benefit of e-procurement was reducing business costs. The business costs could be related to purchasing goods and services (Davila et al., 2003; Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009; Hawking & Stein, 2004; Lefebvre et al., 2005) and administration of the procurement process (Harrigan et al., 2008; Hawking & Stein, 2004). Business cost savings due to e-procurement typically result from the reengineering of a supply chain (Bland, 2003). The use of direct auctions, for instance, increases firm’s chances of getting lower prices for the goods offered (Pearcy et al., 2008). E-catalogues that provide comparisons of all suppliers worldwide expedite the choice of suppliers (Miller, 2011) by increasing price transparency (Tanner et al., 2008), ultimately lowering the cost of goods and services and both assuring the quality of goods and services procured and improving the delivery time (Timmers, 1998). Business cost savings achieved via e-procurement result in increased revenue (Harrigan et al., 2008; Lefebvre et al., 2005) and increased competitiveness (Harrigan et al., 2008; Kheng & Al-Hawamdeh, 2002).

For example, the use of e-sourcing in Procter & Gamble (a consumer goods company based in the US) resulted in business cost savings because of the reduction of price paid for direct materials purchased by 13% to 22%, of packaging costs paid to suppliers by 10% to 50%, and of transportation costs by 5% to 20% (Verespej, 2004).

Reducing purchasing time and streamlining purchasing processes. Most of the authors reported that e-procurement reduces purchasing time (see, for example, Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009) and streamlines purchasing processes (see, for example, Harrigan et al., 2008; Hawking & Stein, 2004; Tanner et al., 2008). Time savings and process efficiency in purchasing are achieved by automating information management and decision making (Bartezzaghi & Ronchi, 2005), simplifying the procurement process (Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009), and eliminating intermediaries such as brokers and dealers (Kheng & Al-Hawamdeh, 2002). The outcomes of reducing purchasing time and streamlining purchasing processes by using e-procurement are reduced consumption of resources (see, for example, Davila et al., 2003; Gunasekaran & Ngai, 2008) and enhanced decision making (Hawking & Stein, 2004).

For example, through the use of an e-marketplace, Cox Enterprises (a communications, media and automotive services company based in the US) reduced the purchasing turnaround time from 10 to five days and replaced a process involving 45 steps with a process involving only three steps (Varmazis, 2008). The e-marketplace was used by Cox Enterprises employees to make purchases from Cox approved suppliers.

Accessing wider markets. E-procurement enables organisations to access wider markets (see, for example, Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009; Harrigan et al., 2008). The use of e-procurement allows organisations to reach trading partners regardless of geographical distances and time differences (Gebauer & Segev, 1998; Standing & Lin, 2007; Teo et al., 2009).

For example, Motorola (a telecommunications company based in the US) used a range of options, from EDI to an e-marketplace accessible via the Internet, to match

the preferences of different suppliers (for smaller suppliers, EDI implementations were too expensive) (Gebauer, Haacker, & Shaw, 2002). This allowed Motorola to work effectively with more than 6,500 suppliers from around the world.

Improving relationships with trading partners. E-collaboration over the Internet allows organisations to strengthen relationships with their trading partners (Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009; Harrigan et al., 2008). Prior to the emergence of the Internet, organisations faced difficulties in forming strategic alliances with their suppliers due to geographical distances (Kheng & Al-Hawamdeh, 2002). Information technology tools offered a broad range of communication capabilities bridging geographical distances. Strong partnerships with suppliers contribute to reliable, timely procurement (Tanner et al., 2008).

For example, Alibaba (an online B2B marketplace company based in China, see http:www.alibaba.com) was reported to offer instant chat functionality intended to facilitate deal making between non-collocated parties (Zhao, Wang, & Huang, 2008).

Reducing environmental footprint. E-procurement enables organisations to reduce their environmental footprint by eliminating paper-based purchasing processes (Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009). Changing purchasing processes to use e-procurement allows organisations to reduce the use of paper and, thus, to preserve the natural environment (MacManus, 2002).

For example, in 2002, Owens Corning (a glass fibre manufacturing company based in the US), through the use of EDI, reduced paper purchase orders by 80%, enabling the company to reduce its environmental footprint, and at the same time, save on storage costs (Hannon, 2004).

2.4.3 Barriers to E-Procurement

To achieve the benefits of e-procurement (discussed in section 2.4.2), the organisations have to overcome challenges associated with implementing e-procurement. The barriers to e-procurement adoption and use reported in the literature are summarised in Table 2-4 and discussed in detail in this section. The

barriers to e-procurement are listed in descending order, starting from the more commonly reported. Normalised barrier scores enabling comparison between studies were calculated similarly to the benefit scores (discussed in section 2.4.2), and are also listed in Table 2-4.

As seen in Table 2-4, technical issues and regulatory and legal issues were rated consistently high. The studies disagreed on the importance of lack of management support and lack of knowledge and skills, and overall rated them lower than technical and regulatory and legal issues. Implementation cost issues were rated nearly as high as technical issues, but there was less consistency between studies.

Tanner et al. (2008) rated technical issues and lack of knowledge and skills considerably lower than implementation cost issues, whereas Davila et al. (2003) rated technical issues and lack of knowledge and skills considerably higher than implementation cost issues. Tanner et al. studied EDI implementations in large companies (complex and, thus, expensive to implement, e-procurement systems in companies with access to technical expertise), and Davila et al. focused on the use of e-marketplaces and e-catalogues by companies of all sizes (thus, many of the participants were likely to be smaller organisations with little access to technology expertise).

Barriers for different forms of e-procurement (see Figure 2-1 for a descriptive model of forms of e-procurement) may differ. E-collaboration with suppliers by exchanging e-mail messages may rely on existing infrastructure and skills and, thus, implementation costs or technical issues are not likely to be a barrier for companies that already have Internet connections. On the contrary, setting up an InterOS involving direct integration of information systems across companies clearly requires a considerable investment and advanced technology skills. Nonetheless, none of the existing descriptive studies of e-procurement use addressed barriers to specific forms of e-procurement. Rather, the studies collected data relative to e-procurement in general. None of the studies provided the details of the research instruments, so it is not entirely clear how the term “e-procurement” was presented or interpreted by the survey respondents.

Table 2-4 *E-Procurement Barrier Scores*

Barrier	Study						
	Kheng & Al-Hawamdeh (2002)	Davila et al. (2003)	Hawking & Stein (2004)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)[c]	Tanner et al. (2008)	Gunasekaran et al. (2009)
Implementation cost issues	.30	.32	.53	.55	.21	.61[b]	.53
Technical issues	.40	.47	.52	.50	.53	.36[b]	.51
Lack of knowledge and skills	.30	.54	.55	.53	.17	.11[b]	.55
Change management issues	.30	.31	.50	.50	.38		.55
Lack of top management support	.20		.33	.55	.08		.35
Regulatory and legal issues		—[a]	.45	.58		.40[b]	.48
Security issues			.45	.53	.25		.53
Supplier issues		—[a]	.50			.55[b]	
Not the top initiative or priority of the organisation	.60			.65			.58
Inadequate business processes to support e-procurement			.48		.25		
Inability to identify potential items for auction		—[a]					
Difficulty of judging the usefulness and potential of new information technology						.48[b]	
Lack of planning					.25		

Note. Most of the studies used 5 or 7-point Likert scales; Kheng and Al-Hawamdeh, Harrigan et al., and Tanner et al. used nominal scales. The details how the studies were conducted are summarised in Table 2-1.

[a]Barriers characterised based on qualitative data; hence, no numeric scores available. [b]I estimated these numbers based on a graph given in the paper. [c]The study by Harrigan et al. involved a very small number of selectively chosen respondents (see Table 2-1); therefore, the scores obtained in the study should be interpreted with care.

In the following, the barriers to e-procurement reported in the literature are discussed in more detail.

Implementation cost issues. The most commonly reported barrier to e-procurement use was implementation cost issues (see, for example, Gunasekaran et al., 2009; Tanner et al., 2008). E-procurement may require a considerable investment in hardware, software, staffing, and training (Kheng & Al-Hawamdeh, 2002). The introduction costs for new information technology solutions supporting e-procurement may be high (Tanner et al., 2008). According to Bland (2003), e-procurement may not suit all businesses, especially SMEs that commonly lack both financial and non-financial resources (Harrigan et al., 2008; Lefebvre et al., 2005). Traditional purchasing practices may need to be maintained in parallel (Bland, 2003), which is very expensive.

As discussed earlier in this section, implementation cost issues are likely to differ considerably depending on the forms of e-procurement. For example, Bland (2003), who claimed that e-procurement may not suit all businesses, explicitly included both the use of e-marketplaces and cross-organisational integration of ERP systems as aspects of e-procurement. Purchasing via e-marketplaces, such as Alibaba.com, is clearly much less expensive (and quite accessible for SMEs), while cross-organisational integration is both expensive and risky (because the implementation project may fail). Thus, it would be more appropriate to claim that not all forms of e-procurement suit all businesses. Further studies that would differentiate barriers by e-procurement form are clearly desirable.

Technical issues. Another commonly reported barrier to e-procurement was technical issues (see, for example, Gunasekaran & Ngai, 2008; Tanner et al., 2008). Technical issues may include the problems of integrating e-procurement with existing information infrastructure such as accounting and inventory management (see, for example, Harrigan et al., 2008), inadequate technological infrastructure (see, for example, Hawking & Stein, 2004), and immaturity of the technology (see, for example, Gunasekaran & Ngai, 2008). Immaturity of the technology creates uncertainty with regards to security, reliability, interoperability, and integration with

other systems (Tatsis, Mena, Wassenhove, & Whicker, 2006). As in case of implementation cost issues, technical issues differ considerably depending on the forms of e-procurement; nonetheless, this aspect was not addressed by the existing studies.

Lack of knowledge and skills. Another barrier to e-procurement was lack of knowledge and skills about e-procurement (see, for example, Gunasekaran et al., 2009; Harrigan et al., 2008). Successful implementation of e-procurement in an organisation depends on the employees' skill and knowledge about e-procurement. Tanner et al. (2008), in the study introduced in section 2.4.1 (in conjunction with the forms and functionalities of e-procurement), found that there was a lack of qualified staff who can work with e-procurement as well as a lack of consultant expertise in information technology projects for e-procurement. Thus, it is important for an organisation to have employees with skills and knowledge about e-procurement to ensure the successful implementation of e-procurement (Gunasekaran & Ngai, 2008).

Change management issues. Six of the studies (see, for example, Gunasekaran & Ngai, 2008; Gunasekaran et al., 2009; Harrigan et al., 2008) reported that change management issues impeded e-procurement adoption and use. Successful implementation of e-procurement requires change in the attitudes of both company employees and suppliers. Davila et al. (2003), in the study introduced in section 2.4.1 (in conjunction with the forms and functionalities of e-procurement), found that there was a lack of enthusiasm for e-procurement. According to the respondents, e-procurement was merely the "flavour of the month" and would soon become obsolete (Davila et al., 2003, p. 20). Lack of enthusiasm for e-procurement may be attributed to a number of factors: to: inadequacy of the business processes used to implement or to support e-procurement (see, for example, Hawking & Stein, 2004); to e-procurement not being perceived as a top initiative or priority of the organisation (see, for example, Kheng & Al-Hawamdeh, 2002); to the inability of businesses to identify potential items for auctions (see, for example, Davila et al., 2003); and to the difficulty of judging the usefulness of new information technology (see, for example, Tanner et al., 2008).

Lack of top management support. Most of the studies (see, for example, Harrigan et al., 2008; Hawking & Stein, 2004) contended that lack of top management support was a barrier to e-procurement adoption and use. Senior managers should be part of e-procurement teams to ensure successful implementation of e-procurement (Gunasekaran & Ngai, 2008). The extent to which senior managers in an organisation believe that e-procurement can positively affect the organisation's performance will influence their decisions on e-procurement adoption and use (Gunasekaran et al., 2009).

Regulatory and legal issues have been cited as barriers to e-procurement in a number of studies (see, for example, Gunasekaran et al., 2009; Hawking & Stein, 2004). In the absence of specific rules and laws governing the conduct of electronic practices (e.g., the use of digital signatures, tax regime, and consumer protection), e-commerce transactions are more risky than transactions conducted in conventional markets where rules and laws are well established (Aladwani, 2003; Gibbs & Kraemer, 2004; Mueller, 2001). A lack of standardised laws to deal with online businesses resulted in slow adoption and use of e-procurement among businesses (Davila et al., 2003).

Security issues. Several studies (see, for example, Harrigan et al., 2008; Hawking & Stein, 2004) raised concerns about security issues in e-procurement. Security issues include the danger of virus attacks (Harrigan et al., 2008) and the risks associated with online payment systems (Kheng & Al-Hawamdeh, 2002). The risk of online payment includes transmitting sensitive information, such as credit card numbers, to suppliers across the Internet. Accordingly, building trading partners' trust is an important element in e-procurement, especially when face-to-face meetings are difficult due to geographical distances. Trust in e-procurement can be enhanced by increasing Internet security (Salisbury, Pearson, Pearson, & Miller, 2001) which may include the implementation of sophisticated security controls such as smart cards and digital signatures (Harrigan et al., 2008).

Supplier issues. Three of the studies (Davila et al., 2003; Hawking & Stein, 2004; Tanner et al., 2008) reported that supplier issues inhibited e-procurement adoption

and use. Hawking and Stein (2004), in the study introduced in section 2.4.1 (in conjunction with the forms and functionalities of e-procurement), found that lack of co-operation of business partners hindered the implementation of e-procurement. Other supplier issues were related to suppliers' slow adoption of e-procurement (Tanner et al., 2008), lack of suppliers accessible through the organisation's e-procurement system, lack of supplier investment in catalogue development, suppliers not ready to participate in e-procurement, and not enough suppliers to create a liquid marketplace (Davila et al., 2003).

Lack of planning. In one of the studies (Harrigan et al., 2008), lack of planning was reported as a barrier to the use of sophisticated dedicated e-procurement systems such as EDI systems. The implementation of advanced e-procurement in an organisation requires a proper plan. Planning should take into account the implementation of the system (the technological factor), both the development of employee skills needed to use e-procurement and the development of policies that govern the e-procurement (the organisational factors), and the status of e-procurement use by trading partners (the environmental factor). Many companies failed in e-commerce projects due to lack of planning (Foster & Lin, 2004; Milgrom, 1989).

2.5 Descriptive Studies of EDI and E-Commerce Use

As introduced in section 2.3.2, EDI is a standard for transferring electronic documents, such as purchase orders, from a buyer's computer system to a seller's computer system without human intervention. In terms of the descriptive model of forms of e-procurement (see Figure 2-1), EDI is an e-procurement functionality from the transaction perspective. The use of EDI has received a lot of attention from researchers in 1990s. Because EDI is one of the e-procurement functionalities, the use of EDI is part of e-procurement practice and is of interest to my study.

E-commerce refers to the use of communication networks to enable purchasing and selling of goods and services (Aalst, 2002). E-commerce applications can be classified into business to business (B2B) and business-to-consumer (B2C). Clearly,

e-procurement, as it is defined in my study (see section 2.2), is part of B2B e-commerce (more specifically, it is B2B e-commerce from the perspective of the purchasers; see Figure 2-2). Descriptive studies of e-procurement (which is synonymous with B2B e-commerce from the perspective of the purchasers) were reviewed in section 2.4.

Numbers indicate section numbers where the corresponding areas are reviewed. Grayed out areas are outside the scope of my study.

	Seller perspective SP	Buyer perspective BP
Business-to-business B2B	B2B-SP EDI (2.5 and 2.8) Businesses selling to businesses using information technology. (2.5, 2.8)	B2B-BP EDI (2.5 and 2.8) E-procurement. (2.4, 2.7)
Business-to-consumer B2C	B2C-SP Businesses selling to individual consumers using information technology. Not in the scope of my study.	B2C-BP Individual consumers buying from businesses using information technology. Not in the scope of my study.

Figure 2-2. E-commerce models and perspectives.

In the rest of this section, I review the descriptive studies of EDI adoption and use and the descriptive studies of B2B e-commerce adoption and use that were not covered in in section 2.4. Explanatory studies of EDI adoption and use and of e-commerce adoption and use are reviewed in section 2.8. The studies of B2C e-commerce adoption and use are not covered as not directly related to the problem addressed in my study.

Comparing to section 2.4, the focus of this section is more on benefits and barriers than on the use of particular functionalities. This is because the studies of EDI are not covering other e-procurement functionalities, and thus one cannot make comparisons between the uses of different functionalities at the level of the descriptive model of forms of e-procurement (see Figure 2-1). Moreover, the set of functionalities of B2B e-commerce from the sellers' perspective is not the same as

the set of B2B functionalities from the buyers' perspective (the set of e-procurement functionalities, which are the primary focus of my study). Nonetheless, in view of the overall relatedness between EDI, B2B e-commerce, and e-procurement, the overall benefits and barriers may be similar.

Because B2C e-commerce was not covered, henceforth in this section (section 2.5), unless explicitly stated otherwise, when referring to e-commerce I refer to B2B e-commerce only.

Similar to the review of descriptive studies of e-procurement use presented in section 2.4, only studies with the organisation as a unit of analysis are covered. Studies with the individual as a unit of analysis are not covered, because they are not directly relevant to the purpose and the research questions of my study (see the discussion in section 2.4).

Similar to the review of the studies of e-procurement adoption and use (see section 2.4), studies were identified for inclusion as follows. First, the Google scholar database (http://scholar.google.com) was searched using combinations of keywords "electronic data interchange," "EDI," "electronic business," "e-business," "electronic commerce," and "e-commerce" with "adoption" and "use". Then, studies testing hypotheses regarding factors affecting EDI and e-commerce adoption or use were classified as explanatory studies of EDI and e-commerce adoption and use, whereas studies summarising the opinions of practitioners regarding benefits of the technologies and regarding barriers to the technologies adoption and use were classified as descriptive. The citation tree was followed; articles cited in the articles identified, as well as articles citing the articles identified, were also considered. Moreover, broad, unstructured search was also conducted. All of the studies of e-commerce identified in the search mixed buyers' and sellers' perspectives.

It should be noted that the exact distinction between what constitutes e-business and what constitutes e-commerce is not entirely clear, and some of the authors, such as Ray (2003), have voiced a view that e-business is broader than e-commerce. Nonetheless, all of the studies presented as studies of e-business adoption and use

that I encountered in the search operationalised e-business in such a way that it was not distinguishable from e-commerce.

In the rest of this section, I discuss the descriptive studies of EDI and e-commerce adoption and use from the perspectives of the benefits of the technologies and the barriers to the technologies' use. Explanatory studies of EDI and e-commerce are discussed in section 2.8.

Descriptive studies of EDI and e-commerce are summarised in Table 2-5 and discussed in detail in the rest of this section.

The studies were conducted in several regions, including Asia (Heung, 2003; Kaynak, Tatoglu, & Kula, 2005; Liang, Xue, Byrd, & Rainer, 2004; Ngai & Gunasekaran, 2004; Teo & Ranganathan, 2004), Australasia (Ramaseshan, 1997), Europe (Maguire, Koh, & Magrys, 2007), North America (Issa, Flood, & Caglasin, 2003; Sriram, Arunachalam, & Ivancevich, 2000; Vijayasarathy & Tyler, 1997), and Southern Africa (Cloete, Courtney, & Fintz, 2002). Thus, similar to the studies of e-procurement adoption and use reviewed in section 2.4, the geographical coverage was very broad.

The studies covered businesses of all sizes, with most of the studies covering both SMEs and large companies (see, for example, Ngai & Gunasekaran, 2004; Ramaseshan, 1997; Teo & Ranganathan, 2004; Vijayasarathy & Tyler, 1997). Three of the studies (Cloete et al., 2002; Kaynak et al., 2005; Maguire et al., 2007) covered SMEs only, and one of the studies (Issa et al., 2003) covered large companies only.

Table 2-5 *Descriptive Studies of EDI and E-Commerce Use*

Study	Country	Organisation size	Industry	Key informant	N^b	Aspects covered	
						Benefits	Barriers
			EDI				
Ramaseshan (1997)	Australia	All	Multiple	Manager/controller/ administrator	64	√	√
Vijayasarathy & Tyler (1997)	US	All	Retail	Senior executive	97	√	
Sriram et al. (2000)	US	All	Multiple	IS manager	166	√	
Liang et al. (2004)	China	—[d]	Healthcare	Manager	68		√
Ngai & Gunasekaran (2004)	Hong Kong	All	Multiple	General manager/information technology manager	107	√	√
			B2B E-commerce				
Cloete et al. (2002)	South Africa	SME	Manufacturing	—[e]	34	√	√
Heung (2003)	Hong Kong	All	Travel	Senior executive	103		√
Issa et al. (2003)	US	Large	Construction	Senior executive/ managerial executive	91	√	
Teo & Ranganathan (2004)	Singapore	All	Multiple	Senior executive	108	√	√
Kaynak et al. (2005)	Turkey	SME[a]	Manufacturing	Manager	411	√	√
Maguire et al. (2007)[c]	UK	SME[a]	Multiple	Information technology manager	123		√

Note. In all of the studies, the unit of analysis was an organisation, with a key informant responding on behalf of the organisation.

[a]Each study defined SMEs differently. Companies with a single CEO and fewer than 50 employees as small in Cloete et al.; companies with fewer than 100 employees in Kaynak et al.; companies with fewer than 200 employees in Maguire et al. [b]*N* is the number of companies that participated in the study. [c]Maguire et al. used a mixed method research design invloving a survey and a series of interviews. [d]Three types of hospitals were covered: general hospitals, traditional Chinese medicine hospitals, and specialised hospitals. [e]Key informant not described.

Most of the studies covered companies from multiple industries, with manufacturing included most consistently. Six of the studies (Cloete et al., 2002; Heung, 2003; Issa et al., 2003; Kaynak et al., 2005; Liang et al., 2004; Vijayasarathy & Tyler, 1997) focused on a single industry: manufacturing industry in Cloete et al. and Kaynak et al.; travel industry in Heung; retail industry in Vijayasarathy and Tyler; construction industry in Issa et al.; and healthcare industry in Liang et al. The study by Issa et al. (2003) was limited to construction companies that had a World Wide Web (WWW) presence, on the premise that companies with WWW presence are more likely to develop an Internet infrastructure.

In all of the studies, a single respondent, such as a senior executive or an information systems/information technology manager, was used to fill in the questionnaire on behalf of the whole organisation.

All of the studies used cross-sectional surveys for data collection. One of the studies (Maguire et al., 2007) combined a survey with follow-up in-depth interviews involving some of the survey participants (with interview participants self-selected). In most of the studies, the potential respondents were reached by means of a self-administered questionnaire posted to them by regular mail (see, for example, Maguire et al., 2007; Ngai & Gunasekaran, 2004); in one of the studies (Liang et al., 2004), the survey questionnaires were delivered by hand. In a study by Cloete et al. (2002), the questionnaires were both posted and faxed to the respondents. None of the studies relied on e-mail or on online questionnaires. The response rates ranged from 9% (Heung, 2003) to 100% (Liang et al., 2004). The high response rate in Liang et al. study was probably due to the convenience sampling approach used in the study; the questionnaires were hand delivered to the hospitals' managers who took a class of healthcare management continuing education offered by Beijing University (indeed, the prospective participants may have felt to be under obligation to participate). The reasons behind low or high response rates in other studies were not clear from what was reported.

Most of the studies (see, for example, Cloete et al., 2002; Kaynak et al., 2005; Ngai & Gunasekaran, 2004; Ramaseshan, 1997; Teo & Ranganathan, 2004) covered both

the benefits and the barriers (thus, the respondents reported their opinion regarding the benefits of EDI or e-commerce use to their organisation and regarding the barriers to EDI or e-commerce use within their organisation).

2.5.1 Benefits of EDI and E-Commerce

The benefits of EDI and e-commerce adoption and use reported in the literature are summarised in Table 2-6. The benefits are listed in descending order, starting from the more commonly reported. Normalised benefit scores enabling comparison between studies were calculated similarly to the benefit scores for e-procurement (discussed in section 2.4.2), and are also listed in Table 2-6.

2.5.1.1 Benefits of EDI

The benefits of EDI with broad support across studies were "reduce purchasing time," "improve data accuracy," "reduce the use of resources," "reduce business costs," "increase competitiveness," and "improve relationships with trading partners".

Reduction in purchasing time and improvement in data accuracy are two obvious potential benefits of automated (rather than manual) processing of purchasing documentation (realised by EDI), and the studies confirmed that these benefits were, indeed, achieved by many organisations (but not by all organisations, as it is clear from variations between studies, which highlights the risks of EDI implementation).

Reduction in the use of resources is another potential benefit of EDI. Once an EDI implementation is successfully completed, purchasing documentation is processed automatically, releasing human resources for use in other areas and thus resulting in the reduction of business costs.

It is likely that an EDI implementation is the result of pressure from business partners (see the discussion in section 3.4.3.2); therefore, it is not surprising that EDI implementation is perceived as resulting in improved relationships with business partners.

Table 2-6 *EDI and E-Commerce Benefit Scores*

	EDI				E-commerce				E-procurement						
Benefit	Ramaseshan (1997)	Vijayasarathy & Tyler (1997)	Sriram et al. (2000)	Ngai & Gunasekaran (2004)	Cloete et al. (2002)	Issa et al. (2003)	Teo & Ranganathan (2004)	Kaynak et al. (2005)	Kheng & Al-Hawamdeh (2002)	Hawking & Stein (2004)	Lefebvre et al. (2005)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)	Tanner et al. (2008)	Gunasekaran et al. (2009)
Reduce business costs	.31	.67	.19	.50	.31	.63[a]	.37	.24	.60	.57	.34	.60	.75	.41[a]	.35
Increase competitiveness	.20	.55	.28	.66	.53		.43		.60				.50		
Improve relationships with trading partners		.58	.11	.52		.98[a]						.58	.58		.43
Reduce the use of resources		.70	.06	.64		.71[a]						.55		.15[a]	.33
Reduce purchasing time	.09	.77	.27	.80						.43		.65			.33
Access wider markets					.62	.51[a]	.35	.21				.56	.33		.33
Improve data accuracy	.09	.77	.20	.67		.63[a]									
Increase revenue		.60						.37			.34		.33		
Improve operations efficiency					.62			.31							
Create new business opportunities					.32			.26							
Convenience			.10					.25							
Increase productivity			.14			.84[a]									
Improve security of data				.49											
Improve organisation image								.24							

Note. Most of the studies used 5 or 7-point Likert scales; Cloete et al., Ramaseshan, and Sriram et al. used nominal scales. The details of how the studies were conducted are summarised in Table 2-5.

[a]Numbers estimated based on a graph given in the paper.

Once specific benefits such as reduced purchasing time, improved data accuracy, reduced use of resources, reduced business costs, and improved relationships with trading partners are realised, they are likely to lead to increased competitiveness, so it is not surprising that increased competitiveness is seen as a benefit of EDI along with more specific benefits.

Improved security of data was considered only in one study (Ngai & Gunasekaran, 2004), but received a good support. One has to note that improved security as a benefit depends on the quality of EDI implementation. Automatic data process suggests digitalisation of the organisation's data and network connectivity. When dedicated connections between organisations are not available, Internet may be used to carry EDI data. Replacing a paper-based system by a digital system with Internet connectivity may well result in decreased security, if the digital security measures are not appropriate.

None of the studies considered access to wider markets and creating new business opportunities as potential benefits of EDI. This may be an omission: even though EDI implementations rely on established relationships between organisations, EDI capability may be a source of competitive advantage making it easier for an organisation to enter a new market, thus creating a business opportunity.

2.5.1.2 Benefits of E-Commerce

The benefits of e-commerce with broad support across studies were "access wider markets" and "reduce business costs," with "access wider markets" getting the most consistent support. Nonetheless, as clear from the absolute values of benefit scores and from variations between studies, these benefits were not always realised in full. Access to wider markets and reduced business costs are likely to lead to increased competitiveness, so it is not surprising that in both of the studies that considered the generic "increase competitiveness" benefit it received a level of support consistent with the level of support for the two most broadly supported benefits of e-commerce.

Two studies (Cloete et al., 2002; Kaynak et al., 2005) considered the "improve operations efficiency" benefit; the benefit was supported strongly by one of the

studies (Cloete et al., 2002), but supported considerably less by another (Kaynak et al., 2005).

One would expect that accessing wider markets would result in creating new business opportunities, therefore, it is surprising that both of the studies that considered this benefit (Cloete et al., 2002; Kaynak et al., 2005) rated it relatively low (particularly, considering that one of these studies rated "access wider markets" very high).

Overall, the results for the benefits of e-commerce are more difficult to interpret than the results for the benefits of EDI, because e-commerce encompasses a very broad range of functionalities, so that it is not always clear which functionalities the respondents have in mind when characterising e-commerce in general.

2.5.1.3 Comparing the Benefits of EDI and E-Commerce with the Benefits of E-Procurement

EDI is just one of the e-procurement functionalities, and sellers have a different view of B2B e-commerce than buyers. Therefore, one would not expect the benefits to be entirely consistent across EDI, B2B e-commerce (from sellers' perspective), and e-procurement.

The only benefit broadly and consistently supported across the studies of EDI, e-commerce, and e-procurement was "reduce business costs," which was not surprising because this benefit is associated with most systems automating manual information processing. Both e-procurement and EDI received broad support for improving relationships with business partners and for reducing purchasing time.

2.5.2 Barriers to EDI and E-Commerce

The barriers to EDI and e-commerce adoption and use reported in the literature are summarised in Table 2-7. The barriers to EDI and e-commerce covered in the literature are listed in descending order, starting from the more commonly reported. Normalised benefit scores enabling comparison between studies were calculated

similarly to the benefit scores for e-procurement (discussed in section 2.4.2), and are also listed in Table 2-7.

2.5.2.1 Barriers to EDI

None of the barriers was supported by all three of the studies of EDI adoption and use. Limiting the consideration to the two quantitative studies (on the grounds that the results of quantitative studies are more likely to be generalisable), the barriers with consistent support were "change management issues," "security issues," and "lack of top management support".

EDI implementation radically changes how business transactions are conducted (Glandon, 2003), changing work patterns and even, possibly, increasing the likelihood of redundancies; therefore, some of the employees are likely to resist EDI adoption and use. Thus, it is not surprising that change management issues were important. To overcome such change management issues, top management support is essential; hence, supporting lack of top management support as a barrier. Information transmitted via EDI is highly sensitive, and the very existence of the company depends on the integrity of such information; therefore, it is not surprising that security issues were a barrier.

2.5.2.2 Barriers to E-Commerce

The barriers to e-commerce with broad support across studies were “security issues,” “implementation cost issues,” “lack of knowledge and skills,” “technical issues,” “regulatory and legal issues,” and “change management issues”.

Companies using B2B e-commerce are likely to rely on a broad range of technologies, such as e-marketplaces and EDI, and it is likely that some of the purchaser organisations are located overseas; therefore, the emphasis on the need to deal with technological complexities, as well as on regulatory issues and on security, is not surprising.

Table 2-7 *EDI and E-Commerce Barrier Scores*

	EDI			E-commerce					E-procurement						
	Ramaseshan (1997)	Liang et al. (2004)	Ngai & Gunasekaran (2004)	Cloete et al. (2002)	Heung (2003)	Teo & Ranganathan (2004)	Kaynak et al. (2005)	Maguire et al. (2007)	Kheng & Al-Hawamdeh (2002)	Davila et al. (2003)	Hawking & Stein (2004)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)	Tanner et al. (2008)	Gunasekaran et al. (2009)
Technical issues	.04	—[a]	.50	.28[b]	.60	.59	.62	—[a]	.40	.47	.52	.50	.53	.36[b]	.51
Implementation cost issues	.07	—[a]	.48	.29[b]	.77		.54	—[a]	.30	.32	.53	.55	.21	.61[b]	.53
Lack of knowledge and skills			.47	.38[b]	.67	.58	.49	—[a]	.30	.54	.55	.53	.17	.11[b]	.55
Change management issues	.19		.49	.18[b]	.60	.63			.30	.31	.50	.50	.38		.55
Regulatory and legal issues	.11	—[a]	.50	.32[b]	.61	.58	.39			—[a]	.45	.58		.40[b]	.48
Security issues	.15		.46	.38[b]	.79	.53		—[a]			.45	.53	.25		.53
Lack of top management support	.20		.47		.40	.38			.20		.33	.55	.08		.35
Cultural and social issues		—[a]	.45			.56									
Difficulty of justifying the usefulness and potential of new information technology						.69								.48[b]	
No efficiency in operations							.52								
EDI products are not widespread			.49												
Locks buyer into a limited number of suppliers	.06														

Note. Most of the studies used 5 or 7-point Likert scales; Cloete et al. and Ramaseshan used nominal scales. The details of how the studies were conducted are summarised in Table 2-5.

[a]Barriers characterised based on qualitative data; hence, no numeric scores available. [b]Numbers extimated based on a graph given in the paper.

2.5.2.3 Comparing the Barriers to EDI and E-Commerce with the Barriers to E-Procurement

There was a considerable consistency between the barriers to e-commerce and the barriers to e-procurement. This was possibly because many of the barriers considered by the studies were quite generic and relevant to any large system resulting in changes to how work is done and relying on Internet connectivity beyond the company's local network (and possibly, across borders). The barriers did not depend on specific functionalities.

The barriers to EDI adoption and use consistently supported by the two quantitative studies, "change management issues," "security issues," and "lack of top management support," were also consistently supported as barriers to B2B e-commerce and to e-procurement adoption and use.

2.6 Theories Explaining Technology Adoption and Use

The aim of this section is to present the theories relevant to information technology adoption and use by organisations. Both the discussion of prior explanatory studies of e-procurement use in section 2.7 and the hypotheses formulated for my study (hypotheses are introduced in section 3.4) rely on the theories and theoretical frameworks introduced in this section.

To-date, explanatory studies of information systems adoption and use at an organisational level have been conducted for a broad range of systems, including e-business (see, for example, Hsu, Kraemer, & Dunkle, 2006; Srinivasan, Lilien, & Rangaswamy, 2002; Zhu & Kraemer, 2005; Zhu, Kraemer, Gurbaxani, & Xu, 2006), e-procurement (see, for example, Soares-Aguiar & Palma-dos-Reis, 2008; Teo et al., 2009; Wu et al., 2007), EDI (see, for example, Kuan & Chau, 2001; Ngai & Gunasekaran, 2004; Premkumar, Ramamurthy, & Crum, 1997), production and inventory control information systems (see, for example, Cooper & Zmud, 1990), human resources information systems (see, for example, Teo, Lim, & Fedric, 2007), and ERP (see, for example, Law & Ngai, 2007; Warrts, Everdingen, & Hillegersberg,

2002). Section 2.7 discusses the explanatory studies of e-procurement adoption and use in detail.

Theories and theoretical frameworks used to explain information technology adoption and use by organisations include diffusion of innovation (DOI) theory (see, for example, Hsu et al., 2006), resource-based view (RBV) theory (see, for example, Zhu & Kraemer, 2005), network effect theory (see, for example, Zhu, Kraemer, Gurbaxani, et al., 2006), institutional theory (see, for example, Soares-Aguiar & Palma-dos-Reis, 2008), path dependency theory (see, for example, Zhu, Kraemer, Gurbaxani, et al., 2006), and technology-organisation-environment (TOE) framework (see, for example, Teo et al., 2009). The rest of this section introduces the specific theories and theoretical frameworks relevant to explaining information technology adoption and use by organisations. My study addresses e-procurement use at the level of an organisation (rather than at the level of an individual); therefore, technology acceptance model (TAM) (Davis, 1985) and its extensions, such as unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003), are not covered.

DOI theory (Rogers, 1962; Rogers, 2003) describes the process of spreading an innovation via communication channels over time among the members of a social system. The four key elements in the diffusion process are innovation (defined as an idea, practice, or object that is perceived as new), communication channels (defined as the means by which messages get from one individual to another), time, and the social system (defined as people or groups of people engaged in the innovation adoption process).

Roger's theory details the stages of the innovation decision process (knowledge, persuasion, decision, implementation, and confirmation). The theory suggests the pertinent attributes of an innovation (relative advantage, compatibility, complexity, trialability, and observability). Moreover, the theory suggests the major categories of adopters (innovators, early adopters, early majority, late majority, and laggards). The category of an adopter and the attributes of an innovation affect the rate of adoption.

The members of a social system, the potential adopters, could be individuals, informal groups, or organisations. When the adopter is an organisation, along with the attributes of the organisation's leader as an adopter, DOI theory suggests that organisational structure (e.g., centralisation, complexity, and formalisation) and organisational openness (links to other organisations) affect the rate of adoption. DOI theory is discussed in more detail, including the examples of its use, in section 2.6.1.

RBV theory (Wernerfelt, 1984; Barney, 1991) suggests that firms create value by combining resources, both tangible and intangible (along with the term *resources*, the terms *capabilities* and *assets* are used in the literature, largely synonymously with *resources*). Examples of tangible resources are land and machinery. Examples of intangible resources include brand names, skills, and knowledge of technology. The resources vary across firms (Barney, 1991) and are not perfectly mobile, resulting in sustained competitive advantage (Peteraf, 1993). Barney (1991) suggested that in order to provide competitive advantage, firm resources must possess four attributes: value (the resources have value to firms in the industry), rarity (unique or rare to find), imperfect imitability (difficult to imitate or copy), and non-substitutability (competitors cannot substitute the resource by another, alternative resource to achieve the same results). The value of a particular resource may depend on the presence of other, related resources (Mohd Salleh, 2009).

RBV theory distinguishes physical capital resources, human capital resources, and organisational capital resources. Information technology can be seen as a physical capital resource. Training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in a firm (all highly relevant to managing innovation and technology) are human capital resources. The structure (formal and informal) and the management systems of a firm, along with the firm's relationships with organisations and entities in its environment are viewed by RBV theory as the firm's capital resources (intra-organisational and inter-organisational). The structure of a firm is both reflected and supported by its information systems, and the firm's relationships with other firms may involve sharing information in digital form and inter-organisational system integration.

Srinivasan et al. (2002), in a survey of companies in multiple industries in the US, found that the adoption and use of e-business was influenced by the technological capabilities of the firms.

Chang, Wang, and Chiu (2008), in a multiple-case study of four manufacturing companies in China, found that firms with low levels of information technology knowledge tend to limit themselves to adopting e-procurement with low levels of integration. In Chang et al. study, technical information technology skills and managerial information technology skills were used to measure the level of information technology knowledge.

RBV theory has been criticised for being not specific enough in defining various types of resources; Priem and Butler (2001) argued that key definitions varied from study to study, with the resulting inconsistency hindering the accumulation of knowledge.

Network effect theory (Katz & Shapiro, 1986; Chwelos, Benbasat, & Dexter, 2001) (also called network externality or demand-side economies of scale) suggests that the actions of a firm may depend on the collective actions of other firms. The value of a technology with network effect is dependent on the number of others using it. The size of the network of firms using a particular technology with network effect is affected by the benefits that adopters derive from using the technology, while the benefits, in turn, depend on the size of the network. Examples of technology with network effect are e-mail and EDI.

Zhu, Kraemer, Gurbaxani, et al. (2006), in a survey of companies in multiple industries and in multiple countries (including United States, Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore, and Taiwan), found that network effects affected the adoption of EDI. Network effects were conceptualised as peer adoption (adoption at the same level of the supply chain) and trading community influence (adoption at other levels of the supply chain). Trading community influence was found to be a stronger determinant than peer adoption.

Lai, Wang, Hsieh, and Chen (2007), in a survey of international trading companies in China, found that network effects affected the adoption of e-business. Similar to Zhu, Kraemer, Gurbaxani, et al. (2006), network effects were conceptualised as peer adoption and trading community influence. Similar to the study by Zhu, Kraemer, Gurbaxani, et al. (2006), trading community influence was found to be a stronger determinant of adoption than peer adoption.

Institutional theory (Scott, 1987; Soares-Aguiar & Palma-dos-Reis, 2008) suggests that mimetic (copying practice at other organisations), coercive (competition with other organisations), and normative pressures (norms embedded in the profession) may influence an organisation's decision to use technology. An organisation is likely to adopt an innovation that other organisations have used successfully, particularly if the organisation's competitors are using (or intend to use) the innovation. If there are regulations or codes of practice in place (or about to be put in place) that suggest that the organisation should use the innovation, it makes the adoption of the innovation particularly likely (Haveman, 1993).

Soares-Aguiar and Palma-dos-Reis (2008), in a survey of large companies in multiple industries in Portugal (mentioned in section 1.2), found that company perceptions about their competitors' success with e-procurement systems and about the extent of adoption among competitors affected the company's decision to adopt an e-procurement system.

Liang, Saraf, Hu, and Xue (2007), in a survey of companies in multiple industries in China, found that mimetic pressures and coercive pressures affected top management participation in the ERP adoption process.

Path dependency theory (Arthur, 1989; Cohen & Levinthal, 1990) suggests that organisations need prior knowledge and experience to assimilate and use new technology. Prior knowledge includes basic skills and shared language, and may also include the knowledge of recent developments in the information technology field. Absorptive capacity refers to a firm's ability to recognise the value of new information, assimilate it, and apply it to commercial ends. (Absorptive capacity is

similar to categories of adopters in DOI theory, but emphasises organisational aspects, rather than dispositions of individuals.) Prior knowledge and experience affect a firm's absorptive capacity, which, in turn, affects adoption.

Zhu, Kraemer, Gurbaxani, et al. (2006), in the study introduced earlier in this section, found that adoption costs were a barrier to open-standard IOS adoption. Proprietary EDI adopters (organisation that already adopted proprietary EDI) and non-adopters treated these adoption costs very differently. Proprietary EDI adopters were more sensitive to the costs of adoption compared to non-adopters. Thus, system adoption was affected by the organisational experience in using the EDI technology.

Krucken (2003) collected qualitative data relating to technology adoption within German universities by interviewing administrators and academics (covering all universities in Germany). By analysing qualitative data, he concluded that the universities need to take into account the path dependent character of their organisations' structures and practices in making decisions regarding adopting new technology.

TOE framework (Tornatzky & Fleischer, 1990) identifies three contexts of organisational decision making that influence the adoption and use of a technological innovation. These contexts are the technological context (T), internal and external technologies relevant to the organisation (both technologies already in use and technologies not currently in use, but potentially useful); organisational context (O), the attributes of the organisation, such as its scope, size, and amount of resources available internally; and environmental context (E), the arena in which the organisation conducts its business (including customers, suppliers, competitors, and the government). These three contexts represent both opportunities and constraints for technological innovation.

TOE framework does not stipulate the specific factors in these three contexts that affect technological innovation; hence, it is a framework that can be used as a basis for formulating theories, rather than a theory per se. In Table 2-8, I summarise the theories introduced in this section in terms of TOE framework.

The technological context is addressed by both DOI theory and RBV theory. RBV theory simply considers technology as a physical capital resource that can be used to generate a sustained competitive advantage. DOI theory suggests the specific attributes of an innovation (applicable to technology innovation) relevant to decisions regarding adoption and use.

Table 2-8 *Theories Relevant to Explaining Information Technology Adoption and Use Viewed Through the Lens of TOE Framework*

Theory	Technology	Organisation	Environment
DOI theory	Characteristics of the technology as an innovation.	Attributes of the leader as an adopter and organisational structure.	Organisational openness.
RBV theory	Technology as physical capital resources.	Information technology related human capital resources and intra-organisational capital resources.	Inter-organisational capital resources.
Network effect theory	—	—	Influence from organisations in vertical and horizontal relationships in the supply chain.
Institutional theory	—	—	Mimetic, coercive, and normative pressures.
Path dependency theory	—	Prior knowledge and experience.	—

The organisational context is addressed by DOI theory, RBV theory, and path dependency theory. DOI theory and RBV theory are similar in terms of modelling the organisational context, because from the perspective of RBV theory, the aspects of organisational structure claimed by DOI theory to affect adoption and use can be seen as human capital and intra-organisational capital resources. Prior knowledge and experience suggested as influencing adoption and use by path dependency theory are, to an extent, covered by both DOI theory and RBV theory (as the complexity aspect of an organisation's structure by DOI theory and as a human capital resource by RBV theory).

The environmental context is addressed by most of the theories considered in this section. Arguably, RBV theory addresses this context in a rather limited way, as the environment cannot be viewed solely as a resource, but also presents constraints and threats. Network effect theory and institutional theory explicitly focus on the environment and can be seen as explaining the consequences of organisational openness (an aspect of the DOI theory).

E-procurement is the practice of using information technology in inter-organisational context (as discussed in section 1.2); thus, for the adoption and use of e-procurement, along with the technological and organisational contexts, the environmental context is highly relevant. DOI theory explicitly targets explaining technology adoption and addresses all the three contexts, which prompted Al-Qirim (2005), Prescott (1995), and Zhu, Dong, Xu, et al. (2006) to suggest that a combination of TOE framework and DOI theory is a good starting point for formulating models of technology adoption and use.

As a theory that is particularly relevant to the research problem of my study, DOI theory is discussed in detail in section 2.6.1, which is followed by section 2.6.2, introducing examples of the use of TOE framework in formulating models explaining technology adoption and use (both in conjunction with the DOI theory and in conjunction with other theories).

2.6.1 DOI Theory

DOI theory was briefly introduced in section 2.6 along with other theories relevant to explaining technology adoption and use at an organisational level. In section 2.6, I argued that the DOI theory is particularly relevant to the research problem of my study. In this section, I discuss the DOI theory in more detail.

DOI theory (Rogers, 1962; Rogers, 2003) describes the process of innovation adoption in a social system. According to DOI theory, an innovation is communicated via channels over time. The communication channels are mass media channels (e.g., radio and newspapers) and interpersonal, interactive channels (such as in face-to-face communication).

DOI theory suggests that innovation adoption involves five stages: knowledge, persuasion, decision, implementation, and confirmation. In the knowledge stage, the potential adopters, individuals, informal groups, or organisations, become aware of the innovation. In the persuasion stage, the potential adopters attain a favourable or unfavourable attitude towards the innovation. In the decision stage, the potential adopters decide to adopt or reject the innovation. In the implementation stage, the adopters make full use of the innovation. Finally, in the confirmation stage, the adopters, based on the initial experience of using the innovation, decide whether to continue using it. The five stages compose the innovation diffusion process. Potential adopters do not necessarily become adopters, as they may never attain a favourable attitude towards the innovation (in stage two), may decide to reject it (in stage three), or may decide to discontinue using the innovation after an initial trial period (in stage five).

DOI theory categorises adopters as innovators (enthusiasts), early adopters (visionaries), early majority (pragmatists prepared to accept some risk), late majority (conservatives trying to minimise risk), and laggards (sceptics prepared to accept the risk of staying behind others).

DOI theory identifies five attributes of innovation: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage is the extent to which an innovation is perceived as being better than the idea it supersedes. Compatibility is the extent to which an innovation is perceived by the potential adopters as being consistent with their values, past experiences, and needs. Complexity is the extent to which an innovation is perceived as difficult to understand and use. Trialability is the extent to which an innovation may be experimented with on a limited basis. Observability is the extent to which the results of an innovation are visible to others. An innovation with greater relative advantage, compatibility, trialability, observability, and less complexity is adopted more rapidly.

Tornatzky and Klein (1982) conducted a meta-analysis on innovation characteristics and innovation adoption-implementation. They reported ten attributes of innovation that were most commonly examined in prior studies: compatibility, relative

advantage, complexity, implementation cost, communicability, divisibility, profitability, social approval, trialability, and observability. Of these characteristics, however, only relative advantage, compatibility, and complexity were consistently found to explain innovation adoption and use. Some recent studies that found relative advantage, compatibility, and complexity to affect innovation adoption and use by organisations are Alam, Khatibi, Ahmad, and Ismail (2007), Ramdani and Kawalek (2007), and Tan, Chong, Lin, and Eze (2009). Alam et al. found relative advantage, compatibility, and complexity to affect the adoption of e-commerce; Ramdani and Kawalek, enterprise systems adoption; Tan et al. (2009), Internet-based ICT adoption.

When an innovation is adopted by an organisation, the innovation-decision process is more complicated because more than one individual is involved in the decision process. Innovations are adopted by organisations via three types of innovation-decisions: optional innovation-decisions, collective innovation-decisions, and authority innovation-decisions. If individual employees make choices to adopt or reject an innovation independent of the decisions by other members of the organisation, the innovation decision is described as an optional innovation-decision. If the choice is made by consensus among the members of the organisation, the innovation decision is described as a collective innovation-decision. If individuals with power, social status, or technical expertise make the choice on behalf of the organisation, the innovation-decision is described as an authority innovation-decision.

The innovation decision process within an organisation consists of five stages that are similar to the innovation-decision process at the level of individuals. These stages are agenda-setting (define a problem), matching (fit the problem with the innovation), redefining/restructuring (modify and re-invent the innovation, and alter the organisational structures), clarifying (simplify the relationship between the organisation and the innovation), and routinising (incorporate the innovation in the organisation). The first two of the five stages constitute initiation activities and the last three constitute implementation activities.

DOI theory identifies three attributes of an organisation's innovativeness: attributes of the organisation's leader as an adopter (innovator, early adopter, early majority,

late majority, or laggard), attributes of the organisational structure, and the organisational openness. The attributes of the organisational structure may include centralisation (concentration of power and control in an organisation), complexity (level of knowledge and expertise of the employees), formalisation (the extent to which the behaviour of employees is determined by formal rules and procedures), and size. Organisational openness refers to the extent to which the members of the organisation are linked to members of other organisations. DOI theory suggests that leaders' positive attitude toward change, higher complexity, higher organisational openness, and greater size positively affect an organisation's innovativeness. Formalisation and centralisation negatively affect an organisation's innovativeness.

It is common to draw distinction between process and variance theories: theories describing typical stages of a process and theories hypothesising cause effect relationships between variables (Gregor, 2006). DOI is clearly a process theory, but it has been used as a source of hypotheses for more parsimonious variance theories, in particularly, theories predicting rates of innovation adoption and use. Beatty, Shim, and Jones (2001) argued that variance models based on DOI theory have been consistently found to explain adoption and use of information technology and information systems innovations.

2.6.2 The Uses of TOE Framework in Formulating Models Explaining Technology Adoption and Use

TOE framework was introduced in section 2.6 as a framework for formulating theories explaining technology adoption and use at an organisational level. TOE framework is used in my study as one of the theoretical foundations for the research model. The uses of TOE framework in formulating models explaining technology adoption and use are discussed in detail in this section.

TOE framework (Tornatzky & Fleischer, 1990) suggests that the adoption and use of a technological innovation are driven by factors from the three contexts: technology, organisation, and environment. The factors empirically tested for each of these contexts vary between studies. In the rest of this section, I introduce three studies that

used TOE framework to formulate models explaining information systems adoption or use and tested these models against empirical data.

Kuan and Chau (2001) tested a model involving six factors hypothesised to affect EDI adoption. The factors were perceived direct benefits and perceived indirect benefits (from the technological context), perceived implementation cost and perceived technical competence (from the organisational context), and perceived industry pressure and perceived government pressure (from the environmental context). The model was tested against 575 responses obtained in a survey of small businesses in multiple industries in Hong Kong. All of the factors included in the model, with the exception of perceived indirect benefits, were found to affect EDI adoption. In terms of the effect size, the effects of perceived technical competence, perceived industry pressure, perceived direct benefits, perceived implementation cost, and perceived government pressure were the strongest (with path coefficients .78, -.75, .53, -.50, and .22, respectively). Thus, all of the three contexts were confirmed to be relevant, but the factors with the largest effect were from the organisational and environmental contexts. Perceived industry pressure was conceptualised as the pressure from other organisations to adopt EDI; the negative effect of perceived industry pressure may be due to the limitation of the correlational survey design in studying adoption (with adoption seen as a binary variable reflecting the existence of use). Organisations that had already adopted EDI would experience less pressure. This does not mean that pressure negatively affects adoption and, most likely, a positive relationship would have been found if a longitudinal design had been used.

Teo et al. (2007) tested a model involving seven factors hypothesised to affect the extent of human resources information systems use. The factors were relative advantage, compatibility, and complexity (from the technological context), top management support, firm size, and human resources information systems expertise (from the organisational context), and competition (from the environmental context). The model was tested against 110 responses obtained in a survey of companies in multiple industries in Singapore. Top management support and organisation size were found to affect the extent of human resources information systems use (with

path coefficients .36 and .29, respectively). Thus, only one of the three contexts (organisational context) was confirmed to be relevant.

Teo et al. (2009) tested a model involving eight factors hypothesised to affect the extent of use of e-procurement. The factors were perceived direct benefits, perceived indirect benefits, and perceived implementation costs (from the technological context), firm size, top management support, information sharing culture, and industry (from the organisational context), and business partner influence (from the environmental context). The model was tested against 141 responses obtained in a survey of companies in multiple industries in Singapore. Only firm size, information sharing culture, and perceived implementation costs were found to affect the extent of use of e-procurement (with path coefficients .24, .22, and -.20, respectively). Thus, only two of the three contexts (technological and organisational contexts) were confirmed to be relevant, but the factors with the largest effect were from the organisational context. However, the extent of use of e-procurement in Teo et al. (2009) was conceptualised as the depth of e-procurement use (see section 2.7.3.1 for a detailed discussion of the operationalisation of depth in the Teo et al. study) and did not cover the breadth of e-procurement use.

As seen from the three examples given in this section, TOE framework is useful not only as a basis for formulating models, but also as a framework for interpreting the results.

2.7 Explanatory Studies of E-Procurement Adoption and Use

This section discusses explanatory studies of e-procurement adoption and use, focusing on the factors likely to affect e-procurement adoption and use by organisations. As mentioned in section 2.4, only the studies with an organisation as a unit of analysis are covered, and studies of e-procurement adoption and use by individual employees (with an individual as a unit of analysis) are not covered. To be covered in this section, a study had to use a research model with either e-procurement adoption or extent of e-procurement use as a dependent variable.

Table 2-9 *Explanatory Studies of E-Procurement Adoption and Use*

	Study	Section	Country	Key informant	*N* [c]	Theoretical framework	Dependent variable	Independent variables (factors)[a]		
								T[d]	O[e]	E[f]
1	Min & Galle (2003)	2.7.2	US	NAPM member[b]	656	—	adoption	t1*	o1*, o3*	e3
2	Batenburg (2007)	2.7.3	EU	Information technology manager	3,475	—	adoption	—	o1*, o3*	—
							breadth	—	o1*, o3*	—
							depth	—	o1, o3*	—
3	Wu et al. (2007)	2.7.4	US	Senior executive	144	Path dependency theory and institutional theory	breadth	—	o4, o6*	e2*
4	Pearcy et al. (2008)	2.7.4	US	Purchasing/supply management professional	142	—	breadth	—	o3*	—
5	Soares-Aguiar & Palma-dos-Reis (2008)	2.7.2	Portugal	Senior executive	240	TOE framework and institutional theory	adoption	t3*	o1*, o2, o5*	e1*, e2*
6	Teo et al. (2009)	2.7.3	Singapore	Senior executive	141	TOE framework	adoption	t1*, t2	o1*, o3, o4*, o7	e2*
							depth	t1, t2*	o1*, o3, o4, o7*	e2

Note. In all of the studies, the unit of analysis was an organisation, with the key informant responding on behalf of the organisation. All studies covered organisations of all sizes in multiple industries, with the exception of Soares-Aguiar and Palma-dos-Reis, who covered large organisations (in multiple industries).

[a]Details of the independent variables are given in Table 2-10. [b]NAPM = National Association of Purchasing Management. [c]*N* is the number of companies that participated in the study. [d]T = technological context. [e]O = organisational context. [f]E = environmental context.

*Found to affect the dependent variable at $p < .05$.

Table 2-10 *Definitions of the Factors Covered*

Independent variables (factors)		Description	Studies in which hypothesised to affect[a]		
			Adoption	Breadth	Depth
Technology:					
t1	Perceived benefits	Relative advantages of using e-procurement.	1*, 6*		6
t2	Perceived implementation costs	Perceived costs of adopting e-procurement.	6		6*
t3	Information technology infrastructure	Information technology capabilities available at the organisation.	5*		
Organisation:					
o1	Firm size	Size of the firm.	1*, 2*, 5*, 6*	2*	2, 6*
o2	Firm scope	Geographical dispersion of a firm's operation.	5		
o3	Industry	Industry in which the firm operates.	1*, 2*, 6	2*, 4*	2*, 6
o4	Top management support	Top management commitment and managerial attention.	6*	3	6
o5	Employee knowledge and skills	Employees' knowledge and skills relevant to e-procurement.	5*		
o6	Organisational learning ability	Ability to evaluate, adopt, and exploit external knowledge.		3*	
o7	Information sharing culture	Intra-organisational and inter-organisational information sharing culture.	6		6*
Environment:					
e1	Partner readiness	Readiness of trading partners to adopt the technology.	5*		
e2	External pressure	Pressures caused by early adopters.	5*, 6*	3*	6
e3	Number of suppliers	Size of the firms' supply base.	1		

[a]Details of the studies are given in Table 2-9.

*Found to be affected at $p < .05$.

Explanatory studies of e-procurement adoption and use are summarised in Table 2-9 and discussed in detail in the following sections.

2.7.1 Research Contexts and Methods

This section introduces the explanatory studies of e-procurement adoption and use and compares their research contexts (in terms of types of organisations covered, industries, and countries) and research methods (in terms of approaches to data collection and analysis, sample sizes and response rates, theoretical frameworks, and conceptualisation and operationalisation of e-procurement adoption and use).

The studies were conducted in different regions, including Asia (see, for example, Teo et al., 2009), Europe (see, for example, Batenburg, 2007; Soares-Aguiar & Palma-dos-Reis, 2008), and North America (see, for example, Min & Galle, 2003; Pearcy et al., 2008; Wu et al., 2007). There were no studies in Australasia (at the time when the literature review was conducted, in February 2012; the procedures used in the literature review are outlined in section 2.4).

The studies covered businesses of all sizes, with most of them covering both SMEs and large companies (see, for example, Batenburg, 2007; Min & Galle, 2003; Pearcy et al., 2008; Wu et al., 2007). Only one study (Soares-Aguiar & Palma-dos-Reis, 2008) covered large companies only. None of the studies covered SMEs only.

All of the studies covered companies from multiple industries, with manufacturing and transportation included most consistently.

In most of the studies, a single respondent, such as a procurement officer or an information technology manager, was used to fill in the questionnaire on behalf of the whole organisation. In two of the studies (Soares-Aguiar & Palma-dos-Reis, 2008; Wu et al., 2007), the respondents (one per company) were drawn from top or middle management, not limited to a particular type of position.

All of the studies used cross-sectional surveys for data collection. In most of the studies, the potential respondents received a self-administered questionnaire posted

to them by regular mail (see, for example, Pearcy et al., 2008; Teo et al., 2009); only in one of the studies (Soares-Aguiar & Palma-dos-Reis, 2008) the participants were contacted via e-mail, with the self-administered questionnaire provided online. The response rates ranged from 14% (Pearcy et al., 2008; Wu et al., 2007) to 23% (Teo et al., 2009). In one of the studies (Batenburg, 2007), the response rate was not reported. Similar to the descriptive studies of e-procurement adoption and use discussed in section 2.4, the reasons behind low or high response rates in different studies were not clear from what was reported.

The studies relied on a range of statistical approaches for hypothesis testing. Min and Galle (2003) used the chi-square test of independence to test the effect of the industry sector, discriminant analysis to test the effects of the firm size and of the number of suppliers, and stepwise discriminant analysis to test the effect of the perceived benefits. (Because different approaches were used for different factors, it is difficult to compare effects and effect sizes.) Soares-Aguiar and Palma-dos-Reis (2008) used logistic regression analysis to test the hypotheses for the determinants of e-procurement adoption. Teo et al. (2009) performed a logistic regression analysis to test the hypotheses for the determinants of e-procurement adoption. In contrast, Teo et al. used partial least squares (PLS) to test the hypotheses for the determinants of the extent of use of e-procurement. Batenburg (2007) performed univariate analysis to test hypotheses one by one (using chi-square tests) and multivariate analysis to test the whole model at once (using general linear modelling). Batenburg reported statistical significance only, and did not report effect sizes. Wu et al. (2007) used covariance-based SEM (using EQS software from Multivariate Software, http://www.mvsoft.com) to test the hypotheses for the determinants of the intensity of e-procurement use. Pearcy et al. (2008) conducted exploratory factor analysis (EFA) and discovered two factors, which they interpreted as corresponding to basic and integrative e-procurement functionalities.

The inconsistency in the statistical methods used made it difficult to compare effect sizes across studies. (I cannot assert that such a comparison was impossible, but I did not have sufficient expertise in multivariate data analysis to conduct it.)

In the following, sections 2.7.2, 2.7.3, 2.7.4, and 2.7.5 discuss the explanatory studies of e-procurement adoption and use. This is followed by a discussion of the nomological framework suggested by the studies (in section 2.7.6) and by a summary of the factors found to have effect (in section 2.7.7).

2.7.2 Studies of Adoption as the Existence of Use

This section discusses the explanatory studies of e-procurement adoption that interpreted adoption as existence of use (and thus, operationalised adoption as a binary variable). In both of the studies (Min & Galle, 2003; Soares-Aguiar & Palma-dos-Reis, 2008), the respondent answering a survey questionnaire on behalf of her company directly indicated if e-procurement was in use within the company. Therefore, the answer depended on the respondents' interpretation of what constitutes e-procurement.

2.7.2.1 Conceptualisation and Operationalisation of Dependent Variables

Min and Galle (2003) did not refer to e-procurement, but to e-purchasing. Nonetheless, Pearcy et al. (2008) and Schoenherr and Tummala (2007), when referring to the article by Min and Galle, described it as a study of "e-procurement" (rather than of "e-purchasing"). Min and Galle tested a number of hypotheses regarding the determinants of e-purchasing adoption and a number of hypotheses comparing the use of EDI with the use of Internet for purchasing. Only hypotheses for e-procurement adoption were directly relevant to my study. Min and Galle operationalised adoption as a binary variable. The respondents were asked to indicate if their company adopted e-purchasing. The survey instrument was not included in the article. Thus, it was not clear if the survey instrument included a definition of what constitutes e-purchasing, and if yes, how exactly it was worded.

Soares-Aguiar and Palma-dos-Reis (2008) used e-procurement system adoption as the dependent variable. Similar to Batenburg (2007) and Min and Galle (2003), Soares-Aguiar and Palma-dos-Reis operationalised adoption as a binary variable. The respondents were asked to indicate if their company adopted e-procurement. The survey questionnaire that was included in the article did not contain a definition of e-

procurement (although it is possible that the questionnaire included has been abridged for publication).

2.7.2.2 Factors Included and their Interpretation in terms of Theoretical Frameworks

Min and Galle (2003) did not explicitly rely on any theories or theoretical frameworks to identify the factors affecting e-purchasing adoption. Similar to Teo et al. (2009), Min and Galle included factors from all of the three contexts of TOE framework (introduced in section 2.6), perceived benefits from the technological context; firm size (measured as the number of purchasing employees) and industry from the organisational context; and number of suppliers from the environmental context.

One of the factors, perceived benefits, was similar to relative advantage in DOI theory (see section 2.6.1 for a detailed discussion of DOI theory). Nonetheless, Min and Galle (2003) did not explicitly mention DOI theory in their article. Min and Galle justified the inclusion of the individual factors by relying on their understanding of the underlying mechanisms based on prior empirical studies.

Soares-Aguiar and Palma-dos-Reis (2008) explicitly relied on TOE framework, institutional theory, and RBV theory to formulate hypotheses regarding factors affecting e-procurement adoption. Soares-Aguiar and Palma-dos-Reis included factors from all of the three contexts (see Tables 2-9 and 2-10 for details): information technology infrastructure, information technology expertise, and B2B know-how from the technological context; firm size and firm scope from the organisational context; and extent of adoption among competitors, trading partner readiness, and perceived success of competitor adopters from the environmental context. Soares-Aguiar and Palma-dos-Reis measured firm size as the number of physical establishments (such as buildings, offices, stores, or warehouses) where the organisation develops business activities (in my opinion, estimating the "number of physical establishments" may have been difficult for the respondents in view of the imprecise meaning of the concept, but the article did not mention any difficulties).

Soares-Aguiar and Palma-dos-Reis (2008) considered information technology expertise and B2B know-how as belonging to the technological context, along with information technology infrastructure. In my view, information technology expertise and B2B know-how should be treated as organisational factors, as they reflect the human capital resources and capabilities that are required to support the use of information technology infrastructure. Therefore, in Table 2-9 summarising the results of explanatory studies of e-procurement adoption and use, I classified information technology expertise and B2B know-how as organisational factors.

The information technology infrastructure factor reflected the firm's use of a range of information technologies (EDI, Internet, intranet, e-mail, groupware tools, and video conferencing). The factor was operationalised as a count of technologies in use within the respondent organisation (the respondents were presented with a set list of technologies). Soares-Aguiar and Palma-dos-Reis (2008) viewed information technology as a physical capital resource in terms of the RBV theory.

Soares-Aguiar and Palma-dos-Reis (2008) justified the inclusion of firm scope, firm size, and trading partner readiness by relying on their understanding of the underlying mechanisms backed by references to prior empirical studies (not explicitly referring to any theories). (The inclusion of trading partner readiness could have been justified by referring to the network effect theory; see section 2.6 for an introduction of the network effect theory.)

2.7.2.3 Findings

Min and Galle (2003) found that the effects of perceived benefits, firm size, and industry on e-purchasing adoption were statistically significant.

From the technological context, perceived benefits positively affected e-purchasing adoption, in agreement with DOI theory. Unlike Teo et al. (2009), who also considered the effect of perceived benefits on adoption (see section 2.7.3), Min and Galle (2003) did not distinguish between direct benefits and indirect benefits (Teo et al., 2009, found that only indirect benefits affected e-procurement adoption).

From the organisational context, firm size positively affected e-purchasing adoption. Min and Galle (2003) concluded that firms with a larger number of employees were more likely to adopt e-purchasing than firms with a smaller number of employees. They suggested that this was probably because firms with more employees have greater financial resources to implement e-purchasing, more bargaining power to convince their partners to allow e-purchasing, and are large enough to benefit from the economies of scale achieved via e-purchasing.

The industry in which the firm operates affected e-purchasing adoption. Min and Galle (2003) argued that firms in different industries have different information processing needs due to different product and service requirements, and concluded that firms in more information-intensive industries, such as healthcare, were more likely to adopt e-purchasing than firms in less information-intensive industries, such as government and manufacturing.

In the study by Soares-Aguiar and Palma-dos-Reis (2008), the effects of firm size, information technology infrastructure, information technology expertise, B2B know-how, trading partner readiness, and perceived extent of adoption among competitors on e-procurement adoption were statistically significant. (Perceived success of competitors was excluded from the analysis because of multicollinearity with extent of adoption among competitors.) In terms of the effect size, the effects of information technology expertise, perceived extent of adoption among competitors, information technology infrastructure, firm size, B2B know-how, and trading partner readiness were the strongest (with odd ratios 3.73, 3.62, 2.05, 1.80, 1.46, and 1.40, respectively). The use of odd ratios as a measure of effect size is discussed by Pallant (2011). (It should be noted that in the article, Soares-Aguiar & Palma-dos-Reis, used *p* values, measures of statistical significance, to rank factors in terms of their effect, which is not appropriate, see Cohen, 1988.)

From the technological context, information technology infrastructure positively affected e-procurement adoption. Soares-Aguiar and Palma-dos-Reis (2008) concluded that firms with higher levels of information technology infrastructure are

more likely to adopt e-procurement (possibly, because the existing infrastructure can be leveraged to implement e-procurement).

From the organisational context, similar to Teo et al. (2009), firm size positively affected e-procurement adoption. Soares-Aguiar and Palma-dos-Reis (2008) concluded that larger firms with more resources are more likely to adopt e-procurement than smaller firms. Soares-Aguiar and Palma-dos-Reis suggested that larger firms have greater ability to bear risks associated with investing in e-procurement and have more power to influence their trading partners to adopt e-procurement.

Information technology expertise and B2B know-how positively affected e-procurement adoption. Soares-Aguiar and Palma-dos-Reis (2008) concluded that firms with higher levels of information technology expertise and B2B know-how are more likely to adopt e-procurement (as these factors facilitate e-procurement implementation).

From the environmental context, trading partner readiness positively affected e-procurement adoption. The use of e-procurement in an organisation depends on the readiness of the organisation's trading partners to get involved in e-procurement. According to Soares-Aguiar and Palma-dos-Reis (2008), because the use of e-procurement requires collaboration and coordination between trading partners, trading partner readiness influences e-procurement adoption.

Extent of adoption among competitors positively affected e-procurement adoption (Teo et al., 2009, also found that business partner influence affected e-procurement adoption). Soares-Aguiar and Palma-dos-Reis (2008) concluded that e-procurement adoption is affected by competitive pressures.

2.7.3 Studies of Extent of Use by Self-Declared Adopters

This section discusses the explanatory studies of e-procurement adoption and use that (a) similarly to the studies covered in section 2.7.2, interpreted adoption as existence of use (and thus, operationalised adoption as a binary variable) and (b) investigated

the determinants of the extent of e-procurement use for the (self-declared) adopters only.

The respondent answering a survey questionnaire on behalf of her company directly indicated if e-procurement was in use within the company (therefore, the answer depended on the respondents' interpretation of what constitutes e-procurement). Only self-declared adopters filled in the part of the questionnaire covering the extent of e-procurement use; therefore, the effective population for the part of the survey covering the extent of e-procurement use and its determinants depended on the respondents' interpretation of what constitutes e-procurement.

2.7.3.1 Conceptualisation and Operationalisation of Dependent Variables

Teo et al. (2009) used two dependent variables in their study: e-procurement adoption and extent (level) of use of e-procurement (extent of use of e-procurement was covered only for the respondents who recognised their firms as adopters).

Teo et al. (2009) used a binary variable of adopted versus not adopted for e-procurement adoption. For the extent of use of e-procurement, the adopters were asked to indicate the percentage of items procured electronically, the percentage of the variety of items procured electronically, the percentage of functional units that can procure items electronically, and the percentage of internal business processes that involve procuring items electronically. The questionnaire items required the respondents to summarise information and to interpret complex terms; therefore, it was likely that different respondents would interpret the questionnaire items differently.

In terms of the distinction between breadth and depth of use introduced in Chapter 1, the extent of use of e-procurement in the study by Teo et al. (2009) can be seen as depth of use (the extent to which the company relies on e-procurement in its procurement practice).

Batenburg (2007) used four dependent variables in their study: e-procurement adoption, extent of use of e-procurement functionalities, percentage of total

purchases conducted online, and year of adoption. Extent of use of e-procurement functionalities, percentage of total purchases conducted online, and year of adoption were considered only for the respondents who explicitly recognised their firms as e-procurement adopters. A binary variable of adopted versus not adopted was used for e-procurement adoption.

In the study by Batenburg (2007), extent of use was considered separately for each of the functionalities included. The functionalities covered were ordering goods from websites of other companies, ordering goods from e-marketplaces, ordering goods or services through access to the extranet of a supplier, and using an integrated information technology system with a supplier to place orders. Thus, in terms of the descriptive model of the forms of e-procurement in Figure 2-1, the information perspective was not covered at all. From the transaction perspective, e-auction, e-tender, and IntraOS were not covered.

Similar to Teo et al. (2009), to report the percentage of total purchases conducted online, respondents had to summarise information and to interpret complex terms; thus, it was likely that different respondents would interpret the questionnaire items differently.

In terms of the distinction between breadth and depth of use introduced in Chapter 1, the extent of use of e-procurement functionalities in Batenburg (2007) can be seen as the breadth of use (the extent to which different forms or functionalities of e-procurement are used); nonetheless, Batenburg did not operationalise the extent of use of e-procurement functionalities as a single variable. Research designs treating the extent of use of each functionality as a separate variable are vulnerable to capitalisation of chance because the number of hypotheses considered in such designs is rather large. Batenburg considered only two determinants, industry and firm size, which limited the number of hypotheses and, thus, held in check capitalisation of chance issues.

In the study by Batenburg (2007), the percentage of total purchases conducted online can be seen as the depth of use (similarly to Teo et al., 2009, operationalised as the extent to which the company relies on e-procurement in its procurement practice).

2.7.3.2 Factors Included and their Interpretation in terms of Theoretical Frameworks

Teo et al. (2009) explicitly relied on TOE framework (introduced in section 2.6) to formulate hypotheses regarding factors affecting e-procurement adoption and extent of use of e-procurement (the same set of factors was hypothesised to affect both of the dependent variables). Teo et al. (2009) included factors from all of the three contexts (see Tables 2-9 and 2-10 for details): perceived direct benefits, perceived indirect benefits, and perceived implementation costs from the technological context; firm size (measured as average annual revenue, number of employees, and number of information technology staff), industry, top management support, and information sharing culture from the organisational context; and business partner influence from the environmental context.

Two of the factors (perceived direct benefits, benefits associated with internal efficiency of the organisation; perceived indirect benefits, benefits associated with the impact of adopting EDI for management of business process and relationships) were similar to relative advantage in Rogers' DOI theory (see section 2.6 for an introduction of the DOI theory). One of the factors (perceived implementation costs) was related to perceived complexity in Rogers' DOI theory. Business partner influence (another factor included by Teo et al., 2009) was similar to coercive pressures in institutional theory (see section 2.6 for an introduction of the institutional theory). Nonetheless, Teo et al. (2009) did not explicitly mention either DOI theory or institutional theory in their article.

Teo et al. (2009) justified the inclusion of the individual factors by relying on their understanding of the underlying mechanisms based on prior empirical studies and on informal conversations with procurement practitioners they met at MBA and executive training programmes.

Batenburg (2007) did not explicitly rely on any theories or theoretical frameworks to formulate hypotheses regarding factors affecting the dependent variables. From the perspective of TOE framework, Batenburg included factors from one of the three contexts only, firm size (measured as the number of employees) and industry from the organisational context.

Batenburg (2007) justified the inclusion of the individual factors by relying on his understanding of the underlying mechanisms based on prior literature. Nonetheless, it appears that the choice of factors was influenced by the data available. Batenburg did not collect data for the purposes of his study, but rather relied on a data set collected for a different purpose.

2.7.3.3 Findings

For e-procurement adoption, Teo et al. (2009) found that the effects of perceived indirect benefits, firm size, top management support, and business partner influence were statistically significant. In terms of the effect size, the effects of perceived indirect benefits, business partner influence, firm size, and top management support were the strongest (with odd ratios 2.31, 1.79, 1.66, and .27, respectively). The use of odd ratios as a measure of effect size is discussed by Pallant (2011). (It should be noted that, similarly to Soares-Aguiar & Palma-dos-Reis, 2008, in the article, Teo et al. used *p* values, measures of statistical significance, to rank factors in terms of their effect, which is not appropriate, see Cohen, 1988.)

For the extent of use of e-procurement, Teo et al. (2009) found that the effects of perceived implementation costs, firm size, and information sharing culture were statistically significant. In terms of the effect size, the effects of firm size, information sharing culture, and perceived implementation costs were the strongest (with path coefficients .24, .22, and -.20, respectively, corresponding to small to medium effect sizes according to Kline, 2011).

From the technological context, perceived indirect benefits affected e-procurement adoption, but did not affect the extent of use of e-procurement. In contrast, perceived

implementation costs negatively affected the extent of use of e-procurement, but had no relationship with e-procurement adoption. Teo et al. (2009) concluded that firms tended to focus more on indirect benefits (such as enhanced relationships with business partners) when considering e-procurement adoption, but switched to focusing on cost when actually using e-procurement.

From the organisational context, firm size positively affected both e-procurement adoption and the extent of use of e-procurement. Teo et al. (2009) concluded that larger firms with more resources (such as revenue and work force) have a greater tendency to adopt e-procurement and to use e-procurement extensively than their smaller counterparts.

Top management support affected e-procurement adoption, but did not affect the extent of use of e-procurement. Teo et al. (2009) concluded that once top management gives support to adopting e-procurement, it tends to delegate decisions determining the extent of use of e-procurement and, therefore, top management support becomes less of an issue.

Information sharing culture positively affected the extent of use of e-procurement, but did not affect e-procurement adoption. Teo et al. (2009) concluded that information sharing is more important when an organisation had already adopted the technology and is deciding the extent of its usage. A possible explanation is that the adoption decision is primarily taken by the top management, but the extent and the pattern of use are determined based on experiences shared by employees involved in using e-procurement.

From the environmental context, Teo et al. (2009) found that business partner influence positively affected e-procurement adoption, but did not affect the extent of use of e-procurement. A possible explanation is that business partners influence the managements' decision to adopt e-procurement, but the pattern of use is primarily decided based on experience accumulated inside the organisation.

As seen from the discussion above, making a distinction between adoption (seen as existence of use, the outcome of an explicit decision by the management) and use (pattern of use established over a period of use since adoption) may enable meaningful interpretations. Distinguishing between adoption and use (and considering use to be a consequence of an organisation-level decision to adopt) is clearly appropriate if e-procurement is conceptualised as the use of sophisticated dedicated e-procurement systems. Nonetheless, practices such as the use of web browsers to search for information related to purchasing or the use of e-mail in the purchasing process are likely to occur spontaneously and do not necessarily require an explicit organisation level decision; if the use of commonly available technologies to facilitate procurement is seen as e-procurement, it may be impossible to identify the organisation-wide adoption event. Therefore, I believe that in the study by Teo et al. (2009) (which relied on a very broad conceptualisation of e-procurement), the overall design did not fit their conceptualisation of e-procurement.

In the study by Batenburg (2007), based on the multivariate analysis, none of the factors were statistically significant. The following discussion is based on the results of univariate analysis. I focus on the findings relevant to the problem addressed in my study (thus, the results for the year of adoption are not discussed).

From the organisational context, firm size positively affected e-procurement adoption (Soares-Aguiar and Palma-dos-Reis, 2008, and Teo et al., 2009, also found that firm size affected e-procurement adoption). Batenburg (2007) concluded that larger firms were more likely to adopt e-procurement than smaller firms, probably because larger firms with many employees commonly have many suppliers and, thus, benefit more from e-procurement as the number and the variety of purchase orders are large.

Similar to Min and Galle (2003), the effect of industry on e-procurement adoption in Batenburg (2007) was statistically significant (In contrast, Teo et al., 2009, found that the industry in which the firm operated did not affect e-procurement adoption).

Unlike in the study by Teo et al. (2009), the effect of industry on the percentage of total purchases conducted online in Batenburg (2007) was statistically significant. (Nonetheless, one has to be cautious when comparing the results of Teo et al., 2009, and of Batenburg, as they used different statistical procedures; the use of univariate modelling by Batenburg may have inflated the effects of the factors considered.)

Firm size did not affect the use of supplier websites or the use of e-marketplaces, but did positively affect the use of supplier extranets and system integration with suppliers. In my interpretation, firms of all sizes used e-procurement functionalities that require little investment in information technology to the same extent, but larger firms were more likely to use e-procurement functionalities that required more investment. Firms from different industries used supplier websites to the same extent, but the firm industry did affect the use of more sophisticated e-procurement functionalities.

Based on considering effects on all of the dependent variables, Batenburg (2007) concluded that firms in the ICT sector were ahead of firms in other industries in using e-procurement. Batenburg suggested that firms in the ICT sector purchase ICT products and services, which are particularly suitable for e-procurement.

2.7.4 Studies of Breadth of Use

This section discusses the explanatory studies of extent of e-procurement use that, unlike the studies covered in section 2.7.3, did not distinguish adopters from non-adopters, but rather collected information relating to extent of use from all of the respondents. Therefore, the results did not depend on the interpretation by the respondents of what constitutes an e-procurement adoption event.

2.7.4.1 Conceptualisation and Operationalisation of Dependent Variables

Wu et al. (2007) included dimensions of the intensity of e-procurement use as dependent variables in their model (the study also considered relationship development and perceived efficiency gains as outcomes of e-procurement use; the results for these variables are not covered here as not relevant to the purpose of my

study). The dimensions were coordination application use and transactional application use. According to Wu et al. (2007), coordination applications involve the use of e-procurement as a strategic tool to facilitate information exchange with suppliers. Examples of coordination applications are sending suppliers regular updates about new product plans and other new developments within the strategic business unit (e.g., via e-mail), providing specific online information about product specifications that suppliers must meet, sharing product and inventory planning information with suppliers, and permitting suppliers to directly link up to database.

In contrast, transactional applications focus on the use of e-procurement to facilitate transactions. Examples of transactional applications include searching and locating potential suppliers online, placing and tracking orders with suppliers electronically, allowing suppliers to submit bids online, and using e-marketplaces to source suppliers. Thus, in terms of the information perspective in the descriptive model of forms of e-procurement formulated in my study (see Figure 2-1), Wu et al. (2007) did not cover e-collaboration. From the transaction perspective, Wu et al. (2007) did not distinguish different forms of e-procurement corresponding to different ways of placing orders, as suppliers can be bidding via tenders or reverse auctions, and orders can be placed via e-catalogue or as an outcome of biddings at an auction, or via EDI. IntraOS was also not covered.

In terms of the distinction between breadth and depth of use introduced in Chapter 1, I interpreted the dimensions of the intensity of e-procurement use in Wu et al. (2007) as characterising the breadth of use, and classified their study accordingly in Table 2-9. Nonetheless, these dimensions can be seen as reflecting both breadth and depth of e-procurement use at the same time, with both broader use of e-procurement functionalities and more use of particular functionalities corresponding to higher intensity of use.

Pearcy et al. (2008) used a combination of EFA and cluster analysis to establish two profiles of e-procurement use within firms to distinguish firms using mainly basic e-procurement functionalities, functionalities that do not require coordination and integration between supply chain members (basic users), from firms using integrative

e-procurement functionalities (integrative users). The profile of e-procurement use within a firm was used as the dependent variable (measured on a binary scale, as basic tool users versus integrative tool users).

Pearcy et al. (2008) investigated the use of a range of e-procurement functionalities. The functionalities covered were (a) searching for low-cost suppliers, visiting suppliers' websites, accessing online catalogues, and placing orders on suppliers' websites (characterised as basic in the analysis by Pearcy et al.); and (b) developing an integrated supply chain, planning and scheduling production, collaborating with suppliers on product design issues, achieving cross-functional coordination, and searching for suppliers that would help the organisation to differentiate offerings (characterised as integrative). Thus, in terms of the information perspective in the descriptive model of forms of e-procurement formulated in my study (see Figure 2-1 in section 2.3), Pearcy et al. did not cover e-informing. From the transaction perspective, e-auction, e-tender, and IntraOS were not covered.

The profile of e-procurement use represented the variety of e-procurement functionalities used within a firm; therefore, in terms of the distinction between breadth and depth of use introduced in Chapter 1, profile membership in the work by Pearcy et al. (2008) can be seen as a measure of breadth.

2.7.4.2 Factors Included and their Interpretation in terms of Theoretical Frameworks

Wu et al. (2007) explicitly relied on path dependency theory (organisational learning ability or absorptive capacity) and institutional theory (normative pressures) to formulate hypotheses regarding factors affecting the intensity of e-procurement use (see section 2.6 for an introduction of these theories). The same set of factors was hypothesised to affect both of the dimensions of intensity of e-procurement use.

From the perspective of TOE framework, Wu et al. (2007) included factors from two of the three contexts only, top management support and organisational learning ability from the organisational context, and normative pressures from the

environmental context. In my view, the use of e-procurement in an organisation is not shaped by the organisational and environmental factors only, but also by the technological factors (see the argument in section 1.2), therefore, in a model aiming to explain e-procurement use, factors from all three contexts of TOE framework should be included.

Pearcy et al. (2008) did not explicitly rely on any theories or theoretical frameworks to identify the variables affecting the use of e-procurement functionalities. From the perspective of TOE framework, Pearcy et al. included a determiner from one of the three contexts only, industry from the organisational context.

2.7.4.3 Findings

Wu et al. (2007) found that the effects of organisational learning ability and normative pressures on both dimensions of the intensity of e-procurement use were statistically significant. In terms of the effect size, organisational learning ability predicted coordination application use slightly better than transactional application use; conversely, normative pressures predicted transactional application use better than coordination application use.

For the effects of organisational learning ability and normative pressures on coordination applications use, the path coefficients were .28 and .18, corresponding, respectively, to medium and small effects according to Kline (2011). In contrast, for the effects of normative pressures and organisational learning ability on the transactional applications use, the path coefficients were .25 and .24, corresponding to medium effect sizes according to Kline. (See section 4.4 for an introduction of the Kline's heuristics for interpreting effect sizes.)

Thus, the results suggested that organisations that can learn are more likely to adopt and use e-procurement and that normative pressures (pressures from trading partners and competitive pressures) result in greater use of e-procurement. In my opinion, the effect of normative pressures on transactional application use was stronger than on coordination application use because some of the normative pressures covered were

primarily pertinent to transactional applications (e.g., trading partners are likely to be more concerned about using e-procurement to conduct transactions than about using information technology for coordinating activities around e-procurement); Wu et al. (2007) did not comment on this aspect.

Pearcy et al. (2008) found that the effect of industry on the profile of e-procurement use (and thus, on the use of e-procurement functionalities) was statistically significant.

2.7.5 Conceptualisations and Operationalisations of E-Procurement Adoption and Use

Most of the studies relied on broad definitions of e-procurement (inclusive of the uses of commonly available technology such as e-mail). The only exception was the study by Soares-Aguiar and Palma-dos-Reis (2008), which may have relied on a narrower definition. As discussed in section 2.7.3.3, a broad definition of e-procurement is difficult to reconcile with defining an organisation-wide e-procurement adoption event. Nonetheless, four of the six prior explanatory studies of e-procurement adoption and use (Batenburg, 2007; Min & Galle, 2003; Soares-Aguiar & Palma-dos-Reis, 2008; Teo et al., 2009) relied on obtaining information from respondents regarding such an event in their research designs, with e-procurement adoption operationalised as the existence of e-procurement use playing a central role.

Ramamurthy et al. (1999), Tornatzky and Klein (1982), and Zhu, Dong, Xu, et al. (2006) criticised binary measures of system or technology adoption as not capturing salient variations in organisational behaviour with respect to information technology. Indeed, a binary summative measure may be interpreted differently by different respondents. For example, one can answer yes to the question "Did your organisation adopt e-procurement" for several different reasons, such as (1) the respondent's organisation adopted a system that was marketed as an e-procurement system, (2) the respondent's organisation adopted a system that was marketed as including e-procurement functionality, or (3) the respondents' organisation relies on purchasing

via Internet (via generic Internet browsers), but never implemented a system that was marketed as an e-procurement system. (It is notable that none of the four studies that relied on a binary measure of e-procurement adoption provided sufficient information regarding how e-procurement was explained to the respondents in their research instruments, if at all.) Methodological literature suggests that the content of a construct should be covered comprehensively and in detail (Clark & Watson, 1995). Thus, relying on an approach involving measures reflecting the details of actual practice is likely to result in greater validity.

The survey instruments in the studies by Pearcy et al. (2008) and Wu et al. (2007) asked the respondents about the use of e-procurement functionalities and did not rely on the notion of an organisation-wide e-procurement adoption event. Pearcy et al. used cluster analysis to present the breadth of e-procurement use within an organisation in terms of the organisation belonging to one of two e-procurement use profiles (basic tool users and integrative tool users).

Wu et al. (2007) presented e-procurement use as a two-dimensional construct, with the dimensions of coordination application use and transactional application use measured via items corresponding to the extent of use of individual e-procurement functionalities. Of the six studies discussed in sections 2.7.2, 2.7.3, and 2.7.4 (and summarised in Table 2-9), the approach by Wu et al. (2007) was most consistent with common practice in Management Information Systems (MIS) research (Gefen, Straub, & Boudreau, 2000). Even though the binary measure of the breadth of e-procurement use used by Batenburg (2007) offers a simple interpretation, it oversimplifies the state of e-procurement use, as considerable variations are likely among organisations belonging to the same profile. Therefore, representations of e-procurement use by using (possibly, multi-dimensional) latent constructs with continuous scales (as used by Wu et al., 2007) are more promising for future research because they can capture subtle differences between organisations.

In terms of the descriptive model of the forms of e-procurement in Figure 2-1 (see section 2.3), none of the studies covered all of the e-procurement functionalities from the information perspective (e-sourcing, e-collaboration, and e-informing) (see

Table 2-11 for an overview of the explanatory studies). E-sourcing was covered by both Pearcy et al. (2008) and Wu et al. (2007), e-collaboration only by Pearcy et al., and e-informing only by Wu et al. (2007). Batenburg (2007) did not cover e-procurement functionalities from the information perspective at all.

From the transaction perspective, InterOS was covered by three studies (Batenburg, 2007, Pearcy et al., 2008, and Wu et al., 2007), and e-catalogue by both Batenburg and Pearcy et al. None of the studies covered e-tender, e-auction, and IntraOS. (Wu et al., 2007, covered placing orders, but did not distinguish between different forms of e-procurement that may be used for placing orders.)

Table 2-11 *Explanatory Studies of E-Procurement: Breadth of Use*

	Study		
Form of e-procurement	Batenburg (2007)	Wu et al. (2007)	Pearcy et al. (2008)
	Information perspective		
E-sourcing		x	x
E-collaboration			x
E-informing		x	
	Transaction perspective		
E-catalogue	x		x
E-tender			
E-auction			
IntraOS			
InterOS	x	x	x

For depth of use, the two studies that covered depth (Batenburg, 2007; Teo et al., 2009) adopted a similar measure of depth, percentage of business transactions conducted online. If depth is conceptualised as the extent to which the organisation relies on e-procurement, this measure clearly captures an important aspect, even though it does not take into account the full richness of e-procurement forms and functionalities available.

2.7.6 Nomological Framework

Factors (independent variables hypothesised to affect e-procurement adoption or use) considered in the explanatory studies of e-procurement adoption and use reviewed in section 2.7 covered all contexts of TOE framework (see section 2.6 for an introduction of the TOE framework). The factors are summarised and defined in Table 2-10. Organisational context was covered in more detail than technological or environmental, with the number of organisational factors explicitly covered in the literature greater than the number of technological and environmental factors put together. The organisational factors, firm size and type of industry, were covered in most of the studies.

The factors considered by the studies were consistent with DOI theory, path dependency theory, institutional theory, RBV theory, and network effect theory (these theories are introduced in section 2.6). All of these theories received some support. The results for individual factors are summarised in section 2.7.7.

The studies were fragmented. As seen in the citation graph in Figure 2-3, the studies by Batenburg (2007) and Wu et al. (2007) did not cite the earlier related study by Min and Galle (2003); possibly, because Min and Galle used adoption as the dependent variable, while Batenburg and Wu et al. (2007) focused on the breadth of e-procurement use (with Batenburg also covering depth). The study by Pearcy et al. (2008), that also used breadth as the dependent variable, did not cite either Batenburg or Wu et al. (2007). Pearcy et al. did cite the study by Min and Galle, but only in connection with defining e-procurement. Pearcy et al. used a model with a single factor, the industry, and did not provide any analysis as to why other relevant factors found to have effect in the study by Min and Galle were not relevant. Soares-Aguiar and Palma-dos-Reis (2008), who used adoption as a dependent variable, did cite the earlier relevant work by Min and Galle, but even though they used a very different model, provided no analysis as to why the factors found to have effect in the study by Min and Galle were not relevant. Finally, the study by Teo et al. (2009), which used both adoption and depth of e-procurement use as dependent variables, cited only the work by Min and Galle. Again, although they used a model that was very different

from Min and Galle, they provided no analysis as to why the factors found to have effect in the study by Min and Galle were not relevant.

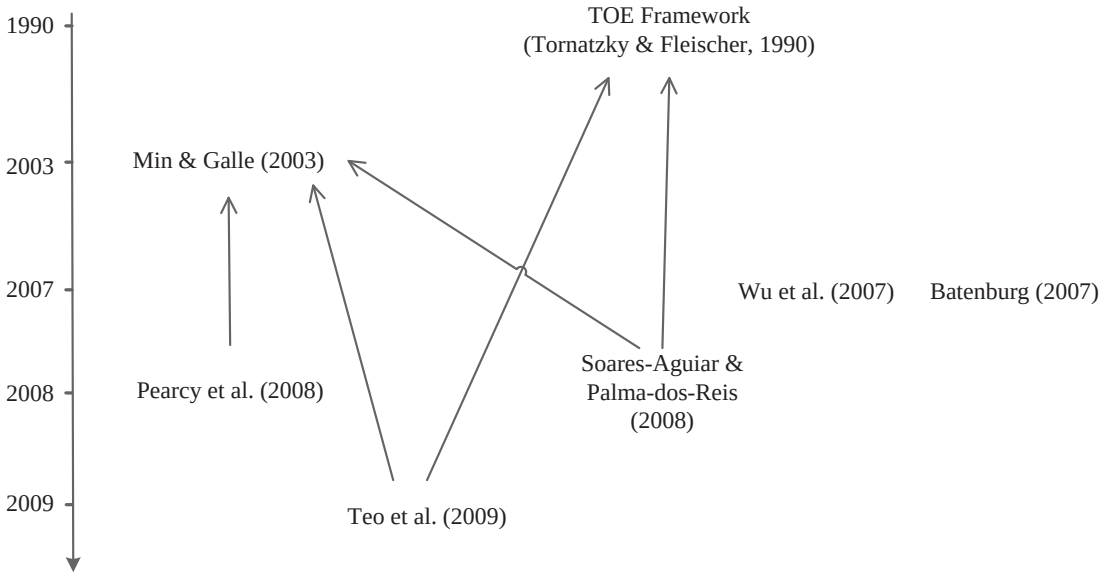

Figure 2-3. The timeline and the citation graph for the explanatory studies of e-procurement adoption and use. The details of the studies are given in Table 2-9.

Overall, it was not clear why factors hypothesised in different studies were different. It appears that this was not because of the differences between the contexts of the studies or even because of the differences between the dependent variables used (e-procurement adoption and breadth and depth of e-procurement use, while distinct, are clearly related). Thus, the existing literature does not provide a well-established nomological framework for the explanation of e-procurement adoption and use.

2.7.7 Factors Found to Have Effect

In all of the studies in which the technological factors were considered, some of the technological factors were found to have effect. One of the technological factors, perceived benefits, was confirmed to have effect in more than one study.

Organisational factors were considered in all of the studies, and in all of the studies, some of them had effect. Two of the organisational factors, firm size and industry were confirmed to have effect in more than one study.

Conversely, in some of the studies that considered environmental factors, none of the environmental factors had effect. In particular, in two of the three studies that included factors from all three of the TOE contexts (Min & Galle, 2003; Teo et al., 2009), the environmental factors were not found to have effect. Nonetheless, external pressure was found to have effect in more than one study.

Of the three studies with breadth of e-procurement use as a dependent variable (Batenburg, 2007; Pearcy et al., 2008; Wu et al., 2007), two studies considered only organisational factors. The study by Wu et al. (2007) considered external pressure (environmental factor) along with the organisational factors and did find external pressure to affect breadth. The organisational factors found to affect breadth were firm size, industry, and organisational learning ability. The industry in which the firm operates was found to affect breadth in more than one study (in two studies, one in the US, Pearcy et al., 2008, and another, in seven countries in the EU, Batenburg, 2007).

Depth of e-procurement use was the dependent variable in two studies, a study in the EU involving organisational factors only (Batenburg, 2007), and a study in Singapore involving factors from all three of the TOE contexts (Teo et al., 2009). The technological factor found to affect depth was perceived implementation costs (Teo et al., 2009). Organisational factors found to affect depth were firm size (Teo et al., 2009), industry (Batenburg, 2007), and information sharing culture (Teo et al., 2009). The only environmental factor considered (external pressure) was not found to affect depth (Teo et al., 2009).

The study by Batenburg (2007) was the only study that included both breadth and depth as dependent variables; only organisational factors, firm size and industry, were considered. Industry affected both breadth and depth, but firm size affected only breadth.

The rest of this section discusses one by one, in detail, the factors that were found to have effect on the dependent variables of particular interest to my study: on the breadth and the depth of e-procurement use or on e-procurement adoption. Even

though I believe that e-procurement adoption as a binary variable (e-procurement either adopted or not) is not an appropriate variable to describe the state of e-procurement practice within an organisation (see the argument in section 2.7.5), the breadth and the depth of e-procurement use can be seen as achieved via a series of adoption decisions (as more e-procurement functions are adopted, or e-procurement is adopted to cover a greater fraction of procurement activities); thus, factors found to affect e-procurement adoption are likely to be also relevant to explaining the breadth and the depth of e-procurement use. The discussion presented in the rest of this section is used as a basis for formulating the research model of my study (see section 3.2 for the details of the model).

2.7.7.1 Technological Factors

In the following, an explanation of why a particular factor is likely to affect e-procurement adoption and use is based on the studies and the theories cited, as well as on my broad understanding of the domain.

Perceived benefits. Perceived benefits refer to the anticipated advantages of e-procurement that can be provided to organisations. Organisations are more likely to use e-procurement if they believe that e-procurement results in benefits. The benefits of e-procurement include reducing transaction errors, reducing transaction costs, enhancing customer services, improving relationships with business partners (Teo et al., 2009), reducing paper transactions, and reducing order cycle (Min & Galle, 2003).

Perceived benefits was found to affect e-procurement adoption in the studies by Min and Galle (2003) and Teo et al. (2009). Perceived benefits (also known as relative advantage) is a factor suggested by the DOI theory (see section 2.6 for an introduction of the DOI theory).

Perceived implementation costs. Perceived implementation costs relate to the anticipated costs of using e-procurement. The use of e-procurement, as any use of technology, is associated with costs (even using the existing infrastructure is not cost free, as the employees have to learn new practices). Examples of e-procurement

implementation costs include administrative costs and training costs (Teo et al., 2009). For dedicated e-procurement systems, the costs of maintaining and implementing the system may be very high (Teo et al., 2009). Organisations that perceive the costs to be high will be reluctant to use e-procurement.

Perceived implementation costs were found to affect the depth of e-procurement use in the study by Teo et al. (2009). Perceived implementation costs can be seen as a factor suggested by the DOI theory (corresponding to the complexity attribute of innovation) (see section 2.6 for an introduction of the DOI theory).

Information technology infrastructure. Information technology infrastructure refers to information technology capabilities available within an organisation. To adopt e-procurement, firms need to possess the relevant information technology infrastructure, such as computers, databases, and communication networks (Soares-Aguiar & Palma-dos-Reis, 2008), so that the technology can be leveraged to implement e-procurement.

Information technology infrastructure was found to affect e-procurement adoption in the study by Soares-Aguiar and Palma-dos-Reis (2008). Information technology infrastructure is a factor suggested by the RBV theory (see section 2.6 for an introduction of the RBV theory).

2.7.7.2 Organisational Factors

Firm size. Firm size refers to the size of the organisation, which is commonly measured by the sales turnover or by the number of employees (Teo et al., 2009). Larger organisations benefit more from e-procurement because: (a) they have more suppliers; purchase orders are large and more diverse; (b) they have more financial resources; they are less restricted in spending budgets on e-procurement; and (c) they have many departments, business units, or establishments in which procurement is implemented; the need for internal coordination and management control is larger (Batenburg, 2007). Hence, larger organisations are more likely to use e-procurement

than smaller organisations (Min & Galle, 2003; Soares-Aguiar & Palma-dos-Reis, 2008: Teo et al., 2009).

Firm size was found to affect the breadth of e-procurement use in the study by Batenburg (2007), and was found to affect the depth of e-procurement use in the study by Teo et al. (2009). In addition, firm size was found to affect e-procurement adoption in the studies by Batenburg, Min and Galle (2003), Soares-Aguiar and Palma-dos-Reis (2008), and Teo et al (2009).

Industry. The industry in which the firm operates may have implications for the organisation's use of e-procurement. Firms in industries that are more technologically advanced, such as ICT or pharmacological firms, are more likely to engage actively in using e-procurement because they deliver complex products and services and, thus, have more complex procurement operations (Pearcy et al., 2008); moreover, such organisations are likely to have greater information technology related expertise and more innovative cultures. Organisations that process information on a large and regular basis gain more benefits from e-procurement than organisations in industries that are less information intensive (Min & Galle, 2003; Pearcy et al., 2008) because e-procurement functions can be integrated with the information systems supporting the operations.

Industry was found to affect the breadth of e-procurement use in the studies by Batenburg (2007) and Pearcy et al. (2008), and was also found to affect the depth of e-procurement use in the study by Batenburg. In addition, the industry in which the firm operates was found to affect e-procurement adoption in the studies by Batenburg and Min and Galle (2003).

It has to be noted that the distinction between industries may be captured in part by other factors, such as perceived benefits (e.g., in technologically advanced industries, the real advantages of using e-procurement are likely to be higher, and at the same time, the management is more likely to have sufficient expertise to recognise such benefits).

Top management support. The use of e-procurement requires sufficient resources in terms of both financial commitment and managerial attention (Teo et al., 2009). Such investments are unlikely to be made without top management's approval and support. Moreover, top management support is crucial to reduce barriers and resistance to change (Teo et al., 2009).

Top management support was found to affect e-procurement adoption in the study by Teo et al. (2009).

Employee knowledge and skills. The use of e-procurement relies on employees having the relevant information technology and management skills (Soares-Aguiar & Palma-dos-Reis, 2008). Greater knowledge of e-procurement enables organisations to be aware of the potential benefits and of the potential barriers of the technology, thereby, allowing organisations to manage the risks associated with investing in the technology.

Employee knowledge and skills was found to affect e-procurement adoption in the study by Soares-Aguiar and Palma-dos-Reis (2008). Employee knowledge and skills is a factor suggested by the RBV theory (see section 2.6 for an introduction of the RBV theory).

Organisational learning ability. Organisational learning ability (or absorptive capacity) is the ability of the organisation to evaluate, adopt, and exploit external knowledge (Wu et al., 2007). To achieve full benefits of e-procurement, an organisation needs to learn to incorporate different e-procurement functions in its business processes (Wu et al., 2007).

Organisational learning ability was found to affect the breadth of e-procurement use in the study by Wu et al. (2007). Organisational learning ability is a factor suggested by the path dependency theory (see section 2.6 for an introduction of the path dependency theory).

By learning, organisations acquire knowledge; knowledge acquired via learning can be within the minds of the employees (tacit knowledge) or can be embedded in documents or processes (explicit knowledge) (Dalkir, 2005). Ultimately, any changes within organisations (such as changing to a broader use of e-procurement) are enacted by the employees. Therefore, the employees' ability to use e-procurement depends on both tacit knowledge and explicit knowledge, and any explicit knowledge has to be internalised by the employees before it is used. Thus, the organisational learning ability is closely connected with employee knowledge, and can be seen as a factor promoting employee knowledge, rather than as a separate factor directly affecting e-procurement use. (It is notable that none of the explanatory studies of e-procurement adoption and use included employee knowledge and organisational learning ability at the same time.)

Information sharing culture. Two aspects of information/knowledge sharing culture are relevant to e-procurement: information sharing culture at the level of the organisation (Lin, 2007) and information sharing culture at the level of the supply chain to which the organisation belongs (Yao, Yue, & Liu, 2008).

First, information/knowledge sharing culture at the level of the organisation refers to the culture of trust, support, and openness inside an organisation that enables the employees to share knowledge, thus, improving the employee knowledge and skills throughout the organisation.

Second, information/knowledge sharing culture at the level of the supply chain refers to a similar culture of trust, support, and openness among the organisations belonging to a supply chain. Information sharing culture and willingness to share information at the level of the supply chain may facilitate e-procurement between the organisations (Teo et al., 2009) because it enables organisations to learn about each other's needs with respect to the forms and functionalities of e-procurement.

There is little research on information sharing culture at the level of the supply chain, even though it appears to be highly relevant to e-procurement use. (In my opinion, information sharing culture at the level of the supply chain may be related to partner

readiness and external pressure, environmental factors discussed in section 2.7.7.3, and, arguably, should be seen as an environmental factor. I covered it in this section because in prior literature it is commonly discussed along with information sharing culture inside the organisation.) As for the information sharing culture inside an organisation, it appears to be closely connected with employee knowledge, as employee knowledge can be seen, in part, as the outcome of an information sharing culture within the organisation.

Information sharing culture was found to affect the depth of e-procurement use in the study by Teo et al. (2009). Even though Teo et al. (2009) provided a strong argument suggesting the importance of information sharing culture at the level of the supply chain, the items they used to measure the construct of information sharing either directly referred to sharing within the organisation, or did not specify the scope of knowledge sharing at all. It appears that it is highly likely that the respondents would interpret all of the items as referring to sharing within the organisation only.

2.7.7.3 Environmental Factors

Partner readiness. Successful implementation of e-procurement in an organisation depends on the readiness of the trading partners to facilitate the use of e-procurement (Soares-Aguiar & Palma-dos-Reis, 2008). As the use of procurement requires collaboration between multiple organisations, partner readiness becomes salient. The use of e-procurement requires trading partners to adopt compatible electronic trading systems and to provide Internet-enabled services for each other (Soares-Aguiar & Palma-dos-Reis, 2008) so that they can engage in electronic interactions and transactions (Zhu, Kraemer, & Xu, 2003). In a trading community with greater partner readiness, organisations are in a better position to use e-procurement due to network effects.

Partner readiness was found to affect e-procurement adoption in the study by Soares-Aguiar and Palma-dos-Reis (2008). Partner readiness is a factor suggested by the network effect theory (see section 2.6 for an introduction of the network effect theory).

External pressure. A decision to use e-procurement depends on the pressures exerted by other organisations that have already done so (Wu et al., 2007). In prior studies, the constructs of normative pressures (Wu et al., 2007), perceived extent of e-procurement adoption among competitors (Soares-Aguiar & Palma-dos-Reis, 2008), and business partners' influence (Teo et al., 2009) cover various facets of external pressure. Organisations use e-procurement in response to external pressures because of the fear of being left behind, to respond to the desire of their partners in the supply chain to be connected to them via e-procurement, as well as because of written and unwritten norms.

External pressure was found to affect the breadth of e-procurement use in the study by Wu et al. (2007). In addition, external pressure was found to affect e-procurement adoption in the studies by Soares-Aguiar and Palma-dos-Reis (2008) and Teo et al. (2009). External pressure is a factor suggested by the institutional theory (see section 2.6 for an introduction of the institutional theory).

2.8 Explanatory Studies of EDI and E-Commerce Adoption and Use

This section discusses explanatory studies of EDI and B2B e-commerce adoption and use, focusing on the factors likely to affect EDI and e-commerce adoption and use by organisations. The procedures used to indentify the studies to cover in this section are described at the beginning of section 2.5. In particular, only the studies with an organisation as a unit of analysis are covered. To be covered in this section, a study had to use a research model with either EDI or B2B e-commerce adoption or extent of EDI or B2B e-commerce use as a dependent variable. Explanatory studies of EDI and e-commerce adoption and use are summarised in Table 2-12 and Table 2-13, respectively, and discussed in detail in the following sections.

Henceforth in this section (section 2.8), unless explicitly stated otherwise, when referring to e-commerce I refer to B2B e-commerce only.

Table 2-12 *Explanatory Studies of EDI Adoption and Use*

	Study	Country	Key informant	*N*[b]	Theoretical framework	Dependent variable	Independent variables (factors)[a]		
							T[c]	O[d]	E[e]
1	Germain & Droge (1995)	US	Senior executive	149	—	depth	t5*	o1*	
2	Crum et al. (1996)	US	CEO/EDI executive	181	—	adoption	t1*, t2*, t4, t5	o4*	e2*, e3*, e4, e5
3	Premkumar et al. (1997)	US	CEO/EDI executive	181	DOI theory	adoption	t1, t2, t4, t5	o1*, o4*	e2*, e3*, e4, e5
4	Chau & Hui (2001)	Hong Kong	Senior executive	627	DOI theory	adoption	t1*, t2*	o5*	e2*, e3*
5	Kuan & Chau (2001)	Hong Kong	Senior executive	575	TOE framework	adoption	t1*, t2*, t3*		e2*
6	Zhu, Kraemer, Gurbaxani, et al. (2006)	Multiple countries[f]	Senior executive	1,394	Network effect, path dependency	adoption	t1*, t2*	o1*, o3*	e2*
7	Seyal et al. (2007)	Brunei	Manager	50	—	adoption	t1*	o4*, o8, o9, o10	e3*

Note. In all of the studies, the unit of analysis was an organisation, with the key informant responding on behalf of the organisation. All studies covered organisations of all sizes in multiple industries, with the exceptions of Chau and Hui, Kuan and Chau, and Seyal et al. who covered SMEs (in multiple industries). Premkumar et al. covered large organisations only, in the transportation industry.

[a]Details of the independent variables are given in Tables 2-14 (from the technological context), 2-15 (from the organisational context), and 2-16 (from the environmental context). [b]*N* is the number of companies that participated in the study. [c]T = technological context. [d]O = organisational context. [e]E = environmental context. [f]Covered Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore, Taiwan, and US.

*Found to affect the dependent variable at $p < .05$.

Table 2-13 *Explanatory Studies of E-Commerce Adoption and Use*

	Study	Country	Key informant	*N*[b]	Theoretical framework	Dependent variable	Independent variables (factors)[a]		
							T[c]	O[d]	E[e]
1	Kendall et al. (2001)	Singapore	Director	58	DOI theory	adoption	t1*, t4*, t5, t6*, t7		
2	Wu et al. (2003)	US	Senior executive	144	—	breadth		o4*, o6*	e2*
3	Gibbs & Kraemer (2004)	Multiple countries[f]	Senior executive	2,139	Institutional theory and TOE framework	breadth	t1*, t3*, t4	o1, o7*	e2*, e3*
4	Grandon & Pearson (2004)	US	Senior executive	100	—	adoption	t1*, t3*, t4, t5*		e2*
5	Wang & Cheung (2004)	Taiwan	CEO	137	Institutional theory	breadth	t1, t3*	o5, o7*	e2*
6	Al-Qirim (2005)	New Zealand	Manager	129	DOI theory	adoption	t1, t2, t4*	o1*, o5*, 011	e2*, e3*
7	Looi (2005)	Brunei	—[g]	184	—	adoption	t1*, t8*	o5*	e2*, e3*
8	Zhu & Kreamer (2005)	Multiple countries[f]	Senior executive	624	TOE framework and RBV theory	breadth	t2*, t3*	o1*, o2	e2*, e3*
9	Hsu et al. (2006)	US	Senior executive	294	—	breadth	t1*, t3*	o1*, o2*	e2*, e3
						depth	t1*, t3	o1*, o2*	e2*, e3
10	Jeon et al. (2006)	Korea	CEO	204	—	adoption	t1*, t2, t5	o1, o2*, o5*	e2, e3*
11	Oliveira & Martins (2010a)	EU	Senior executive	2,459	TOE framework	adoption	t1*, t3*, t4*	o1	e1*, e2*
12	Oliveira & Martins (2010b)	EU	Senior executive	6,694	TOE framework	adoption	t1*, t3*, t4*	o1	e2*

Note. In all of the studies, the unit of analysis was an organisation, with the key informant responding on behalf of the organisation. All studies covered organisations of all sizes in multiple industries, with the exception of Al-Qirim, Grandon and Pearson, Jeon et al., Kendall et al., and Looi who covered SMEs (in multiple industries).

[a]Details of the independent variables are given in Tables 2-14 (from the technological context), 2-15 (from the organisational context), and 2-16 (from the environmental context). [b]*N* is the number of companies that participated in the study. [c]T = technological context. [d]O = organisational context. [e]E = environmental context. [f]Covered Brazil, China, Denmark, France, Germany, Japan, Mexico, Singapore, Taiwan, and US. [g]Key informant not reported.

*Found to affect the dependent variable at $p < .05$.

Table 2-14 *Definitions of the Factors Covered: Technological Context*

			Studies in which hypothesised to affect[a]								
			EDI			E-commerce			E-procurement		
	Independent variables (factors)	Description	Adoption	Breadth	Depth	Adoption	Breadth	Depth	Adoption	Breadth	Depth
t1	Perceived benefits	Relative advantages of using the technology.	2*, 3, 4*, 5*, 6*, 7*			1*, 4*, 6, 7*, 10*, 11*, 12*	3*, 5, 9*	9*	1*, 6*		6
t2	Costs	Perceived costs of adopting the technology.	2*, 3, 4*, 5*, 6*			6, 10	8*		6		6*
t3	Information technology infrastructure	Technology infrastructure used to enable Internet-related businesses.	5*			4*, 11*, 12*	3*, 5*, 8*, 9*	9	5*		
t4	Compatibility	The degree to which an innovation is perceived as being consistent with existing values, past experiences, and the needs of potential adopters.	2, 3			1*, 4, 6*, 11*, 12*	3				
t5	Complexity	The degree to which an innovation is perceived to be relatively difficult to understand and use.	2, 3		1*	1, 4*, 10					
t6	Trialability	The ability to engage in e-commerce without incurring high start-up costs.				1*					
t7	Observability	The ability to see beneficial results of using e-commerce by other businesses.				1					
t8	Security	Security concerns about transactions conducted over the Internet platform.				7*					

[a]Details of the studies are given in Table 2-9 (for e-procurement adoption and use), Table 2-12 (for EDI adoption and use), and Table 2-13 (for e-commerce adoption and use).

*Found to be affected at $p < .05$.

Table 2-15 *Definitions of the Factors Covered: Organisational Context*

			Studies in which hypothesised to affect[a]								
			EDI			E-commerce			E-procurement		
	Independent variables (factors)	Description	Adoption	Breadth	Depth	Adoption	Breadth	Depth	Adoption	Breadth	Depth
o1	Firm size	Size of the firm.	3*, 6*		1*	6*, 10, 11, 12	3, 8*, 9*	9*	1*, 2*, 5*, 6*	2*	2, 6*
o2	Firm scope	Geographical dispersion of a firm's operation.				10*	8, 9*	9*	5		
o3	Industry	Industry in which the firm operates.	6*						1*, 2*, 6	2*, 4*	2*, 6
o4	Top management support	Top management commitment and managerial attention.	2*, 3*, 7*				2*		6*	3	6
o5	Employee knowledge and skills	Employees' knowledge relevant to the technology.	4*			6*, 7* 10*	5		5*		
o6	Organisational learning ability	Ability to evaluate, adopt, and exploit external knowledge.					2*			3*	
o7	Financial slack	Having sufficient level of resources to take the opportunity.					3*, 5*				
o8	Task variety	The extent of diversity across the task within a single role.	7								
o9	Organisational culture	The power distance and perceived autonomy.	7								
o10	Motivation to use EDI	Motivation to perform an activity.	7								
o11	Information intensity	Information intensity of goods and services.				6					

[a]Details of the studies are given in Table 2-9 (for e-procurement adoption and use), Table 2-12 (for EDI adoption and use), and Table 2-13 (for e-commerce adoption and use)..

*Found to be affected at $p < .05$.

Table 2-16 *Definitions of the Factors Covered: Environmental Context*

			Studies in which hypothesised to affect[a]								
			EDI			E-commerce			E-procurement		
	Independent variables (factors)	Description	Adoption	Breadth	Depth	Adoption	Breadth	Depth	Adoption	Breadth	Depth
e1	Partner readiness	Readiness of trading partners to adopt the technology.				11*			5*		
e2	External pressures	Pressures caused by other organisations in the market.	2*, 3*, 4*, 5*, 6*			4*, 6*, 7*, 10, 11*, 12	2*, 3*, 5*, 8*, 9*	9*	5*, 6*	3*	6
e3	Institutional support	The amount of support from outside entities such as government and suppliers.	2*, 3*, 4*, 7*			6*, 7*, 10*	3*, 8*, 9	9			
e4	Trust	Trust between trading partners.	2, 3								
e5	Net-dependence	The respondent's economic dependence on the partner (or vice-versa).	2, 3								

[a]Details of the studies are given in Table 2-9 (for e-procurement adoption and use), Table 2-12 (for EDI adoption and use), and Table 2-13 (for e-commerce adoption and use)..

*Found to be affected at $p < .05$.

2.8.1 Research Contexts and Methods

This section introduces the explanatory studies of EDI and e-commerce adoption and use and compares their research contexts (in terms of types of organisations covered, industries, and countries) and research methods (in terms of approaches to data collection, sample sizes and response rates, and theoretical frameworks).

The studies were conducted in different regions, including Asia (see, for example, Chau & Hui, 2001; Jeon, Han, & Lee, 2006; Seyal, Abd Rahman, & Awg Mohammad, 2007), Europe (see, for example, Oliveira & Martins, 2010a; Oliveira & Martins, 2010b), North America (see, for example, Hsu et al., 2006; Premkumar et al., 1997; Wu, Mahajan, & Balasubramanian, 2003), and Australasia (see, for example, Al-Qirim, 2005).

The studies covered businesses of all sizes, with most of them covering both SMEs and large companies (see, for example, Grandon & Pearson, 2004; Wu et al., 2003; Zhu, Kraemer, Gurbaxani, et al., 2006). Only one study (Premkumar et al., 1997) covered large companies only. Eight of the studies (see, for example, Jeon et al., 2006; Looi, 2005; Seyal et al., 2007) covered SMEs only.

Most of the studies (see, for example, Hsu et al., 2006; Wu et al., 2003; Zhu, Kraemer, Gurbaxani, et al., 2006) covered companies from multiple industries, with retail and manufacturing included most consistently. Four of the studies covered a single industry only, trading industry in Crum, Premkumar, and Ramamurthy (1996), transportation industry in Premkumar et al. (1997), travel industry in Wang and Cheung (2004), and retail industry in Zhu and Kraemer (2005).

In all of the studies, a single respondent, such as a senior executive or an EDI manager, was used to fill in the questionnaire on behalf of the whole organisation.

Most of the studies (see, for example, Jeon et al., 2006; Wang & Cheung, 2004) used cross-sectional surveys for data collection. In most of the studies, the potential respondents received a self-administered questionnaire posted to them by regular

mail (see, for example, Chau & Hui, 2001; Zhu & Kraemer, 2005); in three of the studies (Grandon & Pearson, 2004; Jeon et al., 2006; Looi, 2005), the participants were contacted via both mail and e-mail, with the self-administered questionnaire provided online; only in one of the studies (Kendall et al., 2001), the surveys were delivered by hand, mail, fax, and online. In one of the studies (Seyal et al., 2007), the method of distributing the questionnaires was not explicitly mentioned. The response rates ranged from 7% (Hsu et al., 2006) to 51% (Looi, 2005). In two of the studies (Oliveira & Martins, 2010b; Zhu, Kraemer, Gurbaxani, et al., 2006), the response rates were not reported. The reasons behind low or high response rates in different studies were not clear from what was reported. Two of the studies (Oliveira & Martins, 2010a; Oliveira & Martins, 2010b) used available data from e-business W@tch.

2.8.2 Factors Considered and Found to Have Effect

Factors hypothesised to affect EDI adoption and use and e-commerce adoption and use are summarised in Table 2-12 and Table 2-13, respectively. The factors are defined in Table 2-14 (factors from the technological context), Table 2-15 (factors from the organisational context), and Table 2-16 (factors from the environmental context).

In most of the explanatory studies of EDI adoption and use (see, for example, Premkumar et al., 1997; Seyal et al., 2007), factors from all of the TOE contexts were covered. Technological context was covered in more detail than organisational and environmental contexts. One of the studies (Germain & Droge, 1995) covered factors from technological and organisational contexts only. Another study (Kuan & Chau, 2001) covered factors from technological and environmental contexts only.

In most of the explanatory studies of e-commerce adoption and use (see, for example, Wang & Cheung, 2004; Zhu & Kraemer, 2005), factors from all of the TOE contexts were covered. Similar to the explanatory studies of EDI adoption and use, technological context was covered in more detail than organisational and environmental contexts. One of the studies (Kendall et al., 2001) covered factors from technological context only. One of the studies (Wu et al., 2003) covered factors

from organisational and environmental contexts only. Another study (Grandon & Pearson, 2004) covered factors from technological and environmental contexts only.

The factors considered by the explanatory studies of EDI or e-commerce adoption and use were consistent with DOI theory, path dependency theory, institutional theory, and network effect theory (these theories are introduced in section 2.6). All of these theories received some support.

2.8.2.1 Technological Factors

Technological factors were considered in all of the studies, and in all of the studies, some of them had effect. In most of the explanatory studies of EDI adoption and use, the technological factors, perceived benefits (or relative advantage according to the DOI theory) and perceived costs, were covered. In most of the explanatory studies of e-commerce adoption and use, the technological factors, perceived benefits and information technology infrastructure, were covered.

In all of the studies in which the technological factors were considered, some of the technological factors were found to have effect. For explanatory studies of EDI adoption and use, two of the technological factors, perceived benefits and perceived costs, were confirmed to have effect in more than one study. In two of the studies that considered complexity (Crum et al., 1996; Premkumar et al., 1997), no effect was found. For explanatory studies of e-commerce adoption and use, two of the technological factors, perceived benefits and information technology infrastructure, were confirmed to have effect in more than one study.

Overall, there was a considerable consistency between the technological factors found to have effect in the explanatory studies of e-procurement adoption and use with the technological factors found to have effect in the explanatory studies of EDI or e-commerce adoption and use.

2.8.2.2 Organisational Factors

Organisational factors were considered in all of the explanatory studies of EDI adoption and use and some of them were found to have effect.

In most of the studies, firm size was covered. In all of the explanatory studies of EDI adoption and use in which firm size was covered (Germain & Droge, 1995; Premkumar et al., 1997; Zhu, Kraemer, Gurbaxani, et al., 2006), firm size was found to have effect. For the explanatory studies of e-commerce adoption and use, firm size was found to have effect in more than one study (see, for example, Al-Qirim, 2005; Zhu & Kraemer, 2005).

In all of the studies that covered top management support (Crum et al., 1996, and Premkumar et al., 1997, in EDI adoption; Wu et al., 2003, in breadth of e-commerce use), top management support was found to have effect.

Overall, there was a considerable consistency between the organisational factors found to have effect in the explanatory studies of e-procurement adoption and use with the organisational factors found to have effect in the explanatory studies of EDI or e-commerce adoption and use.

2.8.2.3 Environmental Factors

An environmental factor, external pressures, was covered in most of the studies and was found to have effect.

In all of the explanatory studies of EDI adoption and use in which external pressures was covered (Chau & Hui, 2001; Crum et al., 1996; Premkumar et al., 1997; Zhu, Kraemer, Gurbaxani, et al., 2006), external pressures was found to have effect.

In all the explanatory studies of e-commerce adoption and use in which external pressures was covered, external pressures was found to have effect, with an exception of one study (Jeon et al., 2006) that found no effect. Only one study (Oliveira & Martins, 2010a) covered partner readiness, and no effect was found.

Overall, there was a considerable consistency between the environmental factors found to have effect in the explanatory studies of e-procurement adoption and use with the environmental factors found to have effect in the explanatory studies of EDI or e-commerce adoption and use.

2.9 Small and Medium Enterprises (SMEs)

This section discusses definitions of SMEs and the implications of the SME context for my study.

2.9.1 Definitions of SMEs

The differences between SMEs and large firms are widely recognised by the researchers. Nonetheless, there is no universally accepted definition of SMEs. The definition of an SME is not uniform across countries.

Three criteria commonly used in distinguishing small and large businesses were number of employees, annual sales turnover, and total net assets (Ayyagari, Beck, & Demirguc-Kunt, 2007). Nonetheless, of the three criteria, number of employees is commonly used as the main criterion in distinguishing SMEs (see, for example, Ayyagari et al., 2007; Min & Galle, 2003; Teo et al., 2009). This is because other criteria, such as annual sales turnover and total net assets, are more difficult to apply (as these criteria are frequently treated as confidential by organisations) and can result in misleading classifications (Grandon & Pearson, 2004). Number of employees is, therefore, used to define SMEs in my study. The use of a measure that is widely used simplifies comparisons with existing studies. Alternative classifications of enterprises in terms of the number of employees are summarised in Table 2-17.

In my study, SME is defined as a business that employs from 6 to 99 employees (see sections 4.3.3 and 4.3.4 for a detailed discussion of the population and sample of my study).

Table 2-17 *Classifications of Enterprises in terms of Number of Employees*

Organisation size	Number of employees				
	New Zealand[a]	Australia[b]	Europe[c]	UK[c]	US[c]
Micro	0 to 5	0 to 4	0 to 9	0 to 9	0 to 9
Small	6 to 49	5 to 19	10 to 49	10 to 49	10 to 99
Medium	50 to 99	20 to 199	50 to 249	50 to 249	100 to 499
Large	100+	200+	250+	250+	500+

[a]Adapted from "About SMEs," by the New Zealand Centre for SME Research, 2010, *http://sme-centre.massey.ac.nz*. [b]Adapted from "Australian Small Business: Key Statistics and Analysis," by the Australian Government: Department of Innovation Industry, Science, and Research, 2012, *http://www.innovation.gov.au*. [c]Adapted from "SME and Entrepreneurship Outlook," by the Organisation for Economic Co-operation and Development, 2005, *http://www.camaras.org*.

2.9.2 Implications of the SME Context

SMEs play a significant role in the global economy (Gunasekaran et al., 2009), including New Zealand, both in terms of wealth creation, employment, and poverty alleviation (Ayyagari et al., 2007; Beck, Demirguc-Kunt, & Levine, 2005; McGregor & Gomes, 1999). SMEs boost employment more than large firm growth because SMEs are more labour intensive (Beck et al., 2005).

In New Zealand, SMEs form a significant portion of New Zealand's GDP. In 2009, for instance, SME's contribution to total value-added output (i.e., contribution to total output by enterprises in the economy) was 45% compared to 43% contribution from larger enterprises in the country (Ministry of Economic Development, 2011).

In some countries, like US and New Zealand, more than 90% of businesses are SMEs (Chong, 2008). In February 2010, for instance, the Ministry of Economic Development (2011) reported a total number of 470,346 enterprises in New Zealand, with 99.56% of them employing less than 100 employees (see Table 2-18).

Table 2-18 *Number of Enterprises in New Zealand, By the Number of Employees*

Number of employees	Number of enterprises	Percentage of enterprises
0	323,935	68.87
1 – 5	97,888	20.81
6 – 9	19,571	4.16
10 – 19	15,980	3.40
20 – 49	8,420	1.79
50 – 99	2,489	.53
100 – 499	1,739	.37
500 and more	324	.07
Total	470,346	100

Note. Adapted from "SMEs in New Zealand: Structure and Dynamics 2011," by the Ministry of Economic Development, 2011, *http://www.med.govt.nz/business/business-growth-internationalisation/pdf-docs-library/structure-and-dynamics-2011.pdf*.

Large firms tend to be more advanced in adopting technologies than SMEs, which have traditionally been late adopters of advanced technologies, because of the resource constraints. Prior explanatory studies of e-procurement adoption and use (Batenburg, 2007; Min & Galle, 2003; Soares-Aguiar & Palma-dos-Reis, 2008; Teo et al., 2009) found that larger firms were more likely to adopt and use e-procurement than smaller organisations (see section 2.7 for a more detailed discussion). Larger organisations, with their more extensive resources, were more likely to use e-procurement and thus to draw advantage from the benefits offered by the technology.

Comparing to large firms, SMEs are often characterised as firms with low levels of information technology sophistication, weak market position, and lack of information technology integration (Chau & Hui, 2001). The budgets allocated to information technology in SMEs are usually small or not existent (Kotelnikov, 2007). SMEs also face cost related problems employing staffs with specialised computer expertise and, therefore, need to rely on outside resources (Igbaria, Zinatelli, Cragg, & Cavaye, 1997). Nonetheless, SMEs are more flexible, and therefore in some istances may have higher capacity to adapt technology innovations than large firms (Beck et al., 2005; Igbaria et al., 1997). Hence, government and other financial supports to SMEs can boost economic growth and development (Beck et al., 2005; Beck & Demirguc-Kunt, 2006).

Regardless of all the limitations, SMEs began to implement and use e-procurement because of the emphasis on supply chain management in domestic and international operations (Gunasekaran et al., 2009). Other possible reasons may include competing with other organisations, ability to get more suppliers in the market, and vulnerability of non-participants (Stockdale & Standing, 2004). Barriers to e-procurement adoption and use identified in prior descriptive studies were discussed in detail in section 2.4.3 (see Table 2-4 for a summary and the rest of the section for an in-depth discussion).

2.10 Summary of the Chapter

This chapter presented a literature review. First, alternative definitions of e-procurement were presented and the definition used in my study was introduced and justified. My study viewed e-procurement as an organisational use of information technology in establishing contracts and purchasing goods or services. This definition does not limit e-procurement to the use of sophisticated or integrated systems explicitly purchased, implemented, and labelled as "e-procurement systems," but also includes the uses of commonly available information technology, such as e-mailing or Internet browsing, to facilitate procurement.

Then, the forms of e-procurement suggested by the literature were summarised as a descriptive model. The forms of e-procurement were classified into three perspectives: information, transaction, and infrastructure. From the information perspective, the forms included e-sourcing, e-collaboration, and e-informing; and from the transaction perspective, e-catalogue, e-tender, e-auction, IntraOS, and InterOS. The literature review presented in this chapter suggests that all these forms of e-procurement had not been covered in a single study. The benefits of e-procurement most consistently suggested by the descriptive studies (based on the opinions of the respondents) were reducing business costs, reducing purchasing time, and streamlining purchasing processes; and the most consistently suggested barriers to e-procurement adoption and use were implementation cost issues, technical issues, and lack of e-procurement related knowledge and skills. (Descriptive studies of EDI and B2B e-commerce adoption were also discussed.)

To detail the theoretical foundation of my study (introduced in section 1.4), theories and theoretical frameworks explaining information systems adoption and use were presented, along with examples of their applications, including TOE framework and DOI theory.

The chapter concluded by introducing the factors found in prior studies to affect e-procurement adoption and extent of e-procurement use: in the technological context, perceived benefits, perceived implementation costs, and information technology infrastructure; in organisational context, firm size, industry, top management support, employee knowledge and skills, organisational learning ability, and information sharing culture; and in environmental context, partner readiness and external pressure. Factors affecting adoption and use of EDI and B2B e-commerce, as well as the specifics of SMEs, were also discussed.

CHAPTER 3 RESEARCH MODEL AND HYPOTHESES

3.1 Introduction

This chapter presents the overall research model of my study, describes the constructs of the model, and justifies, based on the literature and on the relevant theories, the hypotheses included in the model.

3.2 The Research Model of the Study

The aim of this section is to present and to justify the overall research model of my study. The research model is based on the high-level model introduced in Chapter 1 (see Figure 1-2 in section 1.4).

The dependent variables (representing the extent of e-procurement use) were the breadth of e-procurement use (the range of e-procurement forms and functionalities used within the organisation, see Figure 2-1 for a descriptive model of forms of e-procurement) and the depth of e-procurement use (the extent to which the organisation relies on e-procurement). The content of the breadth of e-procurement use construct was defined to address research question one (see section 1.3 for the research questions of my study) and, thus, to account for both the information and the transaction perspectives and to include all of the forms of e-procurement identified in the literature review (see Figure 2-1). The dependent variables are discussed in detail in section 3.3.

To address research question two (see section 1.3), factors hypothesised to affect breadth and depth of e-procurement use (the determinants of breadth and depth) were included in the model. The choice of the determinants was based on technology-organisation-environment (TOE) framework (introduced in section 2.6), diffusion of innovation (DOI) theory (introduced in section 2.6), and on the results of prior studies of factors affecting e-procurement adoption and use, summarised in section 2.7.7.

Even though a broad range of theories are relevant to understanding the determinants of the extent of e-procurement use by organisations (as discussed in section 2.6), TOE framework and DOI theory are the most widely validated in prior studies of technology adoption and use. (Al-Qirim, 2005, Prescott, 1995, and Zhu, Dong, Xu, et al., 2006, explicitly recommended combining TOE framework with DOI theory to formulate models of technology adoption and use by organisations.)

Based on DOI theory, relative advantage, compatibility, and complexity were included as factors from the technological context. All factors found in prior studies to affect e-procurement adoption and use (listed in section 2.7.7) were considered for inclusion in the model. (I adopted a view that e-procurement use is the outcome of a large number of adoption decisions, and, therefore, considered factors found to affect adoption along with factors found to affect breadth and depth.) Care was taken to keep the model as parsimonious as possible, and not to include redundant factors.

Perceived benefits are synonymous with relative advantage, the existing practice of relying on information technology infrastructure makes current practices more compatible with the practice of using e-procurement, and high implementation costs are likely to be associated with complex systems (see section 2.7.7.1 for a discussion of perceived benefits, information technology infrastructure, and perceived implementation costs). Therefore, perceived benefits were judged to be covered by relative advantage, information technology infrastructure by compatibility, and perceived implementation costs by complexity. Consequently, to keep the research model parsimonious, perceived benefits, information technology infrastructure, and perceived implementation costs were not added to the model as separate factors.

Organisational learning ability and information sharing culture at the level of the organisation are related to employee knowledge (Hong & Kuo, 1999; Lin, 2007). Therefore, they were not added as separate factors. Information sharing at the level of the supply chain was found to be poorly understood in prior literature and presented considerable challenges in terms of research design (such as deciding which organisations belong to a supply chain and sampling from the population of supply chains); therefore, I judged addressing information sharing at the level of the

supply chain to be not feasible in view of the resource limitations of my study. Employee knowledge was added as a factor from the organisational context, along with top management support.

Normative pressures, extent of adoption among competitors, and business partners' influence were accounted for by a single factor from the environmental context, external pressure (following the approach taken by Grandon and Pearson, 2004, in their study of e-commerce adoption in small and medium US businesses). Partner readiness was added as a separate factor from the environmental context.

Thus, all of the contexts of the TOE framework were covered in the model.

Table 3-1 *Factors Included in the Research Model*

Factor included in the model	Related factors found to have effect in prior studies[a]
	Technological context
Relative advantage	Perceived benefits
Compatibility	Information technology infrastructure
Complexity	Perceived implementation costs
	Organisational context
Top management support	Top management support
Employee knowledge	Organisational learning ability, employee knowledge and skills, information sharing culture
	Environmental context
Partner readiness	Trading partner readiness
External pressure	Normative pressures, extent of adoption among competitors, business partners' influence

[a]Factors found to have effect on e-procurement adoption or use in prior studies (and thus, listed in section 2.7.7) and accounted for in the model. Firm size and industry were found to have effect in prior studies, but were not included in the model because the study focused on firms in a limited size range (small and medium enterprises) and in a single industry (manufacturing).

Firm size and industry were not added to the model; my study focused on a single industry (manufacturing) and on organisations in a limited size range (small and medium organisations). Therefore, it was not expected that these factors would have effect for the population addressed in my study (see sections 4.3.3 and 4.3.4 for a description of the population and of the sample, respectively).

The factors included in the model (listed in Table 3-1) are summarised and related to the factors suggested by the literature review in Table 2-10. The resulting research model is given in Figure 3-1. I found little grounds in the prior literature or in relevant theories to clearly differentiate factors contributing to breadth of e-procurement use from factors contributing to depth of e-procurement use. Therefore, the research model was structured similar to the research model by Wu et al. (2007); all determinants were hypothesised to affect both the breadth and the depth of e-procurement use.

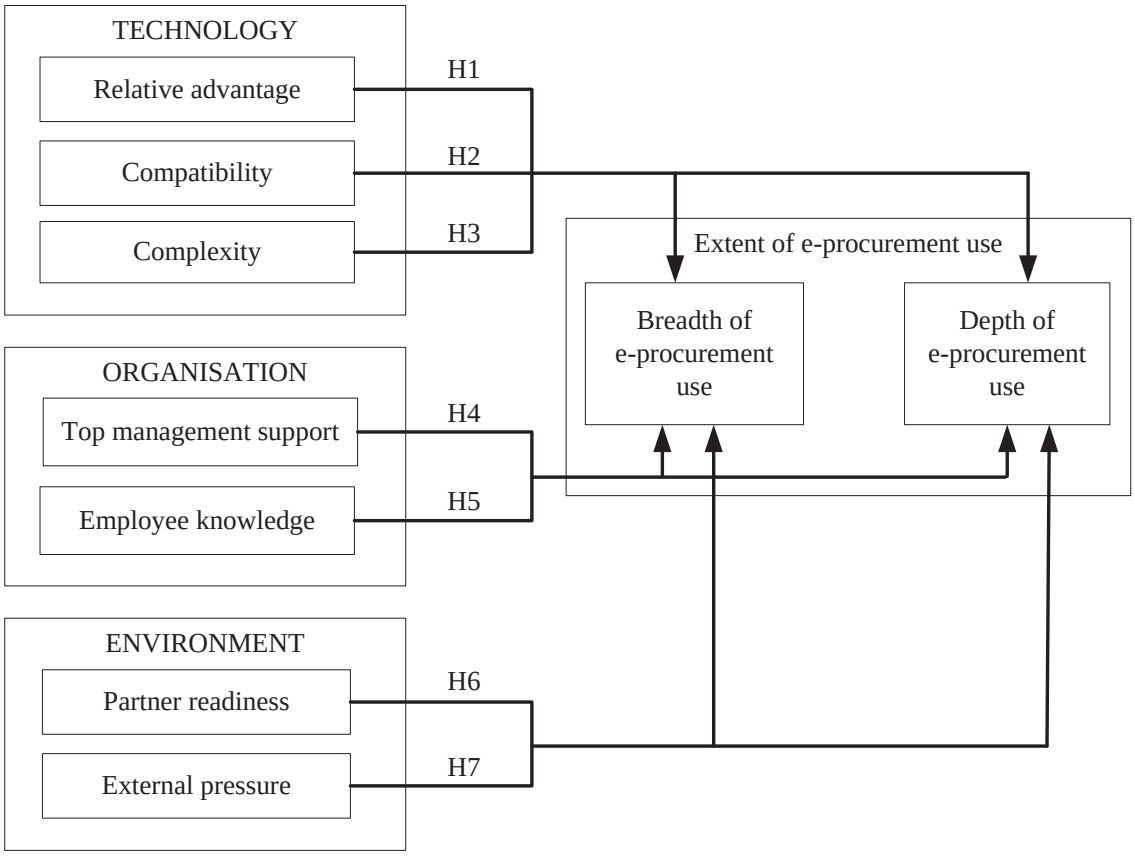

Figure 3-1. The research model.

To further justify the research model presented in Figure 3-1 and to explore its meaning, the content of the dependent variables, the breadth of e-procurement use and the depth of e-procurement use, is elaborated in section 3.3. The content of the determinants is further elaborated and the individual hypotheses are justified one-by-one in section 3.4.

3.3 Dependent Variable: Extent of E-Procurement Use as Breadth and Depth

This section discusses the dependent variable of the study, extent of e-procurement use (see the research model in Figure 3-1). Extent of e-procurement use refers to the extent to which organisations use e-procurement in terms of the range of the e-procurement functionalities used (the breadth dimension) and in terms of the extent to which an organisation relies on e-procurement (the depth dimension) (the distinction between breadth and depth was introduced in section 1.1). Thus, breadth represents the richness and the sophistication of e-procurement practice within an organisation, and depth represents the extent to which the core business processes at the organisation rely on e-procurement.

The distinction between breadth and depth of e-procurement use can be illustrated by considering the dichotomy of exploration versus exploitation (March, 1991). An organisation at the exploration stage of learning to use e-procurement may experiment with a broad range of e-procurement forms and functionalities, but is likely to limit the reliance on e-procurement for its core business to manage risk (with breadth substantial, but with little depth). Once the organisation learns to use e-procurement and transitions to the exploitation stage, it may restrict the use of e-procurement forms and functionalities to the ones that it found to work best, but is likely to rely more on e-procurement for conducting its core business (with breadth reduced, but with considerably more depth).

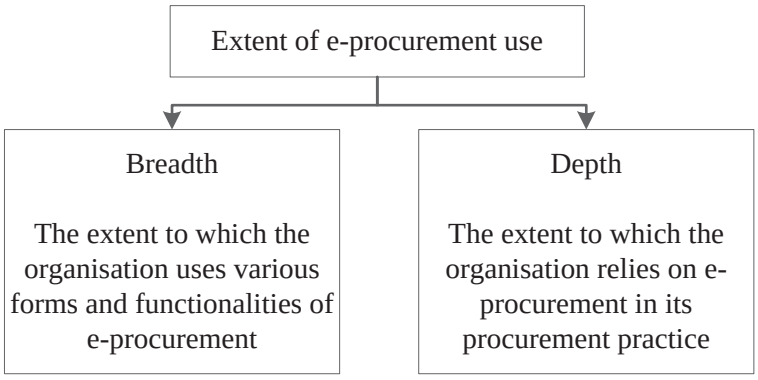

Figure 3-2. Dimensions of the extent of e-procurement use.

By conceptualising the extent of e-procurement use in terms of the dimensions of breadth and depth (as illustrated in Figure 3-2), I follow prior studies of information technology use (Hsu et al., 2006; Xu, Zhu, & Gibbs, 2004; Zhu & Kraemer, 2005; Zhu, Kraemer, Gurbaxani, et al., 2006). The breadth dimension relates to the extent to which an organisation makes use of the capabilities offered by the technology; in the context of e-procurement use, breadth of use is the extent to which an organisation uses the forms and functionalities of e-procurement (see section 2.3 for a review of e-procurement forms and functionalities). The depth dimension relates to the extent to which the organisation relies on the technology; in the context of e-procurement use, depth of use is the extent to which procurement within the organisation relies on e-procurement (e.g., in terms of the proportion of goods and services purchased online). By distinguishing the dimensions of breadth and depth, one can parsimoniously represent the state of e-procurement practice within an organisation (Zhu & Kraemer, 2005).

One can interpret descriptive model of forms of e-procurement as suggesting that the construct of the breadth of e-procurement use is two-dimensional, comprising the dimensions of the breadth of use of informational e-procurement functionalities and the breadth of use of transactional e-procurement functionalities. To explore the viability of such a view, I conducted EFA (reported in section 5.6). The results of the analysis clearly indicated that in terms of the structure of the data, there is no clear separation between informational and transactional functionalities.

An even more detailed understanding of the practice of e-procurement use could be obtained if factors affecting the use of individual functionalities were considered separately. This, however, would result in a very large model, with very large number of parameters to be estimated, making the possibility of a capitalisation of chance very likely. To reduce the possibility of a capitalisation of chance, one could use a larger sample; however, it is quite possible that the size of the sample required would be considerably larger than the number of SMEs in New Zealand. Therefore, to explore the use of a broad range of e-procurement functionalities, a set of constructs capturing the most important aspects was needed, resulting in a parsimonious model than can be tested in practice. Moreover, it is a common view

that in quantitative research in general, parsimonious models capturing the most important aspects are more valuable than models with large numbers of constructs (Anderson & Gerbing, 1988).

3.4 Factors Hypothesised to Affect Breadth and Depth

This section discusses the independent variables (factors) hypothesised to affect the breadth and the depth of e-procurement use.

3.4.1 Technological Context

Technological context refers to the perceptions of an organisation of the existing technologies in use within the organisation and new technologies relevant to the organisation (Tornatzky & Fleischer, 1990; Zhu et al., 2006). The factors from the technological context included in the model (see Figure 3-1) were relative advantage, compatibility, and complexity. These factors were based on DOI theory by Rogers (2003), discussed in section 2.6.1. Relative advantage, compatibility, and complexity are three of the characteristics of innovation that, according to DOI theory, influence adoption decisions. The remaining two characteristics of innovation, trialability and observability, were not included because they received little support in prior empirical studies of technology adoption and use; see section 2.6.1 for a detailed discussion.

3.4.1.1 H1: Relative Advantage

Organisations adopt and use an innovation such as new technology only when they perceive the potential benefits of using the innovation (Rogers, 2003). Numerous prior studies presented evidence supporting the relationship between perceived relative advantage (perceived benefits associated with using a technology) and technology adoption and use by organisations (see, for example, Abu-Elsamen et al., 2010; Alam et al., 2007; Chan & Ngai, 2007; Lee, 2004; Lin & Lin, 2008; Looi, 2005; Pearson & Grandon, 2005; Premkumar & Roberts, 1999; Tan et al., 2009; Teo, Tan, & Buk, 1998; Teo et al., 2007; Teo et al., 2009; Thong, 1999; Zhu, Dong, Xu, et al., 2006; Zhu, Kraemer, Gurbaxani, et al., 2006). For instance, Tan et al. (2009), in a

survey of companies in the manufacturing and services industries in Malaysia, found that relative advantage affected the extent of Internet-based ICT use (as measured by years of use). Studies that presented evidence that perceived benefits of e-procurement positively affect e-procurement adoption by organisations were discussed in section 2.7.7.1.

The benefits of e-procurement adoption and use for organisations found in descriptive studies of e-procurement (identified based on the opinions of the respondents) were discussed in detail in section 2.4.2 and include reducing business cost, reducing purchasing time, streamlining purchasing processes, accessing wider markets, and improving relationships with trading partners (see Table 2-3 for a summary and the rest of the section for an in-depth discussion).

Perceptions of e-procurement resulting in benefits to an organisation are likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H1a: There is a positive relationship between relative advantage and the breadth of e-procurement use.

H1b: There is a positive relationship between relative advantage and the depth of e-procurement use.

3.4.1.2 H2: Compatibility

Organisations are more likely to adopt and use an innovation when it is compatible with their existing practices and values (Rogers, 2003). Prior studies (see, for example, Alam et al., 2007; Lee, 2004; Pearson & Grandon, 2005; Premkumar, 2003; Premkumar & Roberts, 1999; Tan et al., 2009; Teo et al., 1998; Teo et al., 2007; Thong, 1999; Zhu, Dong, Xu, et al., 2006) presented evidence suggesting that organisations are more likely to adopt and use technology that is compatible with the organisations' existing information technology infrastructure, business processes, and value systems. For instance, Zhu, Dong, Xu, et al. (2006), in a survey of

companies in multiple industries in European countries (covering Finland, France, Germany, Italy, Spain, and UK), found that compatibility with business processes and values was a stronger driver in explaining the extent of e-business use (as measured by the percentage of business transactions conducted online) than relative advantage. The prior explanatory studies of e-procurement adoption and use considered e-procurement compatibility in terms of the compatibility with information technology infrastructure; studies that presented evidence that perceived compatibility of e-procurement with existing information technology infrastructure positively affect e-procurement adoption by organisations were discussed in section 2.7.7.1.

Several compatibility issues of e-procurement, technical issues, change management issues, inadequacy of business processes to support e-procurement, inability to identify potential items for auction, and difficulty of judging the usefulness and potential of information technology, were discussed in detail in section 2.4.3 as barriers to e-procurement identified in prior descriptive studies (see Table 2-4 for a summary and the rest of the section for an in-depth discussion).

Perceptions of e-procurement being compatible with preferred work style, existing work practices, prior experience, and values of an organisation are likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H2a: There is a positive relationship between compatibility and the breadth of e-procurement use.

H2b: There is a positive relationship between compatibility and the depth of e-procurement use.

3.4.1.3 H3: Complexity

An innovation that is perceived as easy to use and to understand is more likely to be adopted and used by an organisation (Rogers, 2003). Difficulty in understanding and

applying a new technology increases the risk associated with its adoption (Teo et al., 2007) and may result in slower recognition of the technology's value, fear of failure, and resistance (Cho & Kim, 2002). Prior studies (see, for example, Alam et al., 2007; Lee, 2004; Premkumar & Roberts, 1999; Soliman & Janz, 2004; Tan et al., 2009; Thong, 1999) presented evidence suggesting that organisations are more likely to adopt and use technology that is perceived as less complex. For instance, Tan et al. (2009), in the study introduced in section 3.4.1.1 (in conjunction with justifying hypothesis H1), found that complexity affected the extent of Internet-based ICT use (as measured by years of use). The prior explanatory studies of e-procurement adoption and use considered e-procurement complexity in terms of the perceived cost of e-procurement adoption and use; studies that presented evidence that perceived costs of e-procurement negatively affect the depth of e-procurement use by organisations were discussed in section 2.7.7.1.

Several complexity issues of e-procurement, implementation cost issues, regulatory and legal issues, and security issues, were discussed in detail in section 2.4.3 as barriers to e-procurement identified in prior descriptive studies (see Table 2-4 for a summary and the rest of the section for an in-depth discussion).

Perceptions of e-procurement being easy to implement and use within an organisation are likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H3a: There is a negative relationship between complexity and the breadth of e-procurement use.

H3b: There is a negative relationship between complexity and the depth of e-procurement use.

3.4.2 Organisational Context

Organisational context refers to organisation's scope, size, amount of slack resources available internally, or other internal aspects of the organisation (Tornatzky & Fleischer, 1990; Zhu & Kraemer, 2005). The factors from the organisational context included in the model (see Figure 3-1) were top management support and employee knowledge.

3.4.2.1 H4: Top Management Support

Support from top management is vital to ensure that resources needed to adopt a technology or to expand its use are available (Grover, 1993) and to overcome resistance to change (Teo et al., 1998). Conversely, lack of top management support may result in failure of implementation (Grandon & Pearson, 2004). Prior studies (see, for example, Chong, Ooi, Lin, & Raman, 2009; Premkumar, 2003; Premkumar et al., 1997; Premkumar & Roberts, 1999; Soliman & Janz, 2004; Teo et al., 1998; Teo et al., 2007; Teo et al., 2009) presented evidence suggesting that organisations are more likely to adopt and use a technology when top management support for the technology adoption and use is strong. For instance, Teo et al. (2007), in a survey of companies in multiple industries in Singapore, found that top management support affected human resources information systems use (as measured by the total number of human resources information systems applications used in the organisation). Studies that presented evidence that top management support positively affects e-procurement adoption by organisations were discussed in section 2.7.7.2.

Lack of top management support was identified as a barrier to e-procurement use in descriptive studies of e-procurement, as discussed in section 2.4.3.

Top management support of e-procurement adoption and use within an organisation is likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H4a: There is a positive relationship between top management support and the breadth of e-procurement use.

H4b: There is a positive relationship between top management support and the depth of e-procurement use.

3.4.2.2 H5: Employee Knowledge

Knowledge about technology enables organisations to manage effectively the risks associated with investing in a technology (Mata, Fuerst, & Barney, 1995). Conversely, inadequate knowledge about technology hinders technology implementation and use (Gunasekaran & Ngai, 2008; Hawking & Stein, 2004; Teo et al., 2007). The view that employee knowledge of information technology promotes technology implementation and use is consistent with the resource-based view (RBV) of an organisation, with the employee knowledge acting as a resource (see section 2.6 for an introduction of the RBV theory). Prior studies (see, for example, Chan & Ngai, 2007; Fink, 1998; Lin & Lin, 2008; Looi, 2005; Soares-Aguiar & Palma-dos-Reis, 2008; Teo et al., 2007; Thong, 1999; Thong & Yap, 1995) presented evidence suggesting that organisations are more likely to adopt and use a technology when their employees have knowledge and expertise relevant to the technology. For instance, Teo et al. (2007), in the study introduced in section 3.4.2.1 (in conjunction with justifying hypothesis H4), found that employee knowledge affected human resources information systems adoption. Studies that presented evidence that employee knowledge and skills, organisational learning ability, and information sharing culture positively affect e-procurement adoption, breadth of e-procurement use, and depth of e-procurement use by organisations were discussed in section 2.7.7.2.

Lack of employee knowledge and skills was identified as a barrier to e-procurement use in descriptive studies of e-procurement, as discussed in section 2.4.3.

Employees' information technology-related knowledge within an organisation is likely to result in the organisation using a broader range of e-procurement forms and

functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H5a: There is a positive relationship between employee knowledge and the breadth of e-procurement use.

H5b: There is a positive relationship between employee knowledge and the depth of e-procurement use.

3.4.3 Environmental Context

Environmental context refers to the external environment in which an organisation conducts its business, including other organisations it interacts with and the relevant standards and regulations (Teo et al., 2009; Tornatzky & Fleischer, 1990). The factors from the environmental context included in the model (see Figure 3-1) were partner readiness and external pressure.

3.4.3.1 H6: Partner Readiness

E-procurement functions are available only when both purchasing organisations and selling organisations implement the relevant technology and can use it effectively. The benefits of e-procurement can be realised by an organisation only if its partners are ready to engage in information exchanges or transactions via e-procurement. The view that partner readiness promotes the use of inter-organisational technologies is consistent with network effect theory (see section 2.6 for an introduction of the network effect theory). Prior studies (see, for example, Lin & Lin, 2008; Soares-Aguiar & Palma-dos-Reis, 2008; Zhu, Dong, Xu, et al., 2006) presented evidence suggesting that organisations are more likely to adopt and use inter-organisational information systems when their trading partners are ready to engage in using such systems. For instance, Zhu, Dong, Xu, et al. (2006), in the study introduced in section 3.4.1.2 (in conjunction with justifying hypothesis H2), found that partner readiness affected the extent of e-business use (as measured by the percentage of business transactions conducted online). Studies that presented evidence that partner

readiness positively affect e-procurement adoption by organisations were discussed in section 2.7.7.3.

Trading partner readiness, in terms of supplier issues, was identified as a barrier to e-procurement use in descriptive studies of e-procurement, as discussed in detail in section 2.4.3.

The readiness of the organisation's trading partners to engage in information exchanges or transactions via e-procurement is likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H6a: There is a positive relationship between partner readiness and the breadth of e-procurement use.

H6b: There is a positive relationship between partner readiness and the depth of e-procurement use.

3.4.3.2 H7: External Pressure

Organisations may adopt and use a technology to keep up with competing organisations (Joo & Kim, 2004). Moreover, external pressures to adopt and use technologies used inter-organisationally (such as e-procurement) may come from the organisation's partners. Iacovou, Benbasat, and Dexter (1995) argued that requests from powerful partners to adopt and use a technology have more influence on organisations than similar requests from less powerful partners. The view that external pressure may promote technology adoption and use is consistent with institutional theory (see section 2.6 for an introduction of the institutional theory). Prior studies (see, for example, Chan & Ngai, 2007; Chong et al., 2009; Forman, 2005; Lin & Lin, 2008; Looi, 2005; Pearson & Grandon, 2005; Premkumar, 2003; Premkumar et al., 1997; Premkumar & Roberts, 1999; Soares-Aguiar & Palma-dos-Reis, 2008; Soliman & Janz, 2004; Teo et al., 2007; Teo et al., 2009; Wu et al., 2007; Xu et al., 2004; Zhu & Kraemer, 2005; Zhu, Dong, Xu, et al., 2006; Zhu, Kraemer,

Gurbaxani, et al., 2006) presented evidence suggesting that organisations are more likely to adopt and use a technology when pressured by other organisations to do so. For instance, Xu et al. (2004), in a survey of companies in multiple industries in US and China, found that external pressures from competing organisations affected the extent of Internet use for e-business (as measured by the percentage of use of e-business functionalities). Studies that presented evidence that external pressure positively affects e-procurement adoption and the breadth of e-procurement use by organisations were discussed in section 2.7.7.3.

The external pressure on an organisation to use e-procurement to keep up with the competing organisations or to maintain the relationships with the organisation's partners is likely to result in the organisation using a broader range of e-procurement forms and functionalities and in relying more on e-procurement in the organisation's core business processes. The following hypotheses are, therefore, justified:

H7a: There is a positive relationship between external pressure and the breadth of e-procurement use.

H7b: There is a positive relationship between external pressure and the depth of e-procurement use.

3.5 Summary of the Chapter

This chapter presented the overall research model of my study. The model comprised the dependent variables, the breadth and the depth of e-procurement use, and the factors hypothesised to affect the dependent variables from technological (relative advantage, compatibility, and complexity), organisational (top management support and employee knowledge), and environmental contexts (partner readiness and external pressure). The main theoretical foundations for the model were DOI theory and TOE framework; moreover, the inclusion of individual factors was justified by considering the factors found to have effect in prior literature.

The content of the model constructs, the dependent variables and the factors, was discussed in detail, and the individual hypotheses were re-examined one by one and

justified in view of the results of prior studies of technology adoption and use and in view of the relevant theories (DOI theory, RBV theory, network effect theory, institutional theory, and path dependency theory).

CHAPTER 4 RESEARCH METHOD

4.1 Introduction

This chapter introduces and justifies the overall approach to the research design of my study.

The sequential explanatory mixed methods design was used. Hypotheses were tested by using quantitative data; then, qualitative data were used to enhance the interpretation of the results of hypotheses testing. Hence, the research involved both quantitative and qualitative aspects.

First, the quantitative aspect of the research design is discussed, including the unit of analysis, the population and the sample, operationalisation of constructs, approaches to assuring validity, survey administration procedures, and the statistical techniques and tools used to validate the research model and, thus, to test the hypotheses.

Second, the qualitative aspect is discussed, including the choice of interview participants, semi-structured interview questions, interview procedures, and the approach employed for qualitative data analysis.

The chapter concludes by discussing human ethics and steps taken to minimise any harm to the participants.

4.2 Overall Research Design

My study primarily relied on the positivist approach to research (Gales, 2010): the study relied on prior theory and on prior empirical studies reported in the literature to derive the hypotheses, which were tested against empirical data. The study involved a combination of quantitative and qualitative methods. Quantitative data were used to test the hypotheses introduced in Chapter 3 (thus, implementing the positivist research paradigm); qualitative data were taken into account when interpreting the results of hypothesis testing (thus, implementing elements of the interpretivist research paradigm, with the researcher inductively constructing explanations based

on rich data, see Erlandson, Harris, Skipper, and Allen, 1993). Overall, the research design was a mixed methods design (Creswell, Clark, Gutmann, & Hanson, 2003) with qualitative data playing a supplementary role. In terms of the classification of mixed research designs by Creswell et al. (2003), sequential explanatory mixed methods design was used. The quantitative data were collected first, then, the qualitative data were collected to assist the aspects of quantitative results found to be particularly pertinent. More specifically, qualitative data were collected to clarify the mechanisms behind the relationships found to be statistically significant in the quantitative analysis.

4.3 Quantitative Data Collection

This section discusses the approach to quantitative data collection: the unit of analysis, population and sample, operationalisation of variables, the validity of the research instrument, and data collection procedures.

4.3.1 Approach to Quantitative Data Collection

Quantitative data used to test the model and the hypotheses introduced in Chapter 3 (see Figure 3-1 for the research model) were collected via a cross-sectional, self-administered survey. (An experiment was not feasible because of the impossibility to control the variables; a longitudinal study was not feasible because of the time constraints of my study; and a multiple case study was not feasible because I did not have access to suitable organisations.)

Unlike the quantitative data obtained in experiments and, to a smaller extent, in longitudinal surveys, data obtained in cross-sectional surveys do not allow to distinguish causes from effects. This was partially compensated by collecting qualitative data to clarify the meaning of the relationships found to be statistically significant (as discussed in section 4.2).

4.3.2 Unit of Analysis and Key Informants

The unit of analysis was an organisation (a small or medium enterprise, an SME). For each organisation participating in the study, a single individual, a key informant,

filled in the survey questionnaire on behalf of the organisation. Key informants were senior managers of the SMEs, such as chief executive officers, owners, directors, presidents, or general managers. Xu et al. (2004) suggested that managers at SMEs have an extensive, detailed knowledge of their organisations (because their organisations are relatively small) and are able to provide accurate data. Managers have an extensive knowledge of their organisation's goals and cultures; therefore, their responses are likely to represent well the perspectives of their organisations (To & Ngai, 2006).

4.3.3 Population

The population of my study were SME businesses in the manufacturing industry in New Zealand (see Table 4-1 for the SME definition used in my study). The study covered small and medium businesses only. Micro companies were excluded because I believed that some of the e-procurement forms and functionalities considered in my study (the functionalities that involve sophisticated, dedicated systems, such as IntraOS or InterOS) were not relevant to micro companies.

Table 4-1 *Definition of SME*

Category	Number of full-time equivalents
Micro companies	5 or fewer
Small companies	6 to 49
Medium companies	50 to 99

Note. Adapted from "About SMEs," by the New Zealand Centre for SME Research, 2010, *http://sme-centre.massey.ac.nz*.

Manufacturing firms depend on both direct and indirect materials and, therefore, benefit more from e-procurement than firms in other industries (Batenburg, 2007). Therefore, understanding e-procurement use by manufacturing firms is particularly important.

SMEs have been highlighted as the engine of economic growth (Gunasekaran et al., 2009; Kotelnikov, 2007) and, thus, are an important sector. In addition, there was a technical reason for focusing on SMEs in my study. The New Zealand economy is relatively small, and about 90% of the businesses are SMEs (Ministry of Economic

Development, 2009). Therefore, by focusing on SMEs, I ensured that sufficient number of potential participants was available.

4.3.4 Sample

The list of SME manufacturers was obtained from the Kompass database. For each organisation, the database covers contact details, product and service information, executives' names, and the number of employees in the organisation.

I accessed the Kompass database on 11 August 2010. The database covered 5,296 manufacturing firms from New Zealand (see Table 4-2 for the breakdown of this number by firm size). According to Kompass, of this number, 2,929 firms and 389 firms were small and medium businesses, respectively, resulting in the total of 3,318.

Table 4-2 *Manufacturing Firms in New Zealand*

Category	Full-time equivalent staffing level	Number	Percentage
Micro	1 – 5	1,614	30
Small	6 – 49	2,929	55
Medium	50 – 99	389	8
Large	100 and over	364	7
Total		5,296	100

A random sample of 1,000 manufacturing SMEs was obtained (random sampling was conducted by Kompass, and I had full access to the details of these 1,000 organisations only). The sample included 860 small and 140 medium companies.

Not all SMEs are listed in the Kompass database, and companies need to pay a small fee to get listed. Therefore, the database does not cover the whole population of manufacturing SMEs, and the selection of organisations listed in the database creates a possibility of a bias (e.g., with organisations in financial distress possibly opting not to participate). Nonetheless, there was no alternative to using the Kompass database, and relying on databases of this type is a common practice in organisational research (see, for example, Brounen, Jong, & Koedijk, 2004; Darroch,

2003). The approaches used in my study to guard against bias are discussed in section 5.4.

4.3.5 Overview of the Research Instrument

The questionnaire used to collect quantitative data was designed based on a broad literature review (the questionnaire is given in full in Appendix A). The aim of the questionnaire and the definition of e-procurement used in my study were given at the beginning of the questionnaire (the definition was reworded to make it easy for the target respondents to understand).

The first 12 sections of the questionnaire measured the constructs of the research model (see Figure 3-1 in section 3.2 for the research model). Each section started with a brief definition of the construct covered by the section, followed by the items used to measure the construct. At the end of the section, an open-ended question was included asking the respondents to comment on their answers (which was a secondary source of qualitative data).

The remaining two sections collected demographic data about the organisation and about the respondent (the individual filling in the questionnaire on behalf of the organisation) and asked the respondent if she would like to participate in an in-depth follow-up interview (such interviews were the main source of qualitative data in my study; see section 5.9 for details).

Both online and hard copy (paper) versions of the survey instrument were available. The hard copy version of the questionnaire was posted along with a self-addressed envelope marked by an identification code used to identify the potential participants who responded (and thus, enabling follow-ups to non-respondents). The participants that opted to use the online version of the questionnaire were given token numbers to enter as part of their responses.

The questionnaire was distributed along with a cover letter and an information sheet (see Appendix B and Appendix C, respectively). The cover letter introduced the purpose of my study. The information sheet was supplied in compliance with the

Massey University Human Ethics regulations; the ethics-related issues are discussed in section 4.7.

4.3.6 Measurement of Variables

All of the variables in the research model tested in my study (see Figure 3-1 in section 3.2 for the research model) were latent variables that cannot be measured directly. Therefore, they were measured via indicators, related variables that can be measured directly.

4.3.6.1 Dependent Variables

The breadth of e-procurement use was measured by the range of e-procurement functionalities used within an organisation (see Table 4-3 for a list of the functionalities covered, organised according to the descriptive model of forms of e-procurement introduced in section 2.3, Figure 2-1). The functionalities were taken from the existing literature. Only functionalities relating to information and transaction perspectives were included in the measure of breadth of e-procurement use, because e-procurement forms from the infrastructure perspective in the descriptive model in Figure 2-1, e-marketplace, intranet, and extranet, relate to packaging and securing e-procurement functionalities rather than to providing functionalities of direct business value (see section 2.3 for a review of e-procurement forms and functionalities).

The extent of use of each of the functionalities was measured on a seven-point semantic differential scale from 1 (*not used at all*) to 7 (*used very extensively*). The number of functionalities rated equal to or higher than a certain threshold was used as an indicator of breadth of e-procurement use. In the main analysis, I used the threshold value of 4 (the mid-point of the scale); in post-hoc analysis, I confirmed that the choice of the threshold does not affect the overall results, see section G.1.2 in Appendix G. The survey questionnaire covered 31 e-procurement functionalities; therefore, the resulting indicator of breadth ranged from 0 to 31 (the breadth of e-procurement use construct was measured by a single indicator).

Table 4-3 *Breadth of E-Procurement Use*

Form[a]		Functionality	Source
Information perspective			
Information search	IISE1	Search for suppliers of goods electronically	Gunasekaran & Ngai (2008); Lefebvre et al. (2005); Pearcy et al. (2008)
	IISE2	Search for suppliers of services electronically	Gunasekaran & Ngai (2008); Lefebvre et al. (2005); Pearcy et al. (2008)
	IISE3	Check availability of goods electronically	Teo et al. (2009)
	IISE4	Check availability of services electronically	Teo et al. (2009)
	IISE5	Check prices of goods electronically	Teo et al. (2009)
	IISE6	Check prices of services electronically	Teo et al. (2009)
E-collaboration	IEC1	Electronic communications with suppliers via e-mail	Teo et al. (2009)
	IEC2	Electronic communications with suppliers using technologies other than e-mail	Based on Teo et al. (2009)[c]
	IEC3	Internal electronic communications on issues related to procurement via e-mail	Based on Teo et al. (2009)[c]
	IEC4	Internal electronic communications on issues related to procurement using technologies other than e-mail	Based on Teo et al. (2009)[c]
	IEC5	Exchange purchasing information with external parties electronically	Teo et al. (2009)
	IEC6	Exchange purchasing information with internal parties electronically	Teo et al. (2009)
	IEC7	Negotiate contracts (such as price and volume) with suppliers electronically (such as via e-mail and instant messaging)	Lefebvre et al. (2005)
E-informing	IIF1	Provide online specific information about product specifications that our suppliers must meet	Wu et al. (2007)
	IIF2	Send suppliers regular updates about new developments in our organisation (such as product plans) electronically	Wu et al. (2007)
	IIF3	Share inventory planning information with our suppliers electronically	Wu et al. (2007)
Transaction perspective			
E-catalogue	TECAT1	Purchase goods using e-catalogues	Davila et al. (2003); Lefebvre et al. (2005)
	TECAT2	Purchase services using e-catalogues	Davila et al. (2003); Lefebvre et al. (2005)
E-tender	TTENDER1	Purchase goods by issuing electronic calls for tenders	Lefebvre et al. (2005)
	TTENDER2	Purchase services by issuing electronic calls for tenders	Lefebvre et al. (2005)
E-auction	TEAUCT1	Purchase goods at e-auctions (conventional auctions, with buyers bidding for goods)	Lefebvre et al. (2005)
	TEAUCT2	Purchase services at e-auctions (conventional auctions, with buyers bidding for services)	Lefebvre et al. (2005)
	TEAUCT3	Purchase goods via e-reverse auctions (with sellers bidding to provide goods)	Lefebvre et al. (2005)
	TEAUCT4	Purchase services via e-reverse auctions (with sellers bidding to provide services)	Lefebvre et al. (2005)
IntraOS	TINTRA1	Create purchase requisitions electronically	Teo et al. (2009)
	TINTRA2	Approve purchase requisitions electronically	Teo et al. (2009)
	TINTRA3	Technology integration of the e-procurement system with other internal systems	Teo et al. (2009)
InterOS	TINTER	Permit suppliers to directly access our internal systems	Wu et al. (2007)
ALL[b]	TOTALL1	Make payments to suppliers of goods electronically	Lefebvre et al. (2005); Teo et al. (2009)
	TOTALL2	Make payments to suppliers of services electronically	Lefebvre et al. (2005); Teo et al. (2009)
	TOTALL3	Track orders electronically	Davila et al. (2003); Teo et al. (2009); Wu et al. (2007)

[a]E-procurement perspectives and forms were introduced in section 2.3 (in particular, see Figure 2-1).

[b]E-procurement functionalities from the transaction perspective listed under ALL are relevant to all of the e-procurement forms under the transaction perspective.

[c]These functionalities were not directly given in the literature; I introduced them based on my knowledge of the domain by analogy with functionality IEC1, which was taken from Teo et al. (2009).

This approach to operationalisation of breadth of e-procurement use followed the approach by Al-Khaldi and Wallace (1999) and Thompson, Higgins, and Howell (1991), who used a similar approach to the operationalisation of breadth (counting the number of functionalities rated above a threshold) in their studies of the use of personal computers. The approach employed by Wu et al. (2007), in their study of the extent of use of e-procurement (reviewed in detail in section 2.7.4), using the extent of use for each functionality as a separate indicator, was not used because I believe that counting functionalities better reflects the content of the breadth of use construct (namely, the sophistication, as opposed to the amount of use). Nonetheless, the approach by Wu et al. (2007) was also explored in post-hoc analysis (see section G.2 in Appendix G).

It has to be noted that the terms *indicator* (a manifest variable used to measure a latent variable) and *item* (a line item in a questionnaire used to elicit response) are often used synonymously in the literature (see, for example, Kline, 2011) because in most studies, there is a one to one relationship between indicators and items. In my study, to obtain a single indicator of the breadth of e-procurement use, multiple questionnaire items were used. Nonetheless, I do not attempt to correct the well-established usage and occasionally use the two terms synonymously, assuming that the reader can establish the meaning from context.

As in the studies of breadth of use by Brock and Zhou (2005) and Larsen, Sorebo, and Sorebo (2009), the breadth of use in my study was modelled by using a formative indicator.

The depth of e-procurement use was measured by using the monetary values of direct goods, indirect goods, direct services, and indirect services purchased online as indicators. The measurement items for the depth of e-procurement use were taken from the existing literature (see Table 4-4 for the items listed against literature sources). An open-ended question was used to elicit the value for all of the items of depth; therefore, the respondents were not constrained to a pre-set range of values.

Table 4-4 *Measurement Items: Depth of E-Procurement Use*

Item	Source
Percentage of **'direct goods'** (i.e. goods used in manufacturing/production, e.g., raw materials) purchased online, with respect to the total monetary value of direct goods purchased—in % (0-100 range)	Gottschalk & Abrahamsen (2002); Xu et al. (2004)
Percentage of **'indirect goods'** (i.e., goods used in managing the business, e.g. office supplies) purchased online, with respect to the total monetary value of indirect goods purchased—in % (0-100 range)	Gottschalk & Abrahamsen (2002); Xu et al. (2004)
Percentage of **'direct services'** (i.e., services which are directly related to the main business activity, e.g., transportation of finished goods) purchased online, with respect to the total monetary value of direct services purchased—in % (0-100 range)	Gottschalk & Abrahamsen (2002); Xu et al. (2004)
Percentage of **'indirect services'** (i.e., services which are not directly related to the main business activity, e.g., cleaning the premises) purchased online, with respect to the total monetary value of indirect services purchased—in % (0-100 range)	Gottschalk & Abrahamsen (2002); Xu et al. (2004)

The depth of e-procurement use was measured by using reflective indicators, as in the study by Teo et al. (2009).

4.3.6.2 Independent Variables

To measure the independent variables in the research model (relative advantage, compatibility, and complexity from the technological context; top management support and employee knowledge from the organisational context; and partner readiness and external pressure from the environmental context), I adapted validated measures available in the literature. For the details of the model, see Figure 3-1 in section 3.2.

The items are summarised in Table 4-5 (for the technological context), Table 4-6 (for the organisational context), and Table 4-7 (for the environmental context). All of the items were measured on a seven-point semantic differential scale ranging from *strongly disagree* (1) to *strongly agree* (7), with the exception of the items for partner readiness, which were measured on a seven-point semantic differential scale ranging from *not at all important* (1) to *extremely important* (7). In data analysis, all of the

items used to measure the independent variables were treated as separate indicators, with each of the indicators varying in the range from 1 to 7.

Table 4-5 *Measurement Items: Factors from the Technological Context*

Construct		Item	Source
Relative advantage	RA1[a]	E-procurement makes the purchasing process faster	Teo et al. (2009)
	RA2	E-procurement facilitates better management of our purchasing activities	Nik Abdullah (2009)
	RA3	E-procurement improves relationships with our business partners	Teo et al. (2009)
	RA4[a]	E-procurement reduces the price of procured goods	Teo et al. (2009)
	RA5[a]	E-procurement reduces the price of procured services	Teo et al. (2009)
	RA6	E-procurement reduces operational costs	Teo et al. (2009)
	RA7	E-procurement improves competitive advantage	Teo et al. (2009)
Compatibility	CMP1[a]	E-procurement adoption fits our organisation's preferred way for conducting our purchasing activities	Karahanna et al. (2006)
	CMP2[a]	E-procurement adoption is compatible with our organisation's current purchasing process	Karahanna et al. (2006)
	CMP3[a]	E-procurement adoption is consistent with the way our purchasing activities should be conducted	Karahanna et al. (2006)
	CMP4[a]	E-procurement adoption is consistent with our business strategy	Teo & Pian (2003)
	CMP5[a]	E-procurement adoption is consistent with our organisational beliefs and values	Teo & Pian (2003)
	CMP6[a]	E-procurement adoption is compatible with our information technology infrastructure	Teo & Pian (2003)
	CMP7[a]	E-procurement is a new business experience for our organisation	Karahanna et al. (2006)
Complexity	CPX1[a]	Learning to operate e-procurement is easy	Grandon & Pearson (2004)
	CPX2[a]	It is easy to get e-procurement to do what our organisation wants it to do	Karahanna et al. (2006)
	CPX3[a]	E-procurement is flexible to interact with	Grandon & Pearson (2004)
	CPX4[a]	Interactions with e-procurement are clear and understandable	Grandon & Pearson (2004)
	CPX5[a]	It is easy to become skilful at using e-procurement	Grandon & Pearson (2004)
	CPX6[a]	E-procurement is easy to use	Grandon & Pearson (2004)

[a]These items were slightly reworded to make them better fit the context of the study.

Table 4-6 *Measurement Items: Factors from the Organisational Context*

Construct		Item	Source
Top management support	TMS1[a]	Top management is interested in the adoption of e-procurement	Teo & Pian (2003)
	TMS2[a]	Top management considers e-procurement adoption as important to the organisation	Teo & Pian (2003)
	TMS3[a]	Top management has effectively communicated its support for e-procurement adoption to employees	Teo & Pian (2003)
	TMS4[a]	Top management is committed to the use of e-procurement	Teo & Pian (2003)
	TMS5[a]	Top management is likely to invest funds in e-procurement	Soliman & Janz (2004)
	TMS6[a]	Top management is willing to take risks involved in the adoption of e-procurement	Soliman & Janz (2004)
Employee knowledge	EK1[a]	Our employees have very little knowledge about how e-procurement can help improve our business	Looi (2005)
	EK2[a]	Our employees have the technical knowledge to start using e-procurement	Looi (2005)
	EK3[a]	Our employees would use e-procurement more if they knew more about what it can do for our organisation	Looi (2005)
	EK4[a]	Our employees have the ability to use e-procurement	Lee (2009)
	EK5[a]	Our employees have an overall knowledge about e-procurement	Lee (2009)

[a]These items were slightly reworded to make them better fit the context of the study.

Table 4-7 *Measurement Items: Factors from the Environmental Context*

Construct		Item	Source
Partner readiness	PR1	Trading partner(s) reluctance to change	Chwelos et al. (2001)
	PR2	Lack of trust in trading partner(s)	Chwelos et al. (2001)
	PR3	Training trading partner(s)	Chwelos et al. (2001)
	PR4	Educating trading partner(s)	Chwelos et al. (2001)
	PR5	Non automated/non sophisticated trading partner(s)	Chwelos et al. (2001)
	PR6	Poor reputation of trading partner(s)	Chwelos et al. (2001)
	PR7	Lack of financial controls	Chwelos et al. (2001)
	PR8	Lack of legal controls	Chwelos et al. (2001)
	PR9[a]	Inadequate trading volume to justify e-procurement	Chwelos et al. (2001)
	PR10	Difficulty in achieving "critical mass" of trading partner(s)	Chwelos et al. (2001)
External pressure	EP1[a]	There is a pressure to use e-procurement to meet suppliers' requirements	Premkumar & Ramamurthy (1995)
	EP2[a]	There is a pressure from the industry to use e-procurement as a standard purchasing practice	Premkumar & Ramamurthy (1995)
	EP3[a]	An e-procurement link to our suppliers is necessary to maintain our competitive edge	Premkumar & Ramamurthy (1995)
	EP4[a]	We believe we will lose our suppliers if we do not use e-procurement	Premkumar & Roberts (1999)
	EP5[a]	We feel it is a strategic necessity to use e-procurement to compete in the marketplace	Premkumar & Roberts (1999)

[a]These items were slightly reworded to make them better fit the context of the study.

All of the measures of the independent variables were based on prior studies, in which the indicators of the measures were treated as reflective. The same approach was adopted in my study.

4.3.7 Construct Validity

As much as possible, my study relied on construct measures validated in prior research; nonetheless, all of the measures were also re-validated as much as possible given the time and resources constraints of the study.

Construct validity refers to the extent to which the indicators intended to measure a construct do accurately measure that particular construct (Hair, Black, Babin, Anderson, & Tatham, 2005). Construct validity cannot be assessed directly. Content validity, convergent validity, and discriminant validity are evidence of construct validity and can be assessed using a range of specific criteria. Therefore, content validity, convergent validity, and discriminant validity were assessed for the measures to which they applied.

4.3.7.1 Content Validity

Content validity refers to the indicators used to measure a construct correctly and fully covering the content of the construct. Formal content validity checks involving content experts can be conducted (Nunnally & Bernstein, 1994), but were not feasible in my study. Alternatively, content validity can be ensured by taking into account the prior research relevant to the content of the construct; this approach was used in my study. The items used to obtain the indicator values were explicitly related to prior literature in section 4.3.6. As an extra measure to ensure content validity, the measures were reviewed by two content experts (an expert in enterprise management information systems and an expert in SME management) in the pre-test of the survey instrument (see section 4.3.8 for a detailed description of the pre-test).

4.3.7.2 Convergent Validity

Convergent validity is the extent to which the indicators of a measure correlate, suggesting that they measure the same construct (Hair et al., 2005). Convergent validity can be assessed via item reliability, internal consistency reliability, and the values of the average variance extracted (AVE) (Hair, Black, Babin, & Anderson, 2010).

Item reliability is measured as the standardised loading of an item on its construct (Igbaria, Guimares, & Davis, 1995). Hair et al. (2010) suggested that items loading at .50 or higher should be seen as reliable. Chin (1998a), however, suggested that for PLS analysis (model fitting technique used in my study, see section 4.4 for a

discussion of PLS), the threshold should be at least .60, and ideally .70. My study used a threshold value of .60, as suggested by Chin (1998a).

Internal consistency reliability is the degree to which all items of the measure vary in concert (Nunnally & Bernstein, 1994; Zhu, Dong, Xu, et al., 2006). Internal consistency reliability can be assessed via composite reliability (Lu & Wang, 2008) or via Cronbach's alpha (Igbaria et al., 1995); both of the approaches were employed in my study. In my study, a threshold of .70 was used (following Chin, 1998a, and Hair et al., 2010).

AVE is the average variance shared between a construct and its items (Hulland, 1999; Sanchez-Franco & Roldan, 2005). In my study, a threshold of .50 was used (following Fornell and Larcker, 1981, and Hair et al., 2010).

4.3.7.3 Discriminant Validity

Discriminant validity is the extent to which the items measure their own constructs, rather than other constructs in the model (Zhu & Kraemer, 2005). Discriminant validity can be assessed at item level (Henseler, Ringle, & Sinkovics, 2009) and at construct level (Fornell & Larcker, 1981).

Item level. At the item level, the discriminant validity is assessed by examining cross-loadings. For discriminant validity, all items should load on their own construct higher than on other constructs in the model (Henseler et al., 2009).

Construct level. At the construct level, AVE for individual constructs and correlations between constructs are considered. For discriminant validity, for each pair of constructs in the model, their square roots of AVE should be greater than the correlation between them (Liang et al., 2007; Sanchez-Franco & Roldan, 2005).

4.3.8 Pre-testing

The questionnaire was pre-tested in two stages to detect any problems with readability and formatting.

First, an expert in enterprise management information systems and an expert in SME management (both from academic backgrounds) read the questionnaire and commented on its design. Based on comments from the experts, I slightly reworded several items to improve readability and changed the order of questions to start the questionnaire with the section devoted to breadth of e-procurement use (to establish context, thus, making it easier for the respondents to understand the rest of the questionnaire).

Second, 14 MIS and Management doctoral students filled in the questionnaire as well as provided feedback on its design. This resulted in adjusting the layout of the questionnaire and in minor adjustments to item wordings to further improve readability.

4.3.9 Quantitative Data Collection Procedures

As described in section 4.3.1, the quantitative data were gathered using a self-administered cross-sectional survey. The survey was available both online and as a paper-based survey.

I contacted each of the prospective participants over the phone (using the Skype service to minimise the costs). I described the aims of the research and offered the options of completing the survey questionnaire online or on paper. I asked the participants who opted to respond online to provide an e-mail address (which was not available from Kompass) and used it for subsequent communications. I asked the participants who opted to respond on paper to confirm the postal address I obtained from Kompass (in all cases, the postal address was the same as provided by Kompass). Some of the prospective participants could not be reached in person over the phone, but other company staff could be reached; I attempted to obtain e-mail addresses of the prospective participants who could not be reached from the company staff that could be reached. If e-mail addresses were provided, I applied the same procedure as for the participants who explicitly opted to respond online; if e-mail addresses were not provided, I applied the same procedure as for the participants who explicitly opted to respond on paper. Some of the prospective participants that I talked to over the phone refused to participate; I did not attempt to

contact them any further, and for the purposes of calculating the response rate, they were counted as non-responses.

Survey procedures for the participants who opted to respond online are detailed in Figure 4-1 and for the participants who opted to respond on paper, in Figure 4-2. Two reminders were issued. Participation was tracked by using token numbers generated by the online survey software or (for the paper-based survey) by marking prepaid, self-addressed envelopes issued to the participants with the participants' identification codes. Copies of the cover letter, of the information sheet, and of the reminder letters are given in Appendices B, C, and D, respectively.

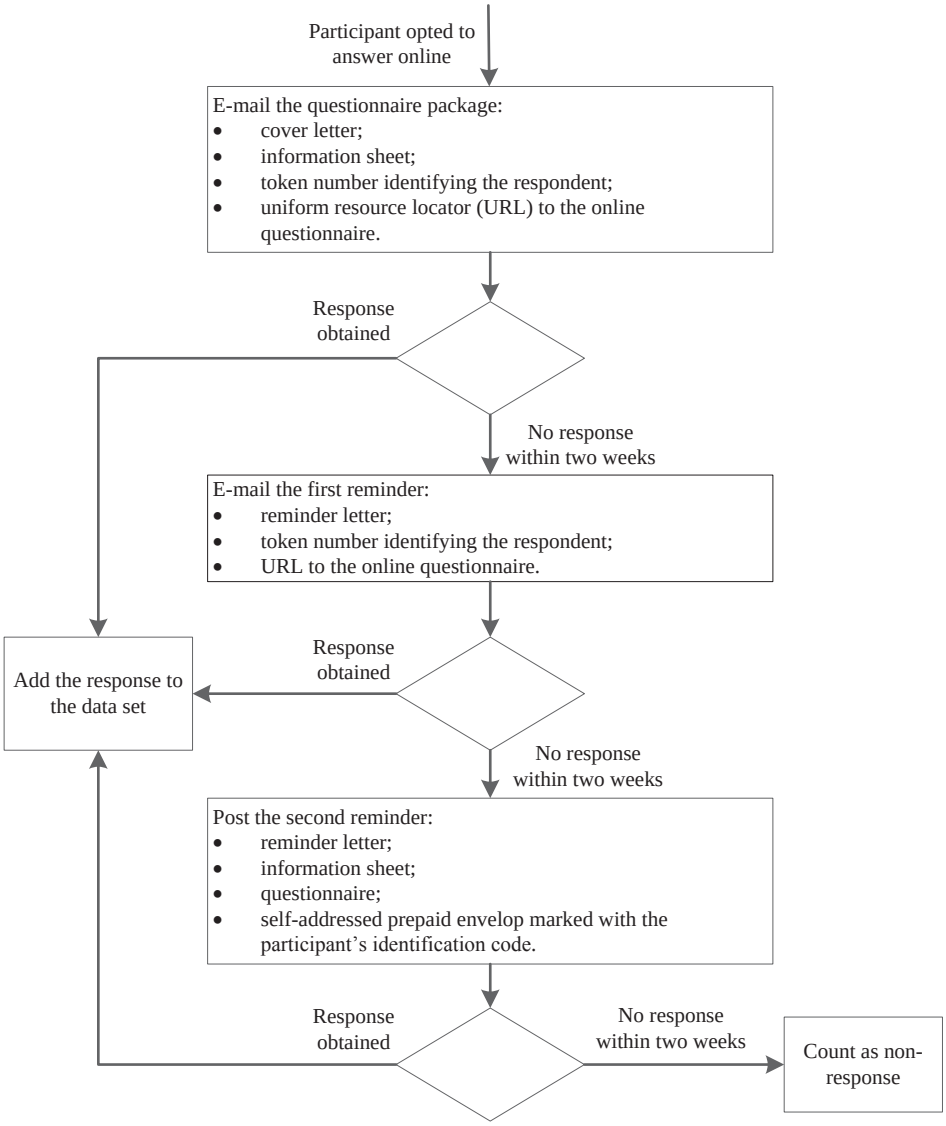

Figure 4-1. Online survey procedures.

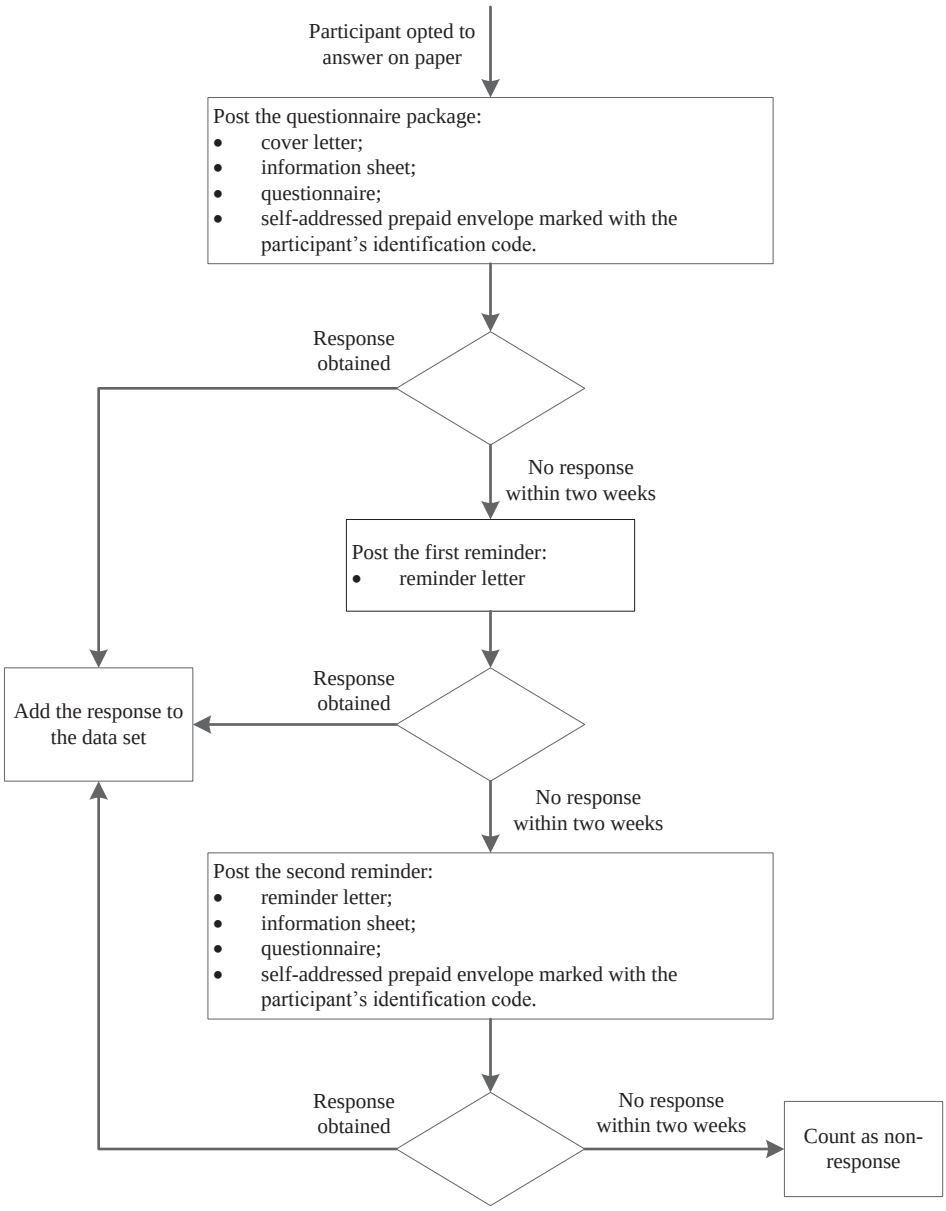

Figure 4-2. Paper-based survey procedures.

The online survey option was used primarily to control costs (most of the respondents opted to respond online, resulting in considerable cost reduction). It was also hoped that because the prospective participants could choose their preferred way to answer, it would increase the response rate. To offer the option to respond online, the initial phone contact was necessary because e-mail addresses were not available from Kompass. It was also hoped that the initial personal contact over the phone

would increase the response rates (e.g., compared to a design involving sending unsolicited e-mails).

Even though in principle there is a possibility that the respondents would interpret items or scales differently depending on whether the questionnaire is administered online or on paper, thus undermining the validity of the results, prior studies (see, for example, Bordens & Abbott, 2011; Fleming & Bowden, 2009) found that online questionnaires and paper questionnaires return equivalent results.

The phone calls were carried out in October and November 2010. Quantitative data collection was completed in February 2011.

4.4 Approach to Model Testing

To test the research model (introduced in Figure 3-1) against data, the PLS SEM technique (as implemented in SmartPLS version 2.0 software) was used. SEM techniques allow testing a model involving multiple latent variables as a whole.

The PLS approach to SEM is particularly common in Information Systems research (Marcoulides, Chin, & Saunders, 2009). PLS is particularly suitable when research is exploratory in nature (the constructs of the model are not very well established) and when the model is relatively large in terms of the number of constructs (Hair, Ringle, & Sarstedt, 2011). The model used in my study matched these criteria: the research was, to a large extent, exploratory as the nomological framework for the constructs of breadth and depth of e-procurement use is not well established (as demonstrated in section 4.3.6). Moreover, the recommended data size to use the covariance-based SEM (an alternative to PLS) with the research model of my study is approximately 500 (Kline, 2011, calculated as ten times the number of indicators in the model). In view of the nature of my study (an SME as a unit of analysis and managers as target respondents, with the target population of a limited size and high likelihood of a low response rate), it was not feasible to obtain a data set that large; however, it was feasible to obtain a data set of moderate size (151 responses were obtained. See section 5.2 for a detailed discussion of the response rate). Even though the use of PLS with very small sample sizes has been criticised (see, for example, Marcoulides

& Saunders, 2006), PLS has been consistently demonstrated to work well with model sizes and data sizes similar to the ones in my study (for a recent example, refer to Furneaux & Wade, 2011). Finally, PLS allows to test models with formative indicators, unlike covariance-based modelling, as it is implemented in commonly available software packages such as LISREL, EQS, and AMOS. In my study, a formative measure was used for the breadth of e-procurement use (see section 4.3.6.1), suggesting the use of PLS.

In applying PLS SEM, I followed the established procedure (Compeau & Higgins, 1995; Gefen et al., 2000). First, the measurement model was tested. The research model (introduced in Figure 3-1) with constructs measured as described in sections 4.3.6.1 and 4.3.6.2, was fitted to data and convergent and discriminant validity checks were conducted (convergent validity and discriminant validity are discussed in sections 4.3.7.2 and 4.3.7.3, respectively). Unreliable or cross-loading items were removed, resulting in minor adjustments to construct measures. Then, the structural model was tested. The updated model was fitted to the data, and bootstrap procedures (Gefen et al., 2000; Henseler et al., 2009) were used to assess the statistical significance of path coefficients. Following Sanchez-Franco and Roldan (2005), 500 resamples were used in the bootstrapping procedure.

The model fit was judged by the magnitudes and statistical significance of path coefficients, as well as by the amount of variance explained in dependent variables.

As to the magnitudes of path coefficients, Chin (1998a) suggested that the standardised paths coefficients should be at least .20 or ideally above .30 to be meaningful. Kline (2011) suggested that standardised paths coefficients with values close to .10 or below should be interpreted as corresponding to small effect sizes, values close to .30 as corresponding to medium effect sizes, and values close or greater than .50 as corresponding to large effect sizes. My study follows Skadberg and Kimmel (2004) in using the Kline's heuristics to interpret effect sizes, along with the more commonly used criterion by Chin (1998a) (see, for example, Hoe, 2008).

As to interpreting the amount of variance explained in dependent variables, Falk and Miller (1992) suggested that the R^2 value should be more than .10 to be meaningful. Venkatesh et al. (2003) tabulated R^2 values obtained in a broad range of technology acceptance studies; most of the values were between .30 and .40, suggesting that SEM models explaining 30% or more variance in dependent variables (in context of MIS research) should be considered to have acceptably high predictive power. Chin (1998b) suggested that R^2 values close to .670 should be seen as substantial, values close to .333 as average, and values close to .190 and lower as weak.

4.5 Qualitative Data Collection

As described in section 4.2, qualitative data were used to enrich the interpretation of the results of hypotheses testing, thus realising the sequential explanatory mixed methods design (Creswell et al., 2003; Ivankova, Creswell, & Stick, 2006). The qualitative data of my study were gathered from two sources. The main source was semi-structured interviews focusing on the meaning behind the outcomes of testing the research model of my study (see section 4.5.1 for a discussion of the semi-structured interview design). Open-ended questions incorporated into each section of the survey instrument (see section 4.5.2 for a detailed discussion of the open-ended questions) were also used as a source of qualitative data.

4.5.1 Interviews

The main source of qualitative data in my study was semi-structured interviews. Semi-structured interviews can result in richer, more in-depth data than survey questionnaires (including survey questionnaires with open-ended questions) because interviewers can ask follow-up questions to clarify the information provided by the respondents, to encourage the respondents to provide more relevant information, and to seize opportunities when unexpected relevant information is mentioned (Gillis & Jackson, 2002; Rahim, 2008).

4.5.1.1 Interview Participants

The survey conducted in my study (introduced in section 4.3.1) included a question asking the respondents if they were willing to participate in a follow-up interview, and, if yes, to provide their contact details. All of the respondents that indicated the willingness to participate in follow-up interviews were contacted; however, only some of them found time to be interviewed. In the survey, 151 responses were obtained, 35 of the respondents were willing to participate in follow-up interviews; and only five of the respondents that initially agreed to be interviewed found time to be interviewed. For a more detailed discussion of the response rate, refer to section 5.2.

All of the respondents that were available for interviews were interviewed. No selection criteria were applied as all of the interview participants self-selected. This may have introduced bias, but there was no alternative way to collect in-depth qualitative data.

4.5.1.2 Interview Questions

I developed the interview questions (listed in Table 4-8) based on the results of the hypotheses testing (relative advantage and external pressure were found to affect the breadth of e-procurement use, and compatibility was found to affect the depth of e-procurement use, see section 5.8.2.1 for details). First, the participants were asked to elaborate in general on the possible determinants of the breadth and the depth of e-procurement use within their organisations. Then, the questionnaire focused on the factors found to have effect based on the analysis of the quantitative data collected in my study.

No evidence of the effects of top management support was found in the quantitative data analysis, which I found to be particularly surprising (see the discussion in section 3.4.2.1). Therefore, I also included questions asking the respondents to elaborate on the possible effects of top management support. Nonetheless, to establish focus and to ensure that interview duration was acceptable to the interview participants, I did not explicitly cover other hypotheses in the research model (see

Figure 3-1 for the research model) that were not confirmed in quantitative data analysis.

Table 4-8 *Semi-Structured Interview Questions*

Breadth of e-procurement use	
According to your response to the original survey, your organisation relies on a range of e-procurement functionalities. How did you come up with the range of the functionalities you use? In particular, how did your organisation arrive at the decision on which e-procurement functionalities to use and which not to use?	
Factors affecting the breadth of e-procurement use	
Relative advantage	At your organisation, how does the perception of the degree to which e-procurement offers advantages influence the range of e-procurement functionalities you use?
External pressure	How do your trading partners and other external organisations influence the range of e-procurement functionalities you use?
Top management support	In your opinion, in which ways does top management support influence the range of e-procurement functionalities you use?
Depth of e-procurement use	
According to your response to the original survey, the total monetary value of goods and services purchased online ranges from 70% for indirect goods to 100% for direct and indirect services. In your opinion, what influences the total monetary value of goods and services purchased online? In particular, how do various factors in your organisation and in its environment determine this number?	
Factors affecting the depth of e-procurement use	
Compatibility	How does the compatibility of e-procurement with your organisation's culture influence this number (if at all)? By organisation's culture, I refer to factors such as your organisation's preferred work style, existing work practices, prior experience, and values.
Top management support	In your opinion, in which ways does top management support influence the total monetary value of goods and services you purchase online?
Other	
Is there anything else you would like to add?	

4.5.1.3 Interview Procedures

As described in section 4.5.1.1, 35 respondents agreed to participate in the interviews. I contacted the respondents via e-mail to make specific arrangement. (Initially, e-mail addresses were available only for 30 of them; I was able to obtain the e-mail addresses of the remaining five by contacting them by phone.)

I e-mailed all of the 35 prospective interview participants a cover letter outlining the purpose of the interview, stating the estimated interview duration (10 to 15 minutes), and asking if they would allow me to record the interview. I also asked the prospective interview participants to indicate the date and the time when they would be available to be interviewed. A copy of this e-mail is given in Appendix E.

Only five of the prospective interview participants found time to be interviewed. All of them were interviewed, and all of them gave me permission to record their interviews.

The interview questions were e-mailed to the interview participants several days prior the interview sessions. This was to enable the participants to reflect on the possible answers in advance.

All of the interviews were conducted in May 2011, two months after the results of the survey were available. The interviews were conducted using the Skype phone service to minimise costs. While conducting the interviews, I asked follow-up questions, depending on the situation, to obtain clarifications and to explore the relevant issues in further detail.

All of the interviews were recorded as MP3 files via MP3 Skype Recorder. The interviews took between 10 to 20 minutes (slightly longer than the initial estimate).

The interview recordings were transcribed in several stages. First, I transcribed the interview recordings in full. The transcription process took about two days to complete. The initial transcription allowed me to identify the parts of the recordings that were particularly relevant to my study. I split the MP3 recordings to extract the parts that were relevant (about 95% of the original recordings), and got them transcribed independently using a professional transcription service. The transcription service took about half a day to return the transcripts and charged me for five hours of work. I validated the transcript by comparing my own transcript with the transcript made by the service. Some minor differences were discovered and resolved by accessing the recordings.

4.5.2 Open-Ended Questions in the Survey

Some of the qualitative data were collected via open-ended questions incorporated in the main survey instrument. In this respect, the design of my study was similar to the design of the study by Bhattacherjee and Premkumar (2004). Bhattacherjee and Premkumar tested a model explaining changes in user attitudes to the use of a computer-based training system and of rapid application development software by fitting quantitative data using PLS SEM. Bhattacherjee and Premkumar incorporated open-ended questions into their survey instrument. The open-ended questions enabled the respondents to elaborate on their attitudes. The resulting qualitative data were used to enrich the interpretation of quantitative findings. Bhattacherjee and Premkumar found that the qualitative data obtained via open-ended questions enabled deeper interpretations of the quantitative findings of their study.

An open-ended question was added at the end of each section of the survey instrument prompting the respondents to comment on their answers to closed-ended questions in the section (the full survey instrument is given in Appendix A).

4.6 Approach to Qualitative Data Analysis

The qualitative data were analysed using a constant comparative method, following the approach suggested by Erlandson et al. (1993). The process is outlined in Figure 4-3.

I read the qualitative data several times in their entirety word by word to gain a broad understanding. Then, the qualitative data were disaggregated into units that were meaningful on their own (in most cases, such units corresponded to sentences of text). Once units were determined, I coded the units one by one. I compared each unit to the units that I already coded, and either reused one of the existing codes, or introduced a new code if the unit suggested a new theme that was relevant to my study. Units of data to which codes could not be assigned were classified temporarily as *other*. After considering all units of data, I returned to the units under the *other* stack and considered them once again, based on the understanding that I attained while coding the rest of the data. The process of coding the units was repeated

several times, with codes amended, added, or removed according to my emerging understanding. The analysis was continued until I found that no new understandings were attained. Then, I presented my interpretation as a narrative description.

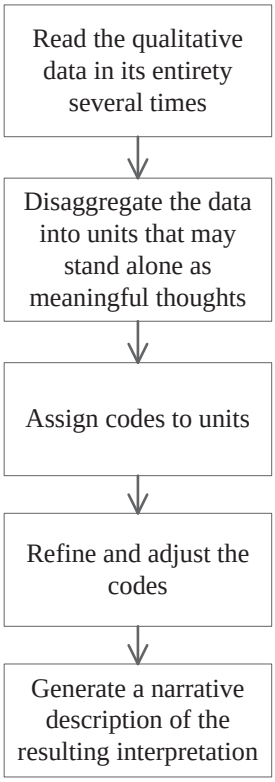

Figure 4-3. Qualitative analysis procedures.

In most cases, a unit would be assigned to a single substantive category (or to the nondescript *other* category, for units that did not appear to fit into any of the categories); but occasionally, a unit would be assigned to more than one category.

Erlandson et al. (1993) suggested the use of member checking (discussing the analysis results with the participants) and investigator triangulation to improve the credibility of the analysis. Member checking, however, could not be conducted because the study participants were managers and their time was very valuable.

Investigator triangulation was conducted by having another researcher (a PhD student in Management who had 10 years' experience as an information technology manager) to independently code the data. The differences were discussed, which

allowed me to further enrich my interpretation of the data. The analysis presented in section 5.9 is based on my own interpretation, enriched via the discussions with the independent coder.

4.7 Human Ethics

To minimise any risks to the participants, I took the following precautions. Participation in the survey and in the interviews was voluntary. I told the prospective participants in writing that they could refuse to participate altogether or withdraw at any moment.

The data collected in my study were treated as confidential and were used for the purposes of my study only. More specifically, the data obtained in the online version of the survey were anonymous, as the software did not allow associating the responses with individual respondents, with the exception of the respondents who opted to participate in the follow-up interview and explicitly provided their contact details. The data obtained in the paper-based survey could be associated with the individual respondents, which was used solely to issue reminders and to arrange follow-up interviews.

Only aggregate quantitative data were included in the thesis and in any other publications or presentations in connection with my study. Any extracts from qualitative data presented in qualitative data analysis reports were checked for the presence of identifying information, which was removed. In qualitative data analysis reports, the participants were not identified.

Permission in writing from the participants was obtained to digitally record the semi-structured interview session and the recordings were treated as confidential data, along with the transcripts of the recordings.

The research complied with the Massey University Human Ethics regulations. Based on a peer review of the research instruments and procedures, a low risk notification was issued to the Massey University Human Ethics Committee. In compliance with the regulations, information about the steps taken to minimise risk was provided to

the prospective participants in the cover letter and in the information sheet included in the questionnaire package. The information sheet included the contact details of the researchers and of the Massey University Human Ethics Committee. The cover letter and the information sheet are provided in Appendices B and C, respectively.

Data collection commenced only after an acknowledgement of the acceptance of the low risk notification was received (see Appendix F).

4.8 Summary of the Chapter

Sequential explanatory mixed methods design was used. Quantitative data were collected via a survey with the organisation as a unit of analysis, with managers responding on behalf of their organisations. The target population was small and medium firms in the manufacturing industry in New Zealand, and the sample was obtained by drawing contact details of organisations at random from the Kompass database.

For factors hypothesised to affect the breadth and the depth of e-procurement use, as well as for depth of e-procurement use, measures were adapted from the literature. For breadth of e-procurement use, the measure was based on counting the number of e-procurement functionalities in use; the list of the functionalities included in the measure was based on prior studies of e-procurement adoption and use (see sections 2.4 and 2.7 in Chapter 2 for a detailed discussion of prior studies of e-procurement adoption and use). The survey questionnaire included open-ended questions asking the respondents to provide comments and clarifications.

The survey questionnaire was administered both online and on paper, and the survey involved two reminders. PLS SEM was used to validate the research model; convergent and discriminant validity were assessed as part of the PLS analysis.

All of the survey respondents who wished to be interviewed were interviewed. The questionnaire used in the semi-structured interviews focused on identifying the mechanisms behind the hypotheses confirmed in the analysis of the quantitative data. Both the interview transcripts and the answers to open-ended questions in the survey

questionnaire were analysed as qualitative data, using the constant comparative method.

Steps taken to minimise harm to the participants included voluntary participation, treating both the data and the participants' identities as confidential, and obtaining written consent for recording the interviews.

CHAPTER 5 DATA ANALYSIS AND FINDINGS

5.1 Introduction

This chapter introduces the results of data analysis.

First, the results of quantitative data analysis are discussed. After introducing the survey response rate, the chapter discusses the outcomes of checking for missing data and outliers, assessing multivariate normality, comparing the respondents to the target population to assess data set representativeness, and comparing early respondents to late respondents to check for non-response bias. This is followed by presenting the characteristics of the participating organisations and of the respondents (the managers who responded on behalf of the organisations). The outcomes of model testing are then discussed, first for the measurement and then for the structural model.

Second, the results of qualitative data analysis are presented, with the focus on the factors affecting e-procurement use discussed and suggested by the participants.

5.2 Survey Response Rate

This section describes the outcome of executing the survey administration procedures introduced in section 4.3.9 in terms of the numbers of responses obtained. The survey was conducted from October 2010 to February 2011.

Out of the 1,000 contacts obtained from the Kompass database, the following were excluded from the sample:

- one contact was removed from the sample because the phone number supplied by Kompass was not valid (I concluded that the organisation was no longer in business);

- one contact was removed because the member of the organisation who could be reached over the phone claimed that the company was not in manufacturing;

- 14 contacts were removed because the paper-based questionnaire packages sent to the addresses provided by Kompass were returned with notes stating that the organisation was no longer in business.

Thus, there were 984 potential respondents.

Only 377 (38%) of the potential respondents could be reached directly by phone:

- 144 (14%) of the potential respondents were reached directly by phone, agreed to participate, and provided their e-mail addresses for the purposes of the survey.

- 233 (24%) of the potential respondents were reached directly by phone but refused to participate. Most frequently mentioned reasons for refusing to participate were the potential respondent being too busy and a company's policy not to respond to surveys. These were counted as non-responses.

As for the 607 (62%) of potential respondents who could not be reached directly by phone, an attempt was made to obtain their e-mail addresses from someone else:

- For 343 (35%) of the potential respondents, e-mail addresses for the purposes of the survey were obtained from the company employees who could be reached by phone.

- For 255 (26%) of the potential respondents, e-mail addresses could not be obtained. For these potential respondents, the postal addresses provided by Kompass were used to send the questionnaire package by post.

- For nine (1%) of the SMEs contacted, the targeted potential respondent was no longer in the organisation and no replacement was suggested by the company employee who could be contacted. These SMEs were counted as non-responses.

As a result, I sent the questionnaire package to 487 (49%) of the potential respondents by e-mail. Thirty-seven of the e-mail addresses turned out to be invalid

(very likely, because I did not record them correctly over the phone). When an e-mail address turned out to be invalid, I sent the questionnaire package by post.

To boost the response rate, reminder letters were sent to the potential respondents that did not respond, in two stages. The first reminder letter was sent two weeks after the original distribution. The second reminder letter with a hard copy of the questionnaire was sent approximately two weeks after the first reminder.

The devastating earthquake on 22 February 2011 created considerable disruption in Christchurch region. I did not distribute the second reminder letters to the 39 SMEs from that area.

Table 5-1 *Total Response*

Mode of contact	Number sent	Number of invalid addresses	Number of responses received	Number of usable responses received
Reached by phone directly, questionnaire package sent by e-mail	144	2[a]	83	73
E-mail obtained from someone else, questionnaire package sent by e-mail	343	35[a]	30	28
Questionnaire package sent by post	497	14[b]	52	50

[a]For these potential respondents, the questionnaire package was re-sent by post. [b]Questionnaire package returned with a note that the company was no longer in business.

Overall, for the 984 SMEs in the sample, 165 responses were received, including 113 online and 52 on paper (see Table 5-1 for a breakdown of response numbers). Thus, the overall response rate was 17%. However, 14 responses were discarded because of incomplete data (see section 5.3 for a discussion of missing values). Hence, only 151 usable responses were analysed, resulting in an effective response rate of 15%.

The response rate of 15% is common for studies involving senior managers as respondents. For example, Grandon and Pearson (2004), in their study of e-commerce adoption by SMEs in the US (with managers or owners as respondents), obtained a response rate of 12%; Gunasekaran et al. (2009), in a study of e-procurement adoption by SMEs in Portugal (with procurement professionals as respondents), obtained a response rate of 16%; and Wu et al. (2007), in a study of the

extent of e-procurement use by organisations of all sizes in the US (with senior executives as respondents), obtained a response rate of 14%.

The following factors may have contributed to the response rate. First, under most circumstances, senior managers are busy people with many demands on their time. Second, major earthquakes happened in New Zealand in September 2010 and in February 2011. This may have resulted in additional stress to company managers. Third, some of the respondents may have perceived the topic of the survey as not relevant or not interesting (Gillis & Jackson, 2002; Pearson & Grandon, 2005).

5.3 Checking for Missing Values, Outliers, and Non-Normality

To prepare for hypothesis testing, the data were analysed for missing values, analysed for the presence of outliers, and tested for normality, in this order.

Missing values. Hair et al. (2010) suggested that variables or cases with more than 50% of missing values should be deleted from the data set and that the remaining cases and variables with missing data should be considered for removal. I inspected the pattern of missing values and found that some of the cases had uncharacteristically large numbers of missing values and clearly differed in this respect from the rest of the data set, with large blocks of items (covering more than one section of the questionnaire) remaining unanswered. I removed 14 cases with uncharacteristically large numbers of missing values; the remaining cases had less than 28% of missing values per case and had less than 13% of missing values per variable.

The indicators of partner readiness were particularly affected by missing values, with four of the ten indicators, covering aspects of the construct content not covered by the rest of the indicators (PR4, PR6, PR7, and PR8, see Table 4-7 for the item wordings), having more than 10% of missing values. (It should be noted that two of the respondents complained that the items used to measure partner readiness were difficult to comprehend.) Because partner readiness is an important construct from the point of view of the theory, I retained all of the items for further analysis, but

took into account the apparent problems with the measure when interpreting the results.

Mean substitution was used to deal with the remaining missing values, with the exception of breadth of e-procurement use. For breadth of e-procurement use, I assumed that when a functionality is not rated, it means that it is not used (because if the functionality was in use, the respondent would be aware of it and would rate it).

Outliers. Mahalanobis distance was used to detect outliers, with a threshold of .001 for the *p* value (Hair et al., 2010). Seven outliers were detected. I carefully examined them. In terms of the demographic data (organisation and respondent characteristics) or patterns of indicator values, the outliers did not appear to clearly differ from the rest of the cases in the data set. Therefore, I concluded that the outliers represented the population and retained them in the data set for further analysis.

Multivariate normality. Although PLS does not require normality, Marcoulides and Saunders (2006) argued that when used with data that is close to normal, PLS has greater statistical power. To check for normality, the values of skewness and kurtosis were calculated for individual indicators (following Kline, 2011). According to Kline (2011), if skewness and kurtosis for individual indicators are below 3 and 10, respectively, the data can be regarded to be close enough to multivariate normal for the purposes of SEM analysis. All of the indicators passed these criteria.

5.4 Checking if the Data Set is Representative of the Population

To test if the 151 usable responses received in my study (with the cases with too much missing data excluded as described in section 5.3) were representative of the New Zealand manufacturing companies in the Kompass database (as of 11 August 2010), I compared the ratio of the number of small to the number of medium firms in the data set with the similar ratio in the Kompass database. There were 129 small and 22 medium firms in the data set (resulting in the ratio of 5.9), and there were 2,929 small and 389 medium manufacturing firms in the Kompass database (personal communication from a Kompass representative, received on 11 August 2010; see Table 5-2 for a line-up of the numbers). According to a chi-square goodness-of-fit

test, there was no significant difference between the two ratios (χ^2 = .944, *df* = 1, *p* = .331), suggesting that the data set was representative of the firms in the Kompass database.

Table 5-2 *Numbers of Small and Medium Manufacturing Firms*

	Dataset of my study	Kompass database	Statistics New Zealand
Number of small firms[a]	129	2,929	4,872
Number of medium firms[b]	22	389	341

[a]Firms with full-time equivalent staffing levels of 6 to 49 (see section 4.3.4 for details about the definitions of small and medium firms used in my study). [b]Firms with full-time equivalent staffing levels of 50 to 99.

As discussed in section 4.3.4, the contents of the Kompass database are not necessarily representative of the whole population. Therefore, I conducted a similar comparison with the ratio of the number of small to the number of medium firms available from Statistics New Zealand (2010) (see Table 5-2). According to Statistics New Zealand (2010), as of February 2010, there were 4,872 small and 341 medium firms in New Zealand. Thus, according to Statistics New Zealand, the ratio of the number of small to the number of medium enterprises (14.3) in New Zealand was larger than in the data set of my study (5.9). The difference was statistically significant (χ^2 = .13.290, *df* = 1, $p < .05$), suggesting the possibility of a bias (most likely the difference was because small firms are less likely to register in the Kompass database than larger firms). This difference was taken into account when considering the limitations of my study.

5.5 Checking for Non-Response Bias

To test for non-response bias, figures reported by early respondents (those who responded to the initial mail out) were compared to the figures reported by late respondents (those who responded to reminders). Following Kanuk and Berenson (1975), it was assumed that late respondents are similar to non-respondents.

Based on the timing of responses, out of the 151 cases in the data set, 84 (56%) were classified as early responses and 67 (44%) as late responses. Numbers of full-time

employees and sales turnover figures were compared (see Table 5-3), similarly to the study by Teo et al. (2009).

Table 5-3 *Average Numbers of Full-Time Employees and Sales Turnovers for Early and Late Respondents*

Item	Early respondents	Late respondents	*p*
Number of full-time employees	26.15	24.88	.71
Annual sales turnover	NZ$7,007,231	NZ$8,713,317	.34

An independent samples *t*-test was used; the outcome is given in Table 5-3. No statistically significant differences were discovered, suggesting that there was no non-response bias.

5.6 Checking if the Breadth of E-Procurement Use Construct is Two-dimensional

Even though the main aim of the descriptive model of forms of e-procurement was to ensure that the construct of the breadth of e-procurement use covers all of the intended content, one can interpret it as suggesting that the construct of the breadth of e-procurement use is two-dimensional, comprising the dimensions of the breadth of use of informational e-procurement functionalities and the breadth of use of transactional e-procurement functionalities. To explore the possibility of the breadth of e-procurement use being two-dimensional, I conducted EFA of the structure of the functionalities' scores. Because the number of functionalities covered by the study was rather large, the size of the data set was not sufficient to use EFA directly on the functionalities' scores. Therefore, I aggregated functionalities' scores for each e-procurement form (as suggested by the Fabrigar, MacCallum, Wegener, and Strahan, 1999). This resulted in a data set with eight variables. With 151 cases in the data set, there were more than ten cases per variable; therefore, the data set was large enough to conduct EFA analysis (Costello & Osborne, 2005).

Table 5-4 *Indicator Pool for EFA of the Structure of Breadth of Use and the Resulting Factor Loadings*

		Geomin rotated loadings	
Indicator	Description	Factor 1	Factor 2
INFOISE	Information: E-sourcing	**.511**	.305
INFOEC	Information: E-collaboration	**.967**	-.135
INFOIF	Information: E-informing	**.693**	.017
TRANECAT	Transaction: E-catalogue	**.510**	.333
TRANTDER	Transaction: E-tender	.091	**.579**
TRANAUCT	Transaction: E-auction	-.006	**.691**
TRANITRA	Transaction: IntraOS	**.748**	.003
TRANITER	Transaction: InterOS	**.290**	.051

The outcome of the EFA analysis with the number of factors set to two is given in Table 5-4 (for Mplus code used to conduct the analysis, refer to Appendix H). Clearly, the separation of the forms of e-procurement into two factors did not reflect the divisions of the forms of e-procurement along the distinction between informational and transactional forms suggested by the Beldona et al. (2005).

5.7 Organisation and Respondent Characteristics

This section presents the characteristics of the organisations in the data set of my study. The characteristics of the respondents (who completed the survey on behalf of the organisations) are also presented, to demonstrate that they were knowledgeable about the organisations.

5.7.1 Organisation Characteristics

Organisation characteristics included the year of establishment, legal form, number of full-time employees, manufacturing industry sector, region inside New Zealand, and annual sales turnover (see Figures 5-1 to 5-6 for details). Overall, the organisations were mostly limited liability companies, well established (in existence for at least ten years), and small in size (less than 50 full-time employees), with manufacturing sectors relying on metals as raw materials best represented.

5.7.1.1 Year of Establishment

The organisations in the data set were established between 1865 and 2009 (*M* = 1973.79, *SD* = 26.85). The majority of the organisations (88.36%) were established before the year 2000 (see Figure 5-1 for a distribution of the organisations by year of establishment).

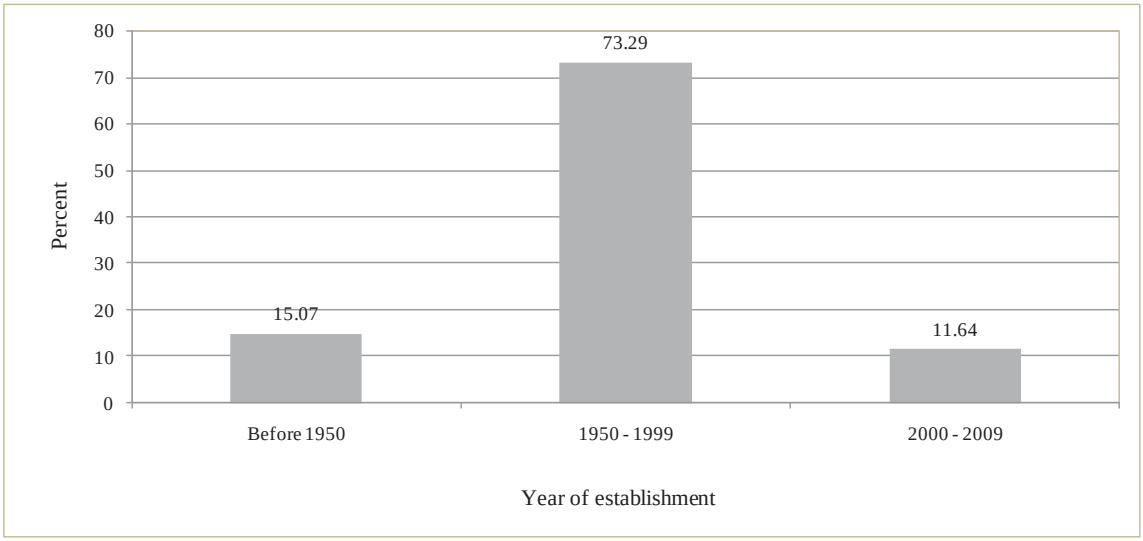

Figure 5-1. Distribution of the organisations in the data set by year of establishment.

5.7.1.2 Legal Form

Most of the organisations (97.33%) were limited liability companies (see Figure 5-2 for a distribution of the organisations by legal form).

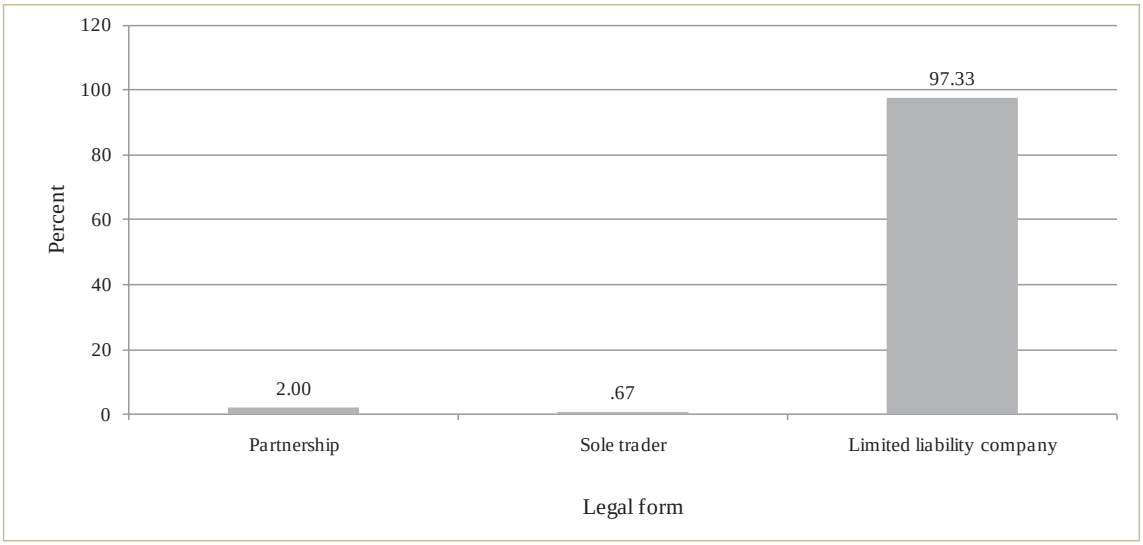

Figure 5-2. Distribution of the organisations in the data set by legal form.

5.7.1.3 Number of Full-Time Employees

The majority of the organisations (84.67%) had fewer than 50 full-time employees (see Figure 5-3 for a distribution of the organisations by number of full-time employees). The average number of full-time employees was 25.61, with a standard deviation of 19.61.

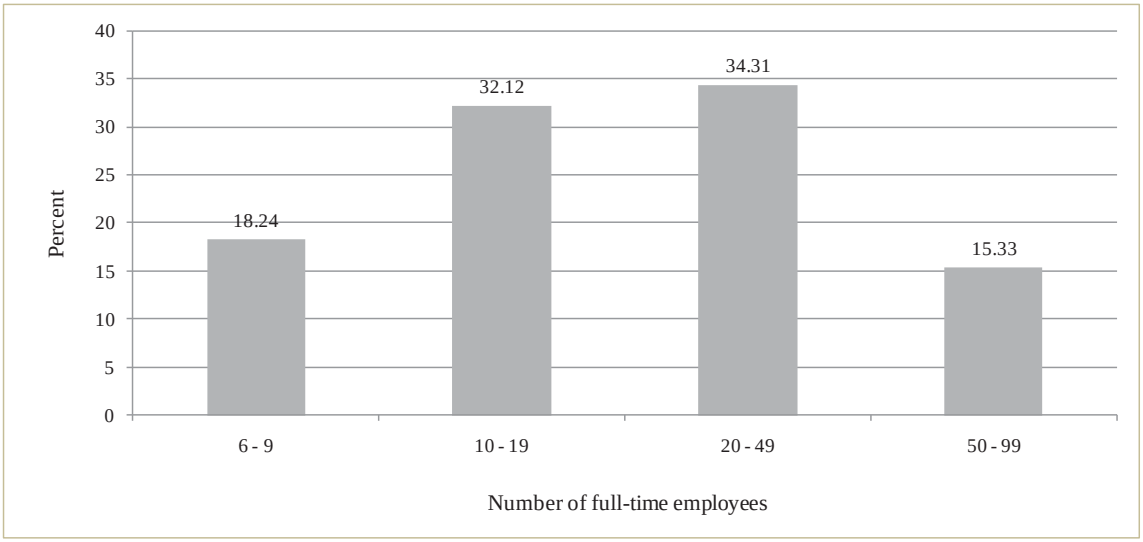

Figure 5-3. Distribution of the organisations in the data set by number of full-time employees.

5.7.1.4 Manufacturing Industry Sector

The manufacturing industry sectors best represented were primary metal and metal product, machinery and equipment, fabricated metal product, and furniture and other manufacturing (covering together 56.77% of the organisations in the data set) (see Figure 5-4 for a distribution of the organisations by manufacturing industry sector).

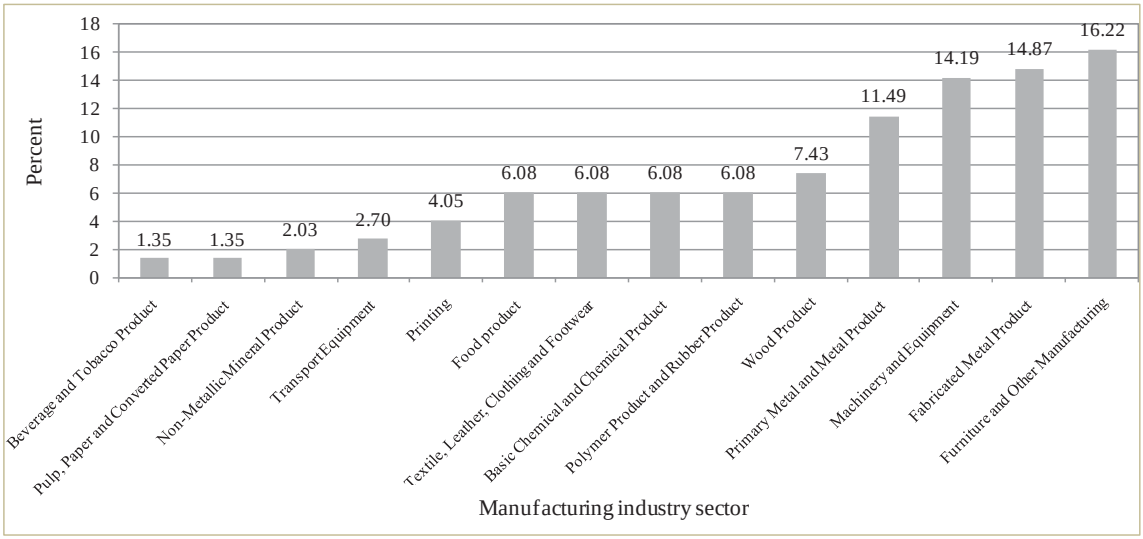

Figure 5-4. Distribution of the organisations in the data set by manufacturing industry sector. Manufacturing industry sectors were defined following the Australian and New Zealand Standard Industrial Classification 2006 (ANZSIC06) (Statistics New Zealand, 2010).

5.7.1.5 Region

Most of the organisations were located in the North Island (see Figure 5-5 for a distribution of the organisations by region), with Auckland (41.61%), Wellington (12.08%), Waikato (8.73%), and Manawatu-Wanganui (8.05%) best represented. In the South Island, Canterbury (8.05%) and Otago (6.72%) were best represented.

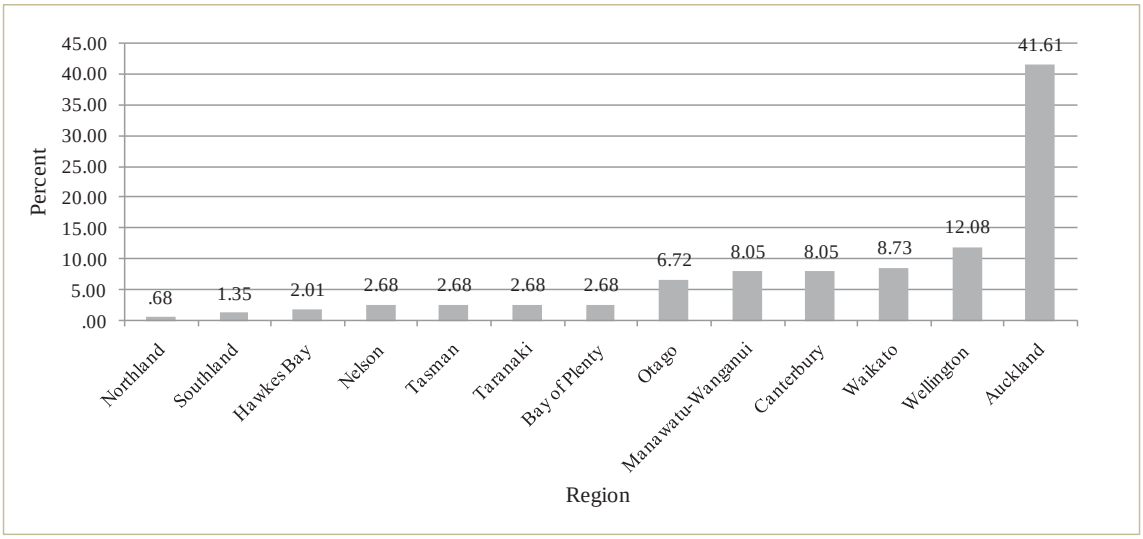

Figure 5-5. Distribution of the organisations in the data set by region. Regions were defined following Ministry of Economic Development (2011).

5.7.1.6 Annual Sales Turnover

The majority of the organisations (84.06%) had annual sales turnovers between $1,000,000 and $19,999,999, with 46.38% within the range between $1,000,000 and $4,999,999 (see Figure 5-6 for a distribution of the organisations by annual sales turnover). Only 6.52% of the organisations had annual sales turnovers of less than $1,000,000, and 2.90% of the organisations had annual sales turnovers of more than $30,000,000. On average, the organisations had an annual sales turnover of $7,749,007.25, with a standard deviation of $10,260,000.

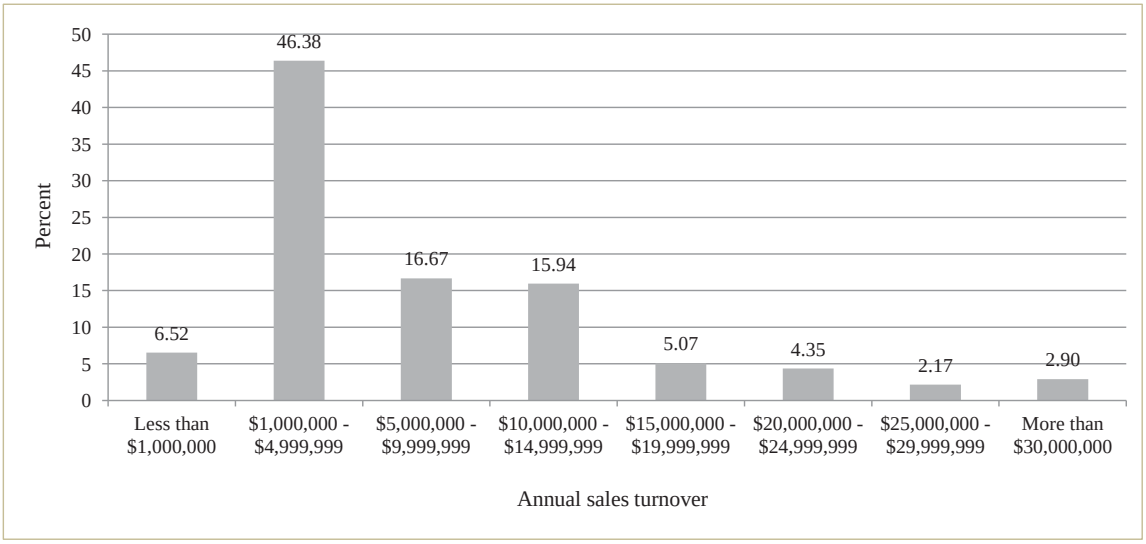

Figure 5-6. Distribution of the organisations in the data set by annual sales turnover.

5.7.2 Respondent Characteristics

This section discusses the demographic characteristics of key informants that filled in the survey questionnaire on behalf of their organisations.

The questionnaire included an open-ended question asking the respondents about their present position within the organisation. Most of the respondents (78.91%) characterised themselves as owners, chief executive officers, directors, or managing directors.

The majority of the respondents were male (85.33%) and were more than 40 years old (84.89%).

Most of the respondents had more than ten years of experience in the industry of their current organisation (69.29%), and most of the respondents had more than ten years of experience in their current organisation (60%). More than half of the respondents had a Bachelor's degree or above (58.21%), and most of the rest of the respondents had at least a post-secondary certificate or diploma (41.79%).

Overall, the respondents were mostly mature, experienced, well educated, and employed in powerful positions, suggesting that they were both knowledgeable about their organisations and capable to understand the survey questions.

5.7.3 Use of E-Procurement Functionalities

This section presents the use of e-procurement functionalities averages over the responses in the data set. The scores of the functionalities from the information perspective are given in Table 5-5 and the scores of the functionalities from the transaction perspective, in Table 5-6. The details of how the scores were calculated are explained in the table notes.

All functionalities had scores above zero and, thus, were in use. Not surprisingly, the functionalities involving the use of commonly available technology, such as the functionalities under e-collaboration, were used more extensively.

E-mail was used more extensively for e-procurement related communication with external parties than internally, possibly reflecting the ease of face-to-face communications at relatively small companies. Even though a number of respondents commented on the value of traditional approaches to communication (such as face-to-face and over the phone), the rate of using information technology to negotiate contracts was very high.

Even though direct integration with the suppliers was relatively rare, integration via e-informing was relatively widespread.

Goods were purchased online at a higher rate than services. E-auctions were used at a higher rate than e-tenders, and the most commonly used e-auctions functionality was purchasing goods at direct auctions.

Functionalities under IntraOS scored unexpectedly high. It is likely that the respondents interpreted them very broadly, for example, it is possible that "technology integration of the e-procurement system with other internal systems" was interpreted as the ability to distribute e-procurement related documents inside

the company by e-mail. The respondents' free-form comments supported this interpretation.

Surprisingly, tracking orders electronically, arguably, a relatively sophisticated functionality, was used very often.

Table 5-5 *Use of E-Procurement Functionalities*: *Information Perspective*

Functionality	Score[a]
E-sourcing	
Search for suppliers of goods electronically	.34
Search for suppliers of services electronically	.31
Check availability of goods electronically	.25
Check availability of services electronically	.22
Check prices of goods electronically	.28
Check prices of services electronically	.21
E-collaboration	
Electronic communications with suppliers via e-mail	.81
Electronic communications with suppliers using technologies other than e-mail (such as instant messaging and video conferencing)	.24
Internal electronic communications on issues related to procurement via e-mail	.62
Internal electronic communications on issues related to procurement using technologies other than e-mail (such as instant messaging, video conferencing, etc.).	.21
Exchange purchasing information with external parties electronically	.48
Exchange purchasing information with internal parties electronically	.52
Negotiate contracts (such as price and volume) with suppliers electronically (such as via e-mail and instant messaging)	.60
E-informing	
Provide online specific information about product specifications that our suppliers must meet	.39
Send suppliers regular updates about new developments in our organisation (such as product plans) electronically	.29
Share inventory planning information with our suppliers electronically	.22

[a]The normalised score was calculated by normalising the semantic differential scale values to fall in the range between 0 and 1, with 0 corresponding to the lowest point on the scale, and 1 to the highest.

Table 5-6 *Use of E-Procurement Functionalities*: *Transaction Perspective*

Functionality	Score[a]
E-catalogue	
Purchase goods using e-catalogues	.42
Purchase services using e-catalogues	.25
E-tender	
Purchase goods by issuing electronic calls for tenders	.08
Purchase services by issuing electronic calls for tenders	.05
E-auction	
Purchase goods at e-auctions (conventional auctions, with buyers bidding for goods)	.16
Purchase services at e-auctions (conventional auctions, with buyers bidding for services)	.06
Purchase goods via e-reverse auctions (with sellers bidding to provide goods)	.05
Purchase services via e-reverse auctions (with sellers bidding to provide services)	.03
IntraOS	
Create purchase requisitions electronically	.53
Approve purchase requisitions electronically	.41
Technology integration of the e-procurement system with other internal systems	.33
InterOS	
Permit suppliers to directly access our internal systems	.07
ALL	
Make payments to suppliers of goods electronically	.81
Make payments to suppliers of services electronically	.77
Track orders electronically	.54

[a]The normalised score was calculated by normalising the semantic differential scale values to fall in the range between 0 and 1, with 0 corresponding to the lowest point on the scale, and 1 to the highest.

5.8 Model Testing

The approach to model testing used in my study is described in section 4.4, and included testing the measurement model to assess the validity of the measurement instrument and testing the structural model to test the hypotheses of my study (as formulated in section 3.2 and in Figure 3-1). Some of the items of the compatibility and employee knowledge were reverse coded; these were converted as appropriate before the analysis.

5.8.1 Testing the Measurement Model

As described in section 4.4, measurement model testing involved assessing convergent (introduced in section 4.3.7.2) and discriminant (introduced in section 4.3.7.3) validity of the construct measures introduced in section 4.3.6.

5.8.1.1 Convergent Validity

Convergent validity and the approaches to assessing it used in my study are introduced in section 4.3.7.2. Item reliability, internal consistency reliability, and AVE values were considered.

Item reliability. Three items loaded on their constructs below the threshold of .60 used in my study (see section 4.3.7.2 for an introduction of the approach used): CMP7 item of the compatibility construct (with the factor loading of .38), EK3, employee knowledge (.35), and PR9, partner readiness (.51) (see Tables 4-5, 4-6, and 4-7, respectively, for these items' details and Table 5-7 for the items loadings). The implications of removing these items for their constructs' content were considered.

CMP7, *e-procurement is a new business experience for the organisation*, describes how new e-procurement is to the organisation. E-procurement may be entirely new and at the same time highly compatible with the existing practices. For example, fast and reliable payments over EDI may be highly compatible with just-in-time manufacturing practices already in place at the organisation even though the organisation currently does not use e-procurement. Therefore, the item CMP7 does not necessarily reflect the compatibility construct and removing it may improve the measure.

EK3, *our employees would use e-procurement more if they knew more about what it can do for our organisation*, appears to reflect employee readiness to act in a way that is of benefit to the organisation, rather than employee knowledge, the construct it purports to measure. Employees may know nothing about e-procurement but still score high on this item. Therefore, removing this item may improve the measure.

Table 5-7 *Items Loadings in the Initial and in the Adjusted Measurement Model*

Technology							
Relative advantage (RA)			Compatibility (CMP)			Complexity (CPX)	
RA1	.82	.82	CMP1	.94	.95	CPX1	.80	.80
RA2	.85	.85	CMP2	.91	.91	CPX2	.87	.87
RA3	.80	.80	CMP3	.93	.93	CPX3	.86	.86
RA4	.77	.77	CMP4	.95	.95	CPX4	.92	.92
RA5	.76	.76	CMP5	.91	.91	CPX5	.88	.88
RA6	.85	.85	CMP6	.85	.86	CPX6	.92	.92
RA7	.85	.85	CMP7[a]	.38				
Organisation							
Top management support (TMS)						Employee knowledge (EK)	
TMS1	.95	.95				EK1	.63	.67
TMS2	.97	.97				EK2	.79	.80
TMS3	.94	.94				EK3[a]	.35	
TMS4	.96	.96				EK4	.84	.83
TMS5	.92	.92				EK5	.93	.94
TMS6	.79	.79						
Environment							
Partner readiness (PR)						External pressure (EP)	
PR1	.60	.60				EP1	.85	.85
PR2	.80	.81				EP2	.88	.88
PR3	.84	.84				EP3	.89	.89
PR4	.86	.86				EP4	.77	.77
PR5	.67	.66				EP5	.85	.85
PR6	.61	.61						
PR7	.71	.71						
PR8	.63	.63						
PR9[a]	.51							
PR10	.60	.60						
Extent of e-procurement use							
Breadth						Depth	
TOTALFUNCTIONS	1.00	1.00				DEPDG	.80	.80
						DEPIDG	.85	.85
						DEPDS	.83	.83
						DEPIDS	.81	.81

Note. An item code is followed by the item's loadings on its construct. The item loading in the initial measurement model is followed by the item loading in the adjusted measurement model. Item wordings are given in Tables 4-5, 4-6, and 4-7. DEPDG = depth of e-procurement use—direct goods; DEPIDG = depth of e-procurement use—indirect goods; DEPDS = depth of e-procurement use—direct services; DEPIDS = depth of e-procurement use—indirect services.

[a]Items found to load poorly in the initial measurement model, and, therefore, dropped in the adjusted measurement model.

PR9, *inadequate trading volume to justify e-procurement*, does not appear to be problematic in terms of its content. Of the items used to measure partner readiness, it appears to be one of the items that are the easiest to understand. Even though some of the items of the partner readiness construct had uncharacteristically many missing values (as discussed in section 5.3), the number of missing values for PR9 was similar to most of the items in the questionnaire. Therefore, low item loading of PR9 may be indicative of a deeper problem with the measure used for partner readiness. This was taken into account as a possible limitation of my study. I followed the common practice in PLS analysis and removed PR9 from the measure of partner readiness in the main analysis presented in section 5.8.2 even though from the perspective of the content of the item, the rationale for removing it was not clear.

PLS analysis was re-applied with the problematic items omitted from the model. All items in the updated measurement model loaded above the threshold of .60, as seen in Table 5-7.

Internal consistency reliability. Composite reliabilities ranged from .89 to .97, and Cronbach's alpha values ranged from .83 to .97 (see Table 5-8 for details). All of the composite reliability and Cronbach's alpha values exceeded the threshold of .70 (see section 4.3.7.2 for an introduction of the approach used), suggesting that all measures were internally consistent.

Table 5-8 *Internal Consistency Reliability*

Construct	Composite reliability	Cronbach's alpha
Compatibility	.97	.96
Complexity	.95	.94
Depth	.89	.84
Employee knowledge	.89	.83
External pressure	.93	.90
Partner readiness	.90	.87
Relative advantage	.93	.92
Top management support	.97	.97

AVE. For all constructs, the AVE values (see Table 5-9 for details) were above the threshold of .50 (see section 4.3.7.2 for an introduction of the approach used), providing further evidence of convergent validity.

Table 5-9 *AVE*

Construct	AVE
Compatibility	.84
Complexity	.76
Depth	.68
Employee knowledge	.67
External pressure	.72
Partner readiness	.50
Relative advantage	.66
Top management support	.86

5.8.1.2 Discriminant Validity

Discriminant validity and the approaches to assessing it used in my study are introduced in section 4.3.7.3. Discriminant validity was assessed at item level and at construct level.

Item level. All items loaded on their own construct higher than on other constructs of the model (factor loadings are presented in Table 5-10). The strongest cross-loadings were between compatibility and top management support; still, the distinction between the two constructs was very clear.

Table 5-10 *Cross Loadings*

	CMP	CPX	DEPTH	EK	EP	PR	RA	TMS
CMP1	**.95**	.55	.55	.57	.67	.24	.70	.81
CMP2	**.91**	.53	.50	.56	.57	.26	.61	.71
CMP3	**.93**	.61	.52	.53	.60	.27	.70	.83
CMP4	**.95**	.58	.50	.59	.62	.23	.69	.83
CMP5	**.91**	.56	.46	.61	.57	.22	.66	.81
CMP6	**.86**	.56	.47	.51	.49	.29	.66	.72
CPX1	.45	**.80**	.28	.48	.23	.09	.39	.43
CPX2	.53	**.87**	.32	.47	.28	.24	.55	.54
CPX3	.52	**.86**	.33	.41	.35	.11	.64	.53
CPX4	.59	**.92**	.44	.48	.35	.17	.59	.59
CPX5	.56	**.88**	.41	.50	.27	.14	.49	.54
CPX6	.53	**.92**	.33	.46	.27	.14	.56	.54
DEPDG	.54	.33	**.80**	.32	.41	.19	.43	.49
DEPDS	.46	.34	**.85**	.31	.31	.13	.39	.42
DEPIDG	.38	.36	**.83**	.31	.22	.16	.38	.35
DEPIDS	.39	.32	**.81**	.31	.30	.22	.35	.36
EK1	.37	.27	.25	**.67**	.25	.05	.29	.35
EK2	.46	.46	.29	**.80**	.25	.31	.35	.40
EK4	.53	.46	.31	**.83**	.28	.11	.35	.54
EK5	.61	.51	.37	**.94**	.44	.15	.46	.60
EP1	.54	.20	.28	.33	**.85**	.26	.48	.51
EP2	.48	.23	.34	.28	**.88**	.29	.50	.47
EP3	.62	.39	.38	.41	**.89**	.29	.64	.63
EP4	.43	.17	.25	.18	**.77**	.29	.45	.44
EP5	.63	.40	.35	.40	**.85**	.25	.66	.64
PR1	.29	.16	.18	.27	.33	**.60**	.26	.27
PR2	.18	.09	.18	.20	.20	**.81**	.20	.17
PR3	.16	.12	.16	.13	.26	**.84**	.19	.16
PR4	.15	.09	.19	.17	.23	**.86**	.19	.16
PR5	.15	.09	.17	.12	.12	**.66**	.10	.13
PR6	.18	.09	.11	.02	.23	**.61**	.10	.13
PR7	.24	.18	.15	.10	.26	**.71**	.16	.21
PR8	.27	.21	.11	.07	.21	**.63**	.17	.22
PR10	.08	.03	.01	.04	.19	**.60**	.11	.06
RA1	.69	.62	.44	.43	.49	.09	**.82**	.67
RA2	.72	.57	.53	.51	.57	.21	**.85**	.72
RA3	.65	.52	.36	.43	.55	.19	**.80**	.65
RA4	.39	.39	.25	.17	.48	.19	**.77**	.38
RA5	.38	.36	.29	.17	.48	.17	**.76**	.39
RA6	.62	.52	.41	.39	.51	.24	**.85**	.59
RA7	.61	.47	.32	.35	.60	.30	**.85**	.60
TMS1	.85	.57	.48	.55	.60	.21	.68	**.95**
TMS2	.83	.58	.49	.54	.64	.23	.69	**.97**
TMS3	.81	.59	.45	.62	.63	.21	.65	**.94**
TMS4	.83	.60	.48	.55	.61	.21	.68	**.96**
TMS5	.79	.54	.49	.57	.60	.29	.70	**.92**
TMS6	.60	.48	.36	.45	.46	.21	.59	**.79**

Note. CMP = compatibility; CPX = complexity; DEPTH = depth of e-procurement use; DEPDG = depth of e-procurement use—direct goods; DEPIDG = depth of e-procurement use—indirect goods; DEPDS = depth of e-procurement use—direct services; DEPIDS = depth of e-procurement use—indirect services; EK = employee knowledge; EP = external pressure; PR = partner readiness; RA = relative advantage; TMS = top management support. Item wordings are given in Tables 4-5, 4-6, and 4-7. Item loadings on the assigned constructs are presented in bold.

Construct level. For all pairs of constructs in the model, their square roots of AVE were greater than the correlations between them (correlations and square roots of AVE are listed in Table 5-11), suggesting discriminant validity.

Table 5-11 *Correlations between Constructs*

	CMP	CPX	DEPTH	EK	EP	PR	RA	TMS
CMP	**.92**							
CPX	.61	**.87**						
DEPTH	.54	.41	**.82**					
EK	.61	.53	.38	**.82**				
EP	.64	.34	.38	.39	**.85**			
PR	.27	.17	.21	.19	.32	**.71**		
RA	.73	.62	.47	.45	.65	.24	**.81**	
TMS	.86	.61	.50	.59	.64	.25	.72	**.92**

Note. Numbers on diagonal (given in bold) are square roots of AVE. Codes for constructs are expanded in the note to Table 5-7.

Thus, the measurement model met the discriminant validity criteria both at the item level and at the construct level.

5.8.2 Testing the Structural Model

As described in section 4.4, structural model testing (see Figure 5-7 for structural model and for testing outcomes) involved assessing the statistical significance of path coefficients and the amount of variance explained in dependent variables. The statistical significance of path coefficients was assessed using a bootstrap procedure with 500 resamples (as described in section 4.4).

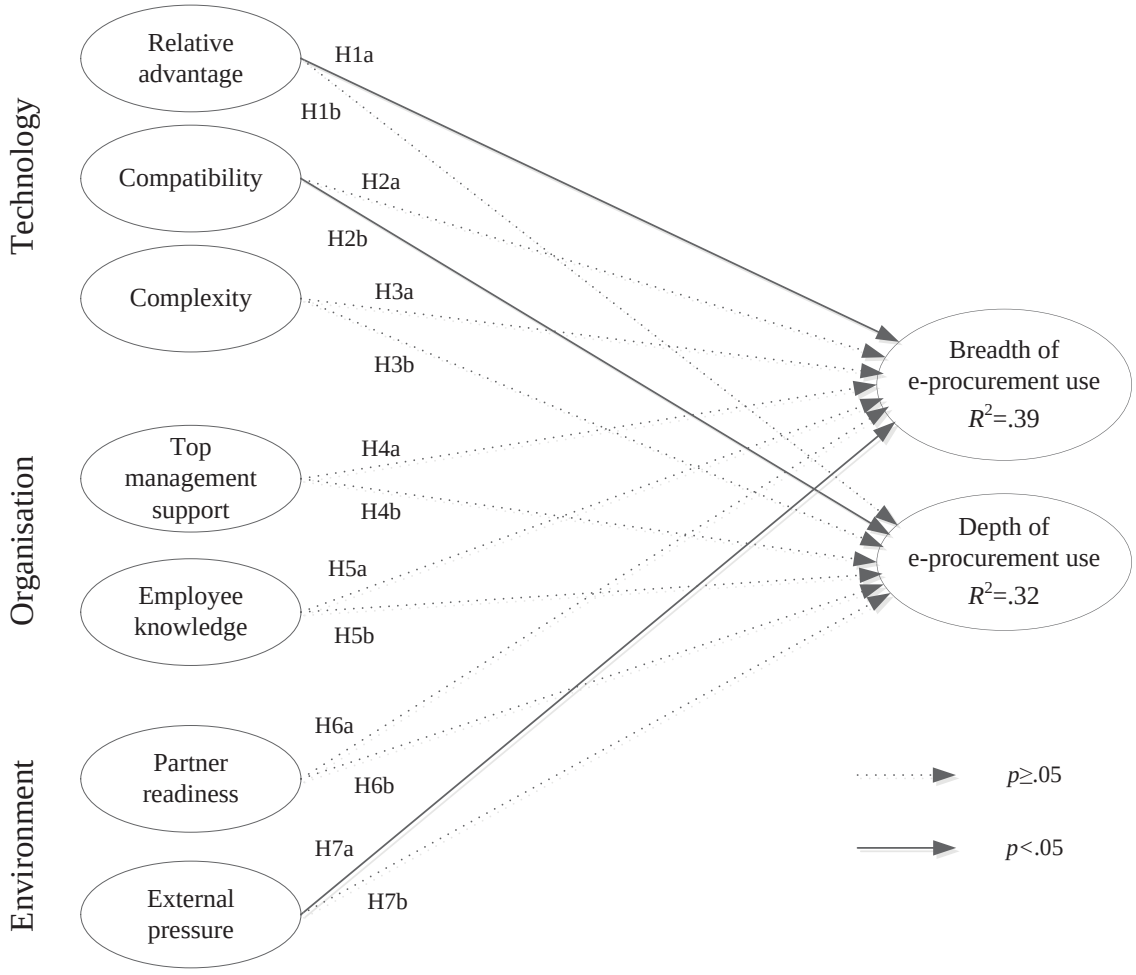

Figure 5-7. The outcome of the structural model testing. The details are given in Table 5-12.

5.8.2.1 Path Coefficients and Hypotheses Testing

The support for the hypotheses of my study (as formulated in section 3.2) was determined by examining, for each path of the structural model, the *p* value and the values of the path coefficient (β) (the values are listed in Table 5-12).

Even though TOE framework (introduced in section 2.6) suggests that factors from all of the three contexts (technology, organisation, and environment) determine the practice of technology use, only the effects of technological and environmental factors on the extent of e-procurement use were confirmed.

Table 5-12 *Outcomes of Hypotheses Testing*

	Hypothesis	β	*p* value	Supported/ not supported[a]
Technology				
H1a	Relative advantage → Breadth	.26	.024	Supported
H1b	Relative advantage → Depth	.11	.344	Not supported
H2a	Compatibility → Breadth	.16	.314	Not supported
H2b	Compatibility → Depth	.33	.024	Supported
H3a	Complexity → Breadth	.00	.988	Not supported
H3b	Complexity → Depth	.08	.425	Not supported
Organisation				
H4a	Top management support → Breadth	-.13	.322	Not supported
H4b	Top management support → Depth	.04	.728	Not supported
H5a	Employee knowledge → Breadth	.08	.325	Not supported
H5b	Employee knowledge → Depth	.05	.593	Not supported
Environment				
H6a	Partner readiness → Breadth	-.07	.342	Not supported
H6b	Partner readiness → Depth	.06	.433	Not supported
H7a	External pressure → Breadth	.37	<.001	Supported
H7b	External pressure → Depth	.01	.918	Not supported

[a]At an alpha significance level of .05 ($p < .05$).

Technological factors affected both the breadth and the depth of e-procurement use. Relative advantage affected the breadth of e-procurement use with a medium effect size (according to the Kline's heuristic introduced in section 4.4), and compatibility affected the depth of e-procurement use, again, with a medium effect size.

An environmental factor, external pressure, affected the breadth of e-procurement use, with a medium to large effect size.

5.8.2.2 Amount of Variance Explained and the Overall Fit of the Model

The model explained 39% of variance in the breadth of e-procurement use and 32% of variance in the depth of e-procurement use (see Table 5-13). Thus, the amount of variance explained by the model in the dependent variables was moderate according to Chin (1998b); the amount of variance explained was acceptably high when

compared to other MIS studies using SEM and was definitely larger than the threshold of .10 for being meaningful suggested by Falk and Miller (1992) (see section 4.4 for a discussion of different interpretation of R^2 values).

Table 5-13 *Amount of Variance Explained*

Dependent variable	R^2
Breadth	.39
Depth	.32

Overall, both the magnitudes of path coefficients for effects found to be statistically significant (corresponding to effect sizes close to medium according to Kline, 2011) and the amount of variance explained in dependent variables suggested an acceptable model fit (as discussed in section 4.4, R^2 values close to .33 suggest an average predictive power). Nonetheless, the number of the hypotheses that were not confirmed was rather large, leaving the model fitting results somewhat vulnerable to criticism, as the possibility of a capitalisation of chance was relatively high.

Unlike in covariance-based SEM, there is no widely acceptable measure of the goodness-of-fit for PLS analysis. The goodness-of-fit measure suggested by Cohen (1988) was estimated, and the value was estimated as .49, which, according to Cohen, corresponds to a good fit.

5.9 Analysis of Qualitative Findings

This section presents the findings of qualitative data analysis. As described in section 4.5, qualitative data were obtained from two sources: via interviews (introduced in section 4.5.1) and via open-ended questions incorporated in the survey questionnaire (introduced in section 4.5.2). A constant comparative method was used for qualitative data analysis (introduced in section 4.6). The remaining subsections of this section present the results of qualitative data analysis.

The following format is used to describe the respondent's organisation and the background of the respondent. The pseudonym of the respondent is followed by the

respondent's gender (M for male and F for female), the respondent's age (A), the respondent's experience in the organisation's industry (EI), the respondent's experience in the organisation (EO), the respondent's position at the organisation, the manufacturing industry sector of the organisation, and the number of full-time employees at the organisation. To ensure confidentiality, gender-appropriate pseudonyms rather than real names are used, and numbers are presented as ranges (even though the actual numbers were available for the analysis).

For example, (Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20–49 employees) refers to a respondent with pseudonym Darrell who is male, is within the age range of 51 to 60 years old, has had between 21 to 30 years' experience in the organisation's industry and between 11 to 20 years' experience at the organisation, and is a General Manager within the organisation. The organisation is in the machinery and equipment manufacturing industry sector and has 20 to 49 full-time employees.

When some of this information is not included, it means that it was not available.

In interpreting qualitative data, I took into account the respondents' and their organisations' characteristics and other quantitative data obtained via closed-ended questions included in the questionnaire (see sections 4.3.1 and 5.6 for an introduction of the types of quantitative data collected). Only three of the survey respondents participated in the interviews, and two of the survey respondents delegated the interviews to other employees in their organisations. The characteristics of interview participants are summarised in Table 5-14. In the analysis, quotes extracted from the interview transcripts are explicitly distinguished from quotes obtained via open-ended questions in the survey instrument.

Table 5-14 *Characteristics of Interviewees and Their Organisations*

	Jonas[a]	Cole[a]	Darrell[a]	Alyssa[b]	Faith[b]
			Interviewee		
Gender	Male	Male	Male	Female	Female
Age	61-70	51-60	51-60	—[c]	—[c]
Years of experience in industry	41-50	31-40	21-30	—[c]	—[c]
Years of experience in organisation	11-20	11-20	11-20	—[c]	—[c]
Position	Manager	Manager	General manager	Office manager	Purchasing manager
			Organisation		
Industry sector	Fabricated metal product	Primary metal and metal product	Machinery and equipment	Furniture and other	Primary metal and metal product
Region	Wellington	Auckland	Auckland	Manawatu-Wanganui	Auckland
Annual sales turnover	$500,000-$999,999	$35,000,000-$39,999,999	$10,000,000-$14,999,999	—[c]	$20,000,000-$24,999,999
Number of full-time employees	6-9	6-9	20-49	50-99	53-99
Number of part-time employees	0-3	0-3	0-3	0-3	0-3
Type of organisation	Small	Small subsidiary of a large international organisation	Small subsidiary of a large international organisation	Medium	Medium

Note. To ensure confidentiality, numbers are given as ranges, even though the actual numbers were available for the analysis.

[a]Responded to the survey and participated in an interview. [b]Participated in an interview only, delegated by survey respondents. [c]Information not available.

The remaining subsections of this section describe the findings of qualitative data analysis. The research model of my study (see Figure 3-1) did not explicitly hypothesise any cause-effect relationships between the factors; in contrast, many of the respondents explicitly viewed the factors as interacting and interrelated.

5.9.1 Relative Advantage and Complexity

Some of the respondents highlighted advantages of e-procurement; others highlighted disadvantages (e.g., some of the respondents viewed e-procurement as

offering extra flexibility, but others considered e-procurement to lack flexibility). The e-procurement advantages suggested by the respondents ranged from objective and quantifiable, such as saving money and speeding up execution, to subjective and internally oriented "convenience" and "ease of use". Many of the respondents appeared to view relative advantage and low complexity as parts of the same theme, and one of the respondents implicitly related usefulness to compatibility with technology infrastructure.

Darrell, a general manager at a machinery and equipment firm, related the use of intranet and e-mail for e-procurement to advantages they offer in terms of ease of use, speed of execution, and information retention (presumably, comparing to paper-based alternatives). Thus, for Darrell, lower complexity ("ease of use") was part of the relative advantage.

> I would say it influences a lot. If we perceive difficulties in the use of e-procurement, then we would not use it. We have a very good electronic internal communication system. Around the world in fact with e-mail and intranet etc., we feel a lot more relaxed in using this e-procurement. So, the ease with which it can be used and degree of the advantages it offers which is usually ease of use and speed of use and also recording information then that affects whether or not you use it a lot. (Interview of Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

Cole, a manager at a primary metal and metal product firm, pointed out two aspects affecting the use of e-procurement functionalities at his firm. First, the firm used an ERP system from a major vendor (SAP), which offered a broad range of functionalities to choose from and the firm received advice (presumably, from the vendor) on which functionalities were appropriate for their situation. Second, the firm relied on focus groups (presumably, with partner organisations) to decide on the use of e-procurement functionalities. Cole highlighted two major advantages of using e-procurement, better financial reporting and better production management.

> We use SAP as our computer system. So, it comes with more functionalities than probably any other system in the world. And, we are told which ones we can use and which ones we cannot. So, I guess in the early days before we chose SAP, we used focus groups around the world to decide on what functionalities we needed, and over time, we have had upgrades to enhance what we have been able to do. And, in fact, in the South Pacific, we are looking at another one probably early next year. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

> Yes. It is a global system for a global company and it allows us to do whatever we need to do in terms of procurement. It's very good for financial reporting and it's really good for production because most of our business is about producing industrial gasses. My little business is actually about welding but the bigger business is about industrial gasses. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

Alyssa, an office manager, remarked that her organisation prepared purchase orders using manufacturing software and placed purchase orders by e-mail. Thus, the use of e-procurement functionality related to the availability of related (and compatible) functionality in the manufacturing system. To her organisation, the main advantage of using this e-procurement functionality was "saving money".

> Well, we e-mail our purchase orders off to our suppliers. So, the advantages of doing that is that we know we get receipts prior to procedure orders, you know in terms of e-mail so we do not have to fax it. So, it's saving money more. So, that's the advantages to us in using that system. (Interview of Alyssa, F, Office Manager, Furniture and Other, 50-99 employees.)

Faith, a purchasing manager at a primary metal and metal product firm, emphasised convenience (hence, low complexity) and top management support as determining the use of e-procurement functionalities.

> Depends on the convenience whether it's easy, it's also the approval of the top management's part. (Interview of Faith, F, Purchasing Manager, Primary Metal and Metal Product, 50-99 employees.)

Cruise, a purchasing officer at a machinery and equipment firm, asserted three advantages of using e-procurement: provides good information when purchasing, provides useful information for past purchases, and is flexible.

> E-procurement provides good information when purchasing and has a useful history on past purchases. (Comment by Cruise, M, A41-50, EI1-4, EO1-4, Purchasing Officer, Machinery and Equipment, 50-99 employees.)

> E-procurement is flexible when purchasing officer is away. Employees can look at the screen to see the status of part. (Comment by Cruise, M, A41-50, EI1-4, EO1-4, Purchasing Officer, Machinery and Equipment, 50-99 employees.)

Thus, effectively, Cruise viewed e-procurement as a way to capture purchasing officers' knowledge; an e-procurement system may automate the procedures that otherwise can only be executed by qualified personnel.

Gracie, a director at a transport equipment firm, noted the ease of using e-procurement for a purchasing officer.

> Not complex for the purchasing officer. (Comment by Gracie, F, EI31-40, EO31-40, Director, Transport Equipment, 10-19 employees.)

Thus, Gracie did not entirely share Cruise's view, and considered e-procurement as something to be used by specialised personnel.

Ryan, a managing director at a fabricated metal product firm, suggested that the usefulness of e-procurement depends on goods or services to be procured.

> Purchasing flights and stuff on TradeMe is easy. Purchasing steel is not. (Comment by Ryan, M, A41-50, EI21-30, EO21-30, Managing Director, Fabricated Metal Product, 50-99 employees.)

A number of survey respondents viewed e-procurement as not flexible, not friendly, or time consuming: "Can be very inflexible and time consuming for a small business" (Comment by Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees), "E-procurement has its uses but in some cases can be time consuming also" (Comment by Annabel, F, EI11-20, EO11-20, Director, Printing, 10-19 employees), and "Never friendly and no flexibility" (Comment by Andrew, M, A61-70, EI31-40, EO11-20, Managing Director, Primary Metal and Metal Product, 6-9 employees).

5.9.2 Compatibility

Compatibility with existing practices was seen as a particularly important factor for organisations associated with large parent companies. Compatibility with the way relationships are maintained with partner companies, compatibility with an aging employee base, and technological compatibility with existing systems were mentioned as specific issues.

Darrell interpreted business culture as the established practice of use. He felt that compatibility of e-procurement with the business culture determines if the use of e-procurement is supported by the top management. The actual use of e-procurement is determined by the extent to which it is encouraged by the top management.

> The business culture influences the use of e-procurement a great deal, because when we use it a lot, it is encouraged by the business. When we don't use it a lot, it isn't encouraged. (Interview of Darrell, M, A51-60, EI21-30, E011-20, General Manager, Machinery and Equipment, 20-49 employees.)

Cole's account was similar to Darrell's. Cole emphasised that e-procurement was the only option available at his organisation (alternatives are incompatible to the extent of not being considered). (Cole's organisation, similarly to the Darrell's organisation, was associated with a large parent company.) For Cole, e-procurement is how things are done, rather than something justified by its benefits comparing to the alternatives.

> I suppose the influence is 100%. Because this is the only way we can procure anything is by e-procurement. It's been like that for long time. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

Bella, an administration manager at a wood product firm, argued that the use of e-procurement is constrained because of the way business is conducted at her firm.

> Management are more hands on than computer savvy. Computers [*sic*] used as a starting base, not utilised to the extent that they could be. (Comment by Bella, F, A41-50, EI1-4, EO1-4, Administration Manager, Wood Product, 20-49 employees.)

Alyssa described her organisation's culture as "to do things efficiently and cost effectively" and viewed e-procurement as compatible with the organisation's culture because e-procurement was perceived as allowing to conduct business more efficiently (and thus, as offering advantages).

> In the old days where you probably have to ring up somebody and wait to talk to them or fax through, that's costing money and time. Now, with our computer programs, we can raise an order in the system or the system can raise it automatically. We have to button in and it just all goes away in the background and does its magic really. So that is our culture: to do things efficiently and cost effectively. (Interview of Alyssa, F, Office Manager, Furniture and Other, 50-99 employees.)

For Emily, an operations manager at a transport equipment firm, e-procurement was not compatible with the current employee base at her firm; the aging employees were not prepared to acquire the necessary knowledge and skills.

> It is the way of the future, so management will have to adopt these methods, but some aging employees struggle with modern electronic methods. (Comment by Emily, F, A31-40, EI5-10, EO5-10, Operations Manager, Transport Equipment, 10-19 employees.)

Zachary, a managing director at a transport and equipment firm, argued that the incompatibility of e-procurement with their internal systems hindered the use of e-procurement: "This often depends on supplier systems and it is not always compatible with internal systems and can mean double entry" (Comment by Zachary, M, A41-50, EI11-20, EO21-30, Managing Director, Transport and Equipment, 20-49 employees).

Maria, a manager at a wood product firm, and Marvin, a managing director at a non-metallic mineral product firm, asserted that business relationships "are built and maintained by phone" and "visits".

> Our business relies more on relationships. They are built and maintained by phone or visits. (Comment by Maria, F, A41-50, EI5-10, EO5-10, General Manager, Wood Product, 20-49 employees.)

> Maybe alright for simple transactions but if we need something slightly out of the ordinary in regards to the product or delivery etc., it is better to speak directly with the organisation then maybe follow up with an e-mail: less chance of something going wrong, also helps the important personal relationship. (Comment by Marvin, M, A41-50, EI21-30, EO21-30, Managing Director, Non-Metallic Mineral Product, 6-9 employees.)

Thus, a combination of traditional practices with e-procurement was seen as effective, and collaboration e-procurement functionalities appeared to be important (but, not yet fully used).

5.9.3 External Pressure and Partner Readiness

Surprisingly, both organisations associated with large parent companies and small independent organisations were unconcerned about external pressure to use e-procurement and felt that as they are purchasing (and therefore, are customers), the supplier organisations should meet their preferences (even though one of the respondents thought that the suppliers should be driving e-procurement). Organisations with large parent companies were influenced in their use of e-procurement by the parent companies.

Cole's parent organisation was influential enough to dictate their suppliers' practices; therefore, the suppliers did not influence the organisation's purchasing practices.

> We lead the market globally. We tell them what to do in an arrogant sort of a way. They don't really have any bearing on what we do because we're such a big business. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

Alyssa's organisation appeared to rely on a less sophisticated e-procurement system and did not have behind it the weight of an influential parent company; however, the attitude was similar: Alyssa felt that rather than her organisation being influenced by its trading partners, the trading partners should offer options that fit the organisation's preferred practices.

> We e-mail it through to our suppliers, so we don't like other people have websites where we can go and place an order on if they want to, but that's not the method we choose to do so. We don't do that. So, they don't influence us at all, we do what suits our needs really. (Interview of Alyssa, F, Office Manager, Furniture and Other, 50-99 employees.)

Darrell's organisation, similar to Cole's, was associated with a large international parent company. Pressure from suppliers did affect e-procurement practices, but it was pressure from the suppliers within the parent company (so, in a sense, it was internal, rather than external pressure).

> To be perfectly honest, the only time it influences really is on internal transactions.… invitation to tenders and bids etc. are submitted electronically to a website.… our internal organisation pressures us to work that way. (Interview of Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

Similarly, Chad, a product catalogue manager, asserted that the use of e-procurement in his organisation was driven by his parent organisation.

> We don't have a choice. Our parent company makes us use e-procurement. (Comment by Chad, M, A20-30, EI5-10, EO1-4, Product Catalogue Manager, Furniture and Other, 20-49 employees.)

Oliver, an information technology manager at a printing firm, remarked that suppliers should drive the use of e-procurement.

> Our main suppliers are big multi nationals. They should be pushing e-procurement and locking us in. Our focus is on doing this to our clients. (Comment by Oliver, M, A41-50, EI5-10, EO5-10, Information Technology Manager, Printing, 50-99 employees.)

Several survey respondents claimed that suppliers did not dictate how they do business.

> We are the driver for e-procurement, not our suppliers. (Comment by Skye, F, A41-50, EI5-10, EO5-10, Managing Business Manager, Primary Metal and Metal Product, 50-99 employees.)

> The 'suppliers' do what we want to get our business, not the other way around. (Comment by Teddy, M, A31-40, EI5-10, EO1-4, Manager, Wood Product, 10-19 employees.)

> Suppliers do not dictate the methods you use to make your purchases and they'd be fools to turn away business because you do not use e-procurement. Costs of procurement are not significant within our business. (Comment by Riley, M, A31-40, EI5-10, EO5-10, Director, Basic Chemical and Chemical Product, 20-49 employees.)

> It is the way of the future, but do not feel we would be compromised with any of our suppliers if we didn't adopt e-procurement across the board. (Comment by Emily, F, A31-40, EI5-10, EO5-10, Operations Manager, Transport Equipment, 10-19 employees.)

Shawn, a national marketing manager at a primary metal and metal product firm, voiced concern regarding the readiness of their partners to allow his firm to use e-procurement and to provide quality of service in e-procurement interactions.

> We are techno savvy as an organisation but the supply side is not. (Comment by Shawn, M, EI11-20, EO11-20, National Marketing Manager, Primary Metal and Metal Product, 50-99 employees.)

> We are experienced manufacturers and some things we just work around. The quality of service from our limited number of suppliers is an issue if we wanted to drive e-procurement. (Comment by Shawn, M, EI11-20, EO11-20, National Marketing Manager, Primary Metal and Metal Product, 50-99 employees.)

> If we had supply side facilities, we can technically adopt and run e-procurement easily. However, in using the facility, we would need to re-train staff away from the manual approach forced on the company by suppliers. (Comment by Shawn, M, EI11-20, EO11-20, National

> Marketing Manager, Primary Metal and Metal Product, 50-99 employees.)

5.9.4 Top Management Support

The interviewees offered a range of views on the role of the top management, with the extent of top management involvement in shaping e-procurement use differing between organisations. Top management (of the parent company) was particularly influential at organisations associated with global parent companies. For a very small organisation, the concept of top management appeared to be not relevant overall, and in an organisation with well-established relationships with the suppliers, top management was seen as not concerned about the details of procurement practices (and therefore, not shaping e-procurement use). Two of the respondents explicitly distinguished management support at initial stages of establishing e-procurement from management support of on-going e-procurement use.

Cole suggested that once the top management is invested in an e-procurement system (in case of Cole's organisation, in a sophisticated system based on SAP), it has to support it.

> The management supports the system from the top down and in fact, insists that's what we use. They buy it, they pay for it, they have it designed and then we can complain if it doesn't work. So, they just support it totally. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

Top management of the international parent company with which Cole's organisation was associated was able to impose the use of e-procurement even in spite of resistance. Cole asserted that key suppliers could only be contacted online by SAP. The suppliers "have to be an approved suppliers, they have to be loaded to our system and we have to deal with the people that are chosen for us most of the time". Thus, top management played a large role in determining the amount of e-procurement use.

> They do insist we purchase online. In fact, we are soon going to a global template for SAP. So, the … owners can have a look anywhere in the world at any time, at similar products and processes, and sales figures. It's not something that I'm excited about but that's what's going to happen. (Interview of Cole, M, A51-60, EI31-40, EO11-20, Manager, Primary Metal and Metal Product, 6-9 employees.)

Similar to Cole's organisation, Darrell's organisation was a part of a multinational company (even though the New Zealand subsidiary was small enough to be regarded as a small organisation). Practices such as the use of e-procurement were decided on outside the New Zealand subsidiary, by top management overseas.

> It's quite a big influence because if top management isn't supporting it, then you're not going to be encouraged to use it. This business here in New Zealand is a small part of a very big multinational company, we are one of the biggest companies in the world and so many of the ways we operate, many of the tools and the procedures we follow, are dictated to us by our bigger parent company. So, we aren't always in the position of being able to decide ourselves how we want to do something. They tell us to do something then we're doing it. So, they have a big influence. (Interview of Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

In contrast, in Alyssa's organisation, top management allowed the employees to make their own decisions: "… top management doesn't really delve in to the day to day processes of that" (Interview of Alyssa, F, Office Manager, Furniture and Other, 50-99 employees). Alyssa's organisation had stable relationships with its suppliers. It is possible that this resulted in e-procurement not being a major issue at the organisation.

> Because of the nature of our business, we have fairly set products that we can use and not use and they have to be certified to specific requirements for our needs. So, most times, they're locked in with a

> supplier that we're using because it's not like we can easily change. (Interview of Alyssa, F, Office Manager, Furniture and Other, 50-99 employees.)

Jonas's organisation was very small, and to Jonas the whole concept of top management was not relevant: "We are only a small organisation. It doesn't really influence us. I will be in charge of the top management. I'm happy to do it or not happy to use it, doesn't matter" (Interview of Jonas, M, A61-70, EI41-50, EO11-20, Manager, Fabricated Metal Product, 6-9 employees).

> For our company here, it's only small, not a large business. So, the management doesn't influence that at all. They're not saying use this or purchase this online from this supplier, doesn't really have any influence. (Interview of Jonas, M, A61-70, EI41-50, EO11-20, Manager, Fabricated Metal Product, 6-9 employees.)

Emily thought that to overcome the lack of relevant knowledge and skills by employees at her firm, management support was essential to both implement and to maintain e-procurement.

> Most of our employees would struggle with the concept. Management would be the ones to implement and maintain a method like this. (Comment by Emily, F, A31-40, EI5-10, EO5-10, Operations Manager, Transport Equipment, 10-19 employees.)

In contrast with Emily's views, Kate, a general manager at a printing firm, thought that explicit top management support is no longer necessary once e-procurement practices are established: "E-procurement is deemed as necessary and well ingrained in company. So, less need for communication of its support or commitment, we are there" (Comment by Kate, F, A31-40, EI5-10, EO5-10, General Manager, Printing, 50-99 employees).

Karl and Gracie, both directors, thought that lack of use of e-procurement at their firms was because of lack of top management support.

> Top management are not information technology minded. (Comment by Karl, M, A61-70, EI31-40, EO31-40, Director, Furniture and Other, 20-49 employees.)

> Managing director is old school, does not know how to turn on a computer. (Comment by Gracie, F, EI31-40, EO31-40, Director, Transport Equipment, 10-19 employees.)

5.9.5 Other Factors that May Affect E-Procurement Use

Two issues that emerged from qualitative data analysis suggested that the model of my study (see section 3.2, Figure 3-1) may need to be extended by including legal compliance and trust as separate factors.

Darrel emphasised the organisation's need to comply with legal requirements, both local and international, as limiting the use of e-procurement.

> Compliance is where the business wants you to comply with all the local laws and regulations, and also with the international laws and regulations. For example, we are not allowed to buy products for our business over the Internet using a credit card. Even though sometimes, it would be cheaper. The reason we're not allowed to do that is because it's very difficult to control and make sure that everything that goes on in that purchasing routine is legal. (Interview of Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

When asked whether the compliance issue was associated with security issues, Darrell asserted that the threat of breaking laws and regulation limited the use of e-procurement more than the risk of fraud.

> Well, not security in the sense of fraud. It's more to do with the fact of making sure that people when they use the credit card, when they buy online, they're buying properly, buying legally, and not breaking any laws. So, that is a hindrance to actually expanding the use of electronic purchasing. (Interview of Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

In terms of TOE framework, the legal environment can be seen as part of the external environment; however, the external pressure construct in my study did not cover the legal environment acting as a constraint for e-procurement use.

The risk associated with using e-procurement was raised by a number of the respondents.

> There are enough risks in business without adding to them. (Comment by Jack, M, EI11-20, EO11-20, General Manager, Fabricated Metal Product, 20-49 employees.)

> I doubt risk is an acceptable trade off. (Comment by Henry, M, A41-50, EI1-4, EO1-4, Operations Manager, Basic Chemical and Chemical Product, 6-9 employees.)

> Top management always want 'guaranteed' no problems with any new technology adopted. (Comment by Skye, F, A41-50, EI5-10, EO5-10, Managing Business Manager, Primary Metal and Metal Product, 50-99 employees.)

Riley argued that the need to manage risk affects the use of some of the e-procurement functionalities.

> If procuring widgets or commodities, e-procurement could be helpful. The problem with electronic tendering and no face-to-face is that it attracts opportunists and oddball suppliers whose reputation you know nothing about and whose quality can be variable and you know nothing

> about their sourcing. Also with Good Manufacturing Practice, production is becoming much standardised and there are few incentives to change suppliers because of price. You are committed to very long term relationships. Relationships are more important than price. Quality is also extremely important. So is service. (Comment by Riley, M, A31-40, EI5-10, EO5-10, Director, Basic Chemical and Chemical Product, 20-49 employees.)

In terms of TOE framework, the risk associated with using e-procurement technology can be seen as part of the technological context or of the environmental context. However, my study did not cover the risk aspect.

5.9.6 Integration of Qualitative Findings

The aim of this subsection is to integrate the qualitative findings of my study.

Following Corbin and Strauss (2008), an integrative diagram was constructed to present a high-level view of the results of qualitative data analysis (see Figure 5-8). As introduced in section 4.2, the main role of qualitative data analysis in my study was to clarify and enrich the interpretation of the results of quantitative data analysis. Therefore, the integrative diagram was constructed by annotating and extending the main research model of my study (see Figure 3-1 for the main research model); thus, the main research model was explicitly included in the integrative diagram. The notation for the main research model is presented in section 5.8.2.1 (in particular, the relationships confirmed in quantitative data analysis are shown as solid lines, and the relationships not confirmed as dotted lines). Themes discovered in qualitative data are shown by using dashed lines.

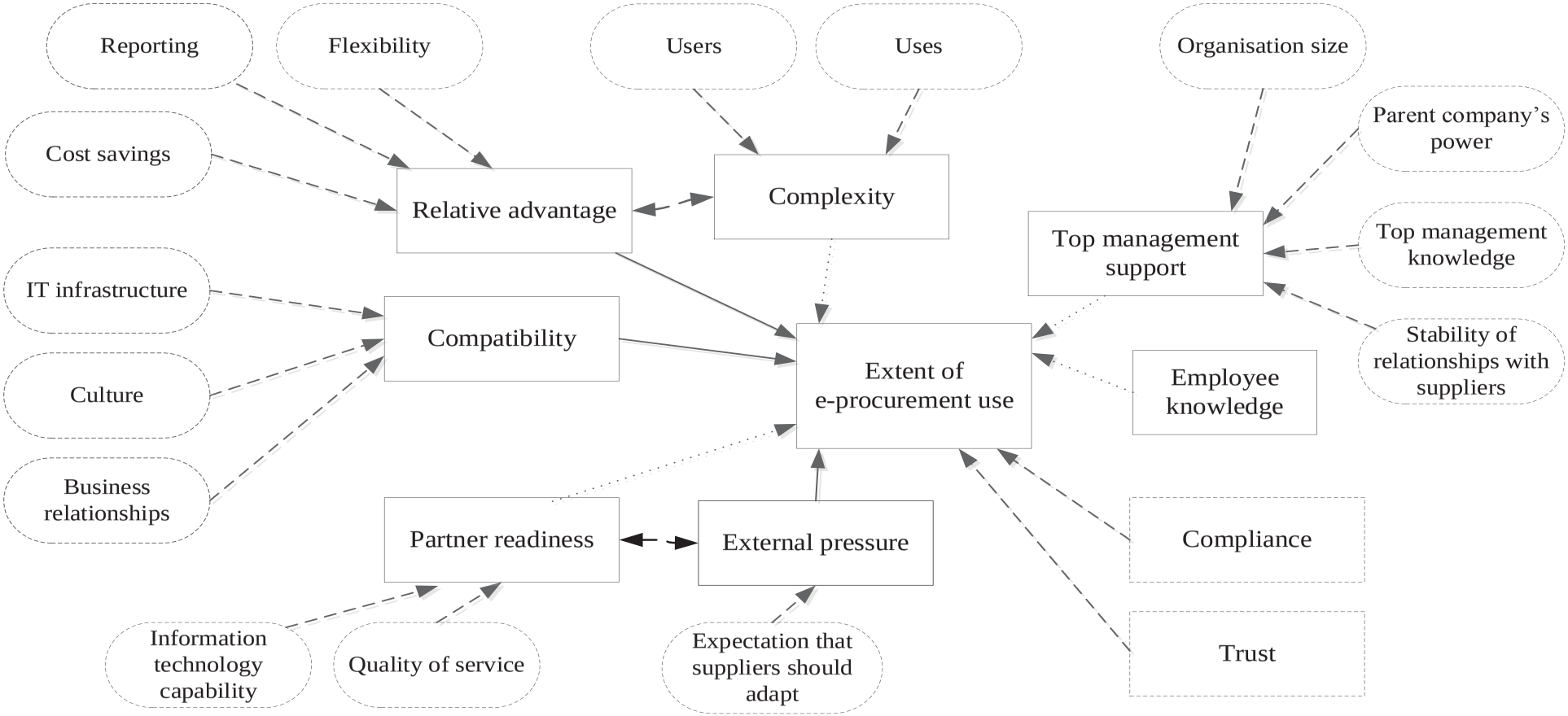

Figure 5-8. Qualitative findings: Integrative diagram. Themes discovered in qualitative data are shown by using dashed lines, with the themes suggesting factors affecting the extent of e-procurement use depicted as rectangles, themes suggesting correlations between factors as double-sided arrows, and themes clarifying the mechanisms behind factor effects as ovals.

The respondents tended to emphasise e-procurement advantages that are internal to the organisation (such as flexibility and better reporting), thus, suggesting a broader view than the operationalisation of the relative advantage construct used in the quantitative part of my study (see Table 4-5 for the operationalisation). Complexity was seen as contingent on who uses e-procurement functionality and on what is being procured. Relative advantage and complexity were perceived by some of the respondents as closely related.

Compatibility with organisational culture was seen in terms of the importance of e-procurement advantages to the organisation. Compatibility with the established communication patterns was emphasised, an aspect not explicitly covered by the operationalisation of the compatibility construct (see Table 4-5 for the operationalisation).

Respondents from small organisations, from organisations with established relationships with the suppliers or established e-procurement practices, and from organisations with management that is not information technology-savvy (and thus, does not understand the concept of e-procurement) saw top management support as not relevant. On the contrary, respondents from organisations strongly associated with large parent companies perceived e-procurement practice at their organisations as being strongly influenced by top management (of the parent company).

For partner readiness, the quality of service by the suppliers was raised as an issue; it was not believed that sufficient quality would be provided if e-procurement was used.

Some of the respondents tended to conceptualise external pressure primarily as pressure from the suppliers, and as purchasers (and hence, customers) expected the suppliers to adapt to their preferences; thus, they did not feel that external pressure had effect. These views were in contrast with external pressure found to have effect in quantitative data analysis.

As introduced in section 5.9.5, compliance with rules and regulations pertinent to procurement and perceived uncertainty/risk associated with using e-procurement were highlighted as additional factors that can affect e-procurement use.

Overall, the results of qualitative data analysis suggested that the research model of my study could be improved by better taking into account the heterogeneity of the population and of e-procurement use. Top management support may matter more in companies that are undergoing a transition or are associated with parent companies, and complexity may be difficult to attribute to e-procurement in general. Partner readiness is more relevant when partners are trusted to deliver sufficient quality of service via e-procurement.

5.10 Summary of the Chapter

This chapter introduced the results of data analysis.

The response rate was 15% (there were 151 usable responses). The response rate was typical for surveys with managers as target respondents. Missing data analysis resulted in cases with uncharacteristically large numbers of missing values excluded from the analysis (14 cases were excluded); mean replacement was used for the remaining missing values. Seven outliers were found, but none was removed because the outliers did not differ in systematic ways from the rest of the cases. According to skewness and kurtosis values for individual indicators, the data were close to normal.

Based on comparing the number of small firms to the number of medium size firms' ratios, the data set of my study was representative of the firms in the Kompass database, but not representative of the population (assuming the ratio provided by Statistics New Zealand is accurate). Comparing early and late respondents according to the characteristics of their organisations did not reveal any evidence of non-response bias.

The characteristics of the organisations in the data set and of the managers who answered the survey on behalf of the organisations were presented. The organisations were mostly limited liability companies, well established, and small in size, with

manufacturing sectors relying on metals as raw materials best represented. The respondents were mature, experienced, and well placed in their organisations, suggesting that they were knowledgeable enough to answer the survey questions accurately.

Measurement model testing suggested that three items (measuring compatibility, employee knowledge, and partner readiness constructs) were not reliable; the items were dropped. The implications of dropping the items for the content of their constructs were considered; it was concluded that the changes in construct content were minor. The updated measurement model fulfilled all of the convergent and discriminant validity criteria.

Structural model testing confirmed three of the 14 hypotheses of the research model: relative advantage affected breadth of e-procurement use with a medium effect size, external pressure affected breadth of e-procurement use with a medium to large effect size, and compatibility affected depth of e-procurement use with a medium effect size. According to the values of R^2, the model explained 39% of variance in breadth of e-procurement use and 32% of variance in depth of e-procurement use.

Qualitative data analysis provided further insights into the possible mechanisms behind the factors determining the extent of e-procurement use; the respondents tended to view the factors as interacting and interrelated. The respondents suggested two factors not considered in prior studies of factors affecting e-procurement use: compliance to legal requirements and trust.

CHAPTER 6 DISCUSSION AND CONCLUSIONS

6.1 Introduction

This chapter concludes the thesis. A brief discussion of the descriptive results on the use of e-procurement forms and functionalities is followed by an in-depth discussion of the implications of the results of hypotheses testing. Then, the chapter highlights the contributions of my study, discusses its limitations, and presents suggestions for further research. The chapter ends by stating a conclusion for the whole thesis.

6.2 Description of Current E-Procurement Practice

Although describing the current state of e-procurement practice was not a major purpose of my study, the study collected data describing the extent of use for all e-procurement forms and functionalities that have been covered in prior descriptive studies of e-procurement. The results for individual functionalities are presented in section 5.7.3, in Table 5-5 (from the information perspective) and in Table 5-6 (from the transaction perspective). Table 6-1 below compares the scores of use of e-procurement forms calculated by using Equation 1 (discussed in section 2.4.2) based on the results for individual functionalities.

Within the organisations covered by my study (all of them SMEs in manufacturing industry in New Zealand), all of the forms of e-procurement from information and from transaction perspectives suggested by the descriptive model introduced in Figure 2-1 of Chapter 2 were in use. The extent to which the specific numbers can be claimed as valid for the target population (SMEs in manufacturing industry in New Zealand) is not clear because the sample was, quite possibly, biased in favour of larger organisations and organisations that are not in financial distress (see section 4.3.4 for a discussion of a possibility of this bias). Nonetheless, as seen from the discussion and comparison in the rest of this section, patterns of use discovered in my study were mostly consistent with prior studies.

Table 6-1 *Scores of Use of E-Procurement Forms*: *Comparison to Prior Descriptive Studies*

Form	Study						
	Davila et al. (2003)	Hawking & Stein (2004)	Lefebvre et al. (2005)	Gunasekaran & Ngai (2008)	Harrigan et al. (2008)	Tanner et al. (2008)	My study
Information perspective							
E-sourcing			.43	.12			.27
E-collaboration			.16	.16			.50
E-informing			.32				.30
Transaction perspective							
E-catalogue	.25		.34		.92		.34
E-tender			.02		.92		.07
E-auction	—[a]		.06		.75		.07
IntraOS							.43
InterOS		.08 direct, .02 MRO		.18	.92	.53	.07

Note. For details on how each study was conducted, including the companies covered, the industry, and the country, refer to Table 2-1 in section 2.4.

[a]The percentage of companies using e-auction was not clear from what was reported in the study, even though e-auction was covered.

Information perspective. All e-procurement forms from the information perspective were used relatively extensively, possibly because most of the corresponding functionalities rely on commonly available technologies.

Both Lefebvre et al. (2005) and my study covered all forms of e-procurement from the information perspective suggested by the descriptive model introduced in Figure 2-1. Even though both Lefebvre et al. and my study covered similar organisations (SMEs in manufacturing industry), the results were not consistent. At the organisations in the Lefebvre et al. study, the most commonly used form of e-procurement was e-sourcing, with the score twice as large as for e-collaboration. In contrast, in my study, e-collaboration scored almost twice as high as e-sourcing. This may be because New Zealand culture is more collaborative than Singapore culture (New Zealand scores 79 on the collectivism dimension of the Hofstede's model of culture, one of the highest scores in South East Asia and Australasia, and Singapore

scores just 20, one of the lowest scores, see Hofstede, 1983, and Hofstede & Bond, 1988).

Some of the respondents emphasised the importance of using e-mail for e-collaboration in their free-form comments submitted with the survey: "Communication on a daily basis with suppliers is done via e-mail wherever possible (some smaller suppliers don't have e-mail)" (Comment by Skye, F, A41-50, EI5-10, EO5-10, Managing Business Manager, Primary Metal and Metal Product, 50-99 employees) and "E-mail plays a large part in complex negotiations" (Comment by Bella, F, A41-50, EI1-4, EO1-4, Administration Manager, Wood Product, 20-49 employees).

It appears that the organisations covered by Lefebvre et al. (2005) had more remote and less stable relationships with their suppliers, so that they emphasised using technology for searching over using information technology to manage and to maintain relationships with the suppliers. The difference is difficult to explain because the samples in the two studies were very similar (it should be noted, though, that although Lefebvre et al. covered SMEs, they did not state explicitly the criteria they used to classify an organisation as an SME; the criteria used in my study are introduced in section 4.3.4).

In terms of the scores of use for e-informing, the Lefebvre et al. (2005) result was similar to that of my study. Gunasekaran and Ngai (2008) did not cover e-informing; for e-sourcing and e-collaboration, the pattern they found (e-collaboration scoring higher than e-sourcing) was somewhat similar to my study, but the difference was not as clear.

Transaction perspective. The forms of e-procurement from transaction perspective most in use were e-catalogue and IntraOS, possibly because most of the correspondent functionalities rely on commonly available technologies.

E-catalogue, e-tender, and e-auction scored, overall, consistently with Davila et al. (2003) and Lefebvre et al. (2005). Harrigan et al. (2008) reported much higher scores,

but their sample was very small and was chosen on purpose to include organisations using e-procurement a lot (see section 2.4 for a discussion of the design of the study by Harrigan et al.). E-tender and e-auction scored considerably lower than e-catalogue, suggesting that even though these more sophisticated forms of e-procurement offer advantages, these advantages did not result in a widespread use. A possible reason (highlighted in free-form comments discussed in section 5.9.5) is lack of trust by the purchasing organisations. E-reverse auctions (not shown separately in Table 6-1, but shown in Table 5-6) were particularly rare, possibly because they can negatively affect buyer-supplier relationships and can harm a buyer's long-term performance by generating distrust with the suppliers (Kwak, 2002; Tassabehji et al., 2006).

The use of IntraOS (a system using information technology to allow access to a centrally controlled procurement process throughout an organisation, introduced in section 1.1) reported in my study was rather high, probably because of a rather broad interpretation by the respondents of what constitutes IntraOS (as discussed in section 5.7.3). This is supported by qualitative findings, as illustrated by the following quotes.

> All my answers assume that when you say 'online' or 'electronically,' you include e-mail, ERP system, as well as our website, and the Internet in general. (Comment by Matthew, M, A51-60, EI11-20, EO11-20, Managing Director, Machinery and Equipment, 20-49 employees.)

> I have assumed that electronically includes e-mail and not just via WWW. (Comment by Darrell, M, A51-60, EI21-30, EO11-20, General Manager, Machinery and Equipment, 20-49 employees.)

Hence, sending purchase requisitions via e-mail, without using a dedicated intra-organisational e-procurement system, was considered by the respondents as using e-procurement IntraOS. IntraOS was not covered in any of the prior empirical studies of e-procurement practice; the results of my study suggest that the use of information technology internally to facilitate e-procurement is very common.

The score of use of InterOS (integrating the company's information systems with the supplier's systems to enable fast processing of transactions, introduced in section 1.1) in my study was consistent with the results by Gunasekaran and Ngai (2008) and by Hawking and Stein (2004). Both of these studies covered organisations of all sizes, so their samples were likely to include many SMEs. Studies by Harrigan et al. (2008) and Tanner et al. (2008) reported results suggesting higher scores for InterOS; however, the study by Harrigan et al. used a small sample biased in favour of organisations extensively using e-procurement, and Tanner et al. covered large companies using e-procurement only. It is easier for large companies (comparing to SMEs) to make the necessary investment to establish an InterOS.

6.3 Factors Affecting Extent of E-Procurement Use

This section discusses the factors found to affect the breadth and the depth of e-procurement use. First, the section takes a high-level view of the results from the perspective of technology-organisation-environment (TOE) framework. Then, the implications of the results for the factors from the three contexts of TOE framework are discussed one by one.

Even though TOE framework suggests that factors from all of the three contexts (technology, organisation, and environment) determine the practice of technology use, only the effects of technological and environmental factors on the extent of e-procurement use were confirmed in my study (see Table 6-2 for a comparison of the outcomes of my study with prior studies). This was in contradiction with the results by Soares-Aguiar and Palma-dos-Reis (2008) and Teo et al. (2009). Both of these studies conceptualised e-procurement use as adoption (as self-reported existence of use). The problems associated with such a conceptualisation were discussed in detail in section 2.7.5; in view of the broad range of e-procurement forms and functionalities available, with many of them relying on commonly available technology, a binary measure is hardly adequate for reflecting the state of use of e-procurement forms and functionalities. Assuming, however, that even though the measures were different, they measured the same construct, the reason for the discrepancy could be that my study covered SMEs only, while Soares-Aguiar and

Palma-dos-Reis and Teo et al. (2009) covered large organisations. Top management support is of greater relevance for larger organisation (as illustrated by some of the comments in qualitative data collected in my study). Therefore, it is more likely to have effect in larger organisations. Moreover, it is likely that employee knowledge varies more in samples involving larger organisations. Large organisations have the resources to hire employees knowledgeable in a particular area; but they may or may not deploy the resources to hire such employees, hence more possibilities for variability. SMEs do not have such resources, and, most likely, do not employ employees with specialised knowledge; therefore, no effect is observed when testing the model.

Table 6-2 *Comparison to Prior Explanatory Studies*: *Overall Results*

	Study	Country	Dependent variable	Factors similar to the factors considered in my study[a]		
				T[b]	O[c]	E[d]
1	Min & Galle (2003)	US	adoption	t1*		
3	Wu et al. (2007)	US	breadth	—	o4, o5*	e2*
5	Soares-Aguiar & Palma-dos-Reis (2008)	Portugal	adoption	t3*	o6*	e1*, e2*
6	Teo et al. (2009)	Singapore	adoption	t1*, t2	o4*, o7	e2*
			depth	t1, t2*	o4, o7*	e2
7	My study	New Zealand	breadth	t1*, t4, t5	o4, o5	e1, e2*
			depth	t1, t4*, t5	o4, o5	e1, e2

Note. In all of the studies, the unit of analysis was an organisation, with the key informant responding on behalf of the organisation. All of the prior studies covered organisations of all sizes in multiple industries, with the exception of Soares-Aguiar and Palma-dos-Reis, who covered large organisations (in multiple industries). My study covered small and medium firms in manufacturing industry.

[a]Details of the factors are given in Table 6-3. [b]T = technological context. [c]O = organisational context. [d]E = environmental context.

*Found to be affected at $p < .05$.

The only prior study (out of the explanatory studies identified in the literature review presented in Chapter 2) that did not rely on the concept of existence of use was the study by Wu et al. (2007), which measured the extent of e-procurement use for all participating organisations and included factors from organisational and environmental contexts. Wu et al. (2007) found that factors from both of the contexts affected the breadth of e-procurement use. Thus, my study was not in agreement with the study by Wu et al. (2007) in terms of the effects of factors from organisational

context (even though the same factors were hypothesised to have effect); nonetheless, my study was in agreement with the study by Wu et al. (2007) in terms of the effects of factors from environmental context (the same factor, external pressure, was found to have effect in both studies). Wu et al. (2007) conducted a study with organisations of all sizes. Thus, once again, the difference may be attributed to the organisations' size. In the study by Wu et al. (2007), organisational learning ability (an organisational factor) was found to have effect. Larger organisations have the resources to employ knowledgeable and educated employees to increase their learning ability, but do not necessarily do so. Hence, there is variation from organisation to organisation. SMEs do not have such resources, hence, the variability in learning ability is likely to be less than in large organisations. An effect is observable only if there is variability in the factor value.

Two of the prior studies that found factors from organisational context to have effect, the studies by Batenburg (2007) and Pearcy et al. (2008) (see Table 2-9 for a summary of the outcomes of prior explanatory studies of e-procurement adoption and use), considered an organisation's industry and size, organisational factors that were not included in the research model of my study. In my study, all of the participating organisations were from the same industry and the range of organisations' sizes was intentionally restricted. The effect of the organisation's size was tested in post-hoc analysis (presented in section G.1.4 in Appendix G) and no effect was found.

Overall, because none of the organisational factors had effect, the results of my study offered only a limited support of TOE framework. Nonetheless, if a broader range of organisations were included (e.g., organisations of broader range of sizes and from different industries), and if the size of the sample were larger, resulting in higher statistical power, it is highly likely that the effects of factors from all three contexts of TOE framework would be discovered.

Table 6-3 *Comparison to Prior Explanatory Studies*: *By Individual Factors*

	Independent variables (factors)	Studies in which hypothesised to affect[a] Adoption	Breadth	Depth
Technology:				
t1[b]	Relative advantage (perceived benefits)	1*, 6*	7*	6, 7
t4[b]	Compatibility		7	7*
t3	Information technology infrastructure	5*		
t5[b]	Complexity		7	7
t2	Perceived implementation costs	6		6*
Organisation:				
o4[b]	Top management support	6*	3, 7	6, 7
o5[b]	Employee knowledge and skills	5*	7	7
o6	Organisational learning ability		3*	
o7	Information sharing culture	6		6*
Environment:				
e1[b]	Partner readiness	5*	7	7
e2[b]	External pressure	5*, 6*	3*, 7*	6, 7

Note. Only factors related to the factors considered in my study are covered here. For a full list of factors covered in the prior studies, refer to Table 2-10. Related factors are grouped to appear next to each other.

[a]Details of the studies are given in Table 6-2; my study is the study 7. [b]Factors covered in my study, see the research model in Figure 3-1.

*Found to be affected at $p < .05$.

6.3.1 Factors from Technological Context

The technological context of TOE framework and the factors from the technological context included in the research model of my study (see Figure 3-1) were introduced in section 3.4.1. I followed Premkumar and Roberts (1999) (a survey-based study of the use of information technologies, e-mail, online data access, Internet access, and EDI, by companies in multiple industries in the US) in assuming that the most important factors describing the technology and the perceptions of technology are the factors suggested by diffusion of innovation (DOI) theory: relative advantage, compatibility, and complexity. (For a discussion of DOI theory, refer to section 2.6.1.)

Because my study fully relied on DOI theory for representing the technological context, the results of my study can be interpreted as a validation of the implication

of DOI theory that relative advantage, compatibility, and complexity influence adoption decisions, such as decisions to use e-procurement forms and functionalities to facilitate particular aspects of procurement. Of the three factors suggested by DOI theory, two were found to have effect on the extent of e-procurement use: relative advantage affected the breadth of e-procurement use with a medium effect size (according to the Kline's heuristic introduced in section 4.4) and compatibility affected the depth of e-procurement use, also with a medium effect size.

Therefore, overall, the results of my study were in agreement with DOI theory, but the support for DOI theory was mixed because not all of the factors implied by DOI theory had effect. This can be compared with the results of Premkumar and Roberts (1999), who found that all of the three factors, relative advantage, compatibility, and complexity, had an effect on technology adoption, but not for all technologies covered by their study. Similar to my study, the support by Premkumar and Roberts's study for interpreting the technological context of TOE framework in terms of relative advantage, compatibility, and complexity was mixed.

In the remaining subsections of this section, the results for individual factors from the technological context are discussed in detail.

6.3.1.1 Relative Advantage

Relative advantage affected the breadth of e-procurement use with a medium effect size ($\beta = .26$, $p = .024$) (as introduced in section 4.4). The studies by Min and Galle (2003) and Teo et al. (2009) also found relative advantage to have effect (on e-procurement adoption; both of the studies relied on a binary measure of e-procurement use).

Relative advantage was not found to affect the depth of e-procurement use. This was consistent with the study by Teo et al. (2009) that also found no effect of relative advantage on the depth of e-procurement use.

The finding that relative advantage affects the breadth of e-procurement use suggests that when deciding to use a particular e-procurement functionality to facilitate certain

aspects of procurement, organisations rely on their perceptions of relative advantage offered by e-procurement. Nonetheless, the extent to which the organisation ends up relying on e-procurement is determined by how well e-procurement use fits the organisation, on compatibility (see the discussion in section 6.3.1.2).

The finding that relative advantage affects extent of e-procurement use is consistent with findings reported in broader literature on technology adoption and use (see, for example, Abu-Elsamen et al., 2010; Alam et al., 2007; Chan & Ngai, 2007; Lee, 2004; Lin & Lin, 2008; Looi, 2005; Pearson & Grandon, 2005; Premkumar & Roberts, 1999; Tan et al., 2009; Teo et al., 1998; Teo et al., 2007; Teo et al., 2009; Thong, 1999; Zhu, Dong, Xu, et al., 2006; Zhu, Kraemer, Gurbaxani, et al., 2006, as discussed in section 3.4.1.1).

Qualitative data analysis (discussed in section 5.9.1) revealed a broad range of views regarding relative advantages of e-procurement, suggesting that a broader conceptualisation of relative advantage may result in better explanatory power.

6.3.1.2 Compatibility

Compatibility affected the depth of e-procurement use with a medium effect size ($\beta = .33$, $p = .024$) (as introduced in section 4.4). Nonetheless, compatibility was not found to affect the breadth of e-procurement use.

None of the explanatory studies of e-procurement adoption and use included compatibility as a factor; the study by Soares-Aguiar and Palma-dos-Reis (2008) found that information technology infrastructure, just one of the aspects of compatibility (discussed in section 3.4.1.2), affected e-procurement adoption. Because the breadth of e-procurement use is decided by adopting e-procurement functionalities, adoption (of e-procurement overall) can be seen as being closer to breadth than to depth of e-procurement use. Therefore, the result by Soares-Aguiar and Palma-dos-Reis can be seen as contradicting the finding of my study. The discrepancy may be because the aspect of information technology infrastructure was covered by just one out of the seven items used to measure compatibility in my study and corresponded to a relatively small part of the content of the compatibility

construct. Another possible explanation is that the organisations that participated in my study had similar basic information technology infrastructures (in aspects such as the availability of Internet connections and basic capabilities such as e-mail), so that for e-procurement forms and functionalities that did not depend on dedicated e-procurement software, information technology infrastructure was not an issue.

The finding that compatibility affects the depth of e-procurement use suggests that e-procurement is used intensively enough to play an important role only when it is compatible with the organisation's practices and values. Yet, in deciding to use particular forms and functionalities of e-procurement, organisations are guided more by their perceived benefits rather than by their fit with the organisation's practices and values; therefore, unlike relative advantage, compatibility does not directly affect the breadth of e-procurement use. Nonetheless, information technology infrastructure by itself may affect the breadth of e-procurement use, because the presence of suitable information technology infrastructure has direct and immediate implications for the feasibility of using forms and functionalities of e-procurement.

The finding that compatibility affects depth of e-procurement use is consistent with findings reported in broader literature on technology adoption and use (see, for example, Tan et al., 2009; Zhu, Dong, Xu, et al., 2006, as discussed in section 3.4.1.2).

Qualitative data analysis (discussed in section 5.9.2) suggested that compatibility with existing practices was seen as a particularly important factor at organisations associated with large parent companies. The survey did not distinguish SMEs associated with large parent companies from SMEs operating independently; qualitative results suggest that the relationship between compatibility and the extent of e-procurement use may be moderated by this aspect.

6.3.1.3 Complexity

Complexity was not found to affect the extent of e-procurement use (neither on breadth nor on depth of e-procurement use). None of the explanatory studies of e-procurement adoption and use included complexity as a factor. Complexity was

found to have effect on adoption in a number of studies of adoption, such as the study by Premkumar and Roberts (1999). Similar to my study, Premkumar and Roberts used relative advantage, compatibility, and complexity to represent the technological context of TOE framework (the study by Premkumar and Roberts is discussed in more detail at the start of the enclosing section, section 6.3.1). Further studies that found complexity to affect adoption are discussed in section 3.4.1.3. In contrast, Chong (2008) (a survey-based study of the adoption of Internet-based e-commerce by companies in multiple industries in Australia and Singapore) and Teo et al. (2007) (a survey-based study of the adoption of human resources information systems by companies in multiple industries in Singapore), consistently with my study, did not confirm the effect of complexity on technology adoption.

A possible reason for complexity not having an effect in my study was that the study used a broad conceptualisation of e-procurement, inclusive of the use of commonly available tools, such as web browsers or e-mails. It is possible that employees at the participating organisations were mostly proficient at using such common tools, resulting in little variation in complexity and, hence, the effect of complexity was not observed.

Another possible reason is the operationalisation of complexity in my study. The study attempted to reuse existing measures whenever possible and used the operationalisation of complexity from the study by Grandon and Pearson (2004) and Karahanna et al. (2006). Even though the measure of complexity (see Table 4-5 in section 4.3.6.2 for the operationalisation of complexity) did appear to reflect the content of the concept introduced in section 3.4.1.3, it overemphasised the ease of use aspects, and aspects such as legal issues, implementation cost, and security were covered only implicitly.

The analysis of qualitative data (discussed in section 5.9.1) suggested that some of the participants viewed aspects such as ease of use (hence, low complexity in terms of the conceptualisation of my study) as advantages of e-procurement. Nonetheless, correlation between complexity and relative advantage (correlations between

constructs are listed in Table 5-11) was not markedly higher than correlations between other factors, and, overall, there were no discriminant validity issues.

6.3.2 Factors from Organisational Context

Neither top management support nor employee knowledge were found to have effect. This was in contradiction with some of the prior explanatory studies of e-procurement adoption and use: Teo et al. (2009) found top management support to affect e-procurement adoption (but not affect depth of e-procurement use), and Soares-Aguiar and Palma-dos-Reis (2008) found employee knowledge and skills to affect adoption. Moreover, Wu et al. (2007) found organisational learning ability (a concept that can be seen as related to employee knowledge) to affect adoption, and Teo et al. (2009) found information sharing culture (another concept that can be seen as related to employee knowledge) to affect depth of e-procurement use.

A possible reason for the effects of top management support and employee knowledge not found in my study (see Table 6-2 for a comparison of the outcomes of my study with prior studies) was that the study focused on smaller organisations that primarily relied on the use of commonly available tools, such as browsers for e-procurement (as discussed in section 6.2). Top management support is critical for the implementation of complex dedicated e-procurement systems (see, for example, Liang et al., 2007). In contrast, e-procurement functionalities, such as searching for suppliers using Internet browsers, can be executed as grassroots initiatives, without the involvement of managers (as explicitly suggested in an interview with Jonas, see section 5.9.4).

Similarly, employees' knowledge may be critical for sophisticated uses of dedicated e-procurement systems. In contrast, knowledge and skills needed to use e-procurement functionalities that rely on the use of commonly available tools are widely available; little variation in employees' knowledge in the sample resulted in no observable effect.

6.3.3 Factors from Environmental Context

As described in section 3.4.3, the environmental context is the external environment in which the organisation conducts its business, including other organisations it interacts with and the relevant standards and regulations. The factors covered from the environmental context are partner readiness and external pressure.

In the following, the results of the environmental factors are discussed in more detail.

6.3.3.1 Partner Readiness

Partner readiness was not found to affect the extent of e-procurement use (neither on breadth nor on depth of e-procurement use). This contradicted the finding by Soares-Aguiar and Palma-dos-Reis (2008) that partner readiness affects e-procurement adoption.

Even though partner readiness is crucial for InterOS, which involves close technology integration, most of the e-procurement functionalities considered in my study (such as the use of e-mail to negotiate contracts) require much less investment or technology skills on the part of the seller companies. Another plausible reason for partner readiness not affecting the extent of e-procurement use is that it is easy for an organisation to find online trading partners as more sellers can be reached over the Internet, which leads decision makers to consider this factor as less important comparing to other relevant factors. (This view is consistent with qualitative findings of my study, as reported in section 5.9.3; a number of the participants commented that they expected their partners to offer e-procurement to an extent that meets their needs.)

6.3.3.2 External Pressure

External pressure affected the breadth of e-procurement use with a medium to large effect size ($\beta = .37$, $p < .001$) (as introduced in section 4.4). The study by Wu et al. (2007) found external pressure to affect the breadth of e-procurement use; moreover, the studies by Soares-Aguiar and Palma-dos-Reis (2008) and Teo et al. (2009) found external pressure to affect e-procurement adoption.

External pressure was not found to affect the depth of e-procurement use. This was consistent with the study by Teo et al. (2009), which also found no effect of external pressure on the depth of e-procurement use.

The finding that external pressure affects the breadth of e-procurement use suggests that when deciding to use a particular e-procurement functionality to facilitate certain aspects of procurement, organisations rely on their perceptions of the needs of their suppliers with respect to e-procurement and on their understanding of the competitive environment. Nonetheless (as argued in sections 6.3.1.1 and 6.3.1.2), the extent to which the organisation ends up relying on e-procurement, expressed in terms of the fraction of purchases conducted by using e-procurement, is determined by how well e-procurement use fits the organisation, on compatibility. Hence, it appears that ultimately, buyer organisations are in a strong enough position to use e-procurement practice that fits their internal needs, rather than are driven by the environment. Qualitative findings of my study were consistent with this view, as both organisations associated with large parent companies and small independent organisations appeared to be unconcerned about external pressure to use e-procurement (see section 5.9.3 for a detailed discussion).

6.4 Contributions of the Study

The research questions of my study (as introduced in section 1.3) were:

1. How can the existing measures of the extent of e-procurement use be extended to better account for the richness of the existing practice?

2. What are the main factors affecting the breadth and the depth of e-procurement use?

Research question one was addressed by formulating a descriptive model of forms of e-procurement based on reviewing the literature and by extending the content of the breadth of e-procurement use construct (relative to prior studies) to cover all of the forms of e-procurement included in the descriptive model.

Research question two was addressed by including into the research model (see Figure 3-1) the major factors likely to affect the breadth and the depth of e-procurement use (as suggested by the literature) and by testing the model against data collected in a survey of SMEs in manufacturing industry in New Zealand.

The descriptive results, in terms of the patterns of use of e-procurement forms by SMEs in manufacturing industry in New Zealand, are introduced in section 5.7.3 and summarised in section 6.2. The results of testing the research model are introduced in section 5.8.2.1 and summarised in section 6.3, which also outlines the relevant insights gained from analysing the qualitative data obtained in the main survey and in follow-up interviews (the details of qualitative data analysis are given in section 5.9).

The rest of this section discusses (based on the outcomes of my study) the overall state of e-procurement use in the SMEs in the manufacturing industry in New Zealand as well as the factors found to affect the extent of e-procurement use. This is followed by discussing the contributions of the study to theory and to practice.

6.4.1 The Overall Picture

All of the forms of e-procurement from the information perspective and from the transaction perspective suggested by the descriptive model of forms of e-procurement introduced in Figure 2-1 were in use. From the information perspective, the most commonly used form of e-procurement was e-collaboration, and from the transaction perspective, the most commonly used forms of e-procurement were e-catalogue and IntraOS. The use of e-tender, e-auction, and InterOS was less common.

The e-procurement functionalities that were most commonly in use relied on commonly available technology. It is likely that complexity, employee knowledge, and partner readiness were not issues; technology (such as Internet browsing or the use of e-mail) was not complex, it was readily available, and employees knew how to use it. This may explain why the effects of complexity, employee knowledge, and partner readiness were not confirmed.

Respondents' comments (analysed as qualitative data in section 5.9) suggest that even though in some of the organisations e-procurement use was imposed by parent companies or regulated by the management, in other organisations the employees were free to use e-procurement on their own initiative, with little management involvement. The presence in the study sample of companies in which e-procurement is driven by grassroots efforts rather than by top management may explain why the effect of top management support was not confirmed.

The results of the study suggest that relative advantage and external pressure drive the breadth of e-procurement use, and compatibility drives the depth of e-procurement use. This is consistent with organisations trying out new e-procurement functionalities when there is a perception that such functionalities are useful and their use is expected by the suppliers. Ultimately, though, only the functionalities that are compatible with the organisations' way of doing things make a difference in terms of the percentage of goods and services purchased online.

One can interpret descriptive model of forms of e-procurement as suggesting that the construct of the breadth of e-procurement use is two-dimensional, comprising the dimensions of the breadth of use of informational e-procurement functionalities and the breadth of use of transactional e-procurement functionalities. This possibility was explored by using EFA, and it was found that a separation between informational functionalities and transactional functionalities is not supported by the data structure. Therefore, the distinction between transactional and informational functionalities should be seen as a difference in emphasis, and not as a distinction between two clearly separated categories.

6.4.2 Contributions to Theory

This section discusses the contributions of my study to theory, including contributions to describing current e-procurement practice, to conceptualising and operationalising the extent of e-procurement use, and to testing the validity of theories and frameworks suggesting factors that are likely to affect the extent of e-procurement use. The novelty of the scope of my study is also discussed.

6.4.2.1 Description

Synthesised the literature to formulate a descriptive model of e-procurement forms and functionalities.

A descriptive model presenting e-procurement functionalities currently in use in terms of 11 e-procurement forms from three e-procurement perspectives (information, transaction, and infrastructure) was formulated based on the literature (see Figure 2-1 in section 2.3). The model extends the model by Beldona et al. (2005). The part of the model comprising the information and the transaction perspectives of e-procurement was indirectly validated via its successful use in formulating a measure of breadth of e-procurement use (see Table 4-3 in section 4.3.6.1 for the operationalisation of breadth of e-procurement use).

Demonstrated the relevance of inclusive conceptualisation of e-procurement by providing empirical evidence of broad use of e-procurement functionalities by SMEs in New Zealand.

By conducting a survey of the use of e-procurement functionalities by manufacturing SMEs in New Zealand, it was established that all of the forms of e-procurement suggested by the descriptive model formulated in my study (see Figure 2-1 in section 2.3) are in use (see Tables 5-5 and 5-6 in section 5.7.3 for details). In particular, both the use of common software tools for e-procurement and the use of dedicated e-procurement systems were relevant to the target population (New Zealand SMEs in manufacturing industry). The results suggest that a measure of the breadth of e-procurement use should cover all of the forms of e-procurement from the information and transaction perspectives of the descriptive model (see the discussion in section 6.2).

The patterns of use were similar to prior studies (see Table 6-1 and the discussion in section 6.2). My study covered a broader set of e-procurement functionalities than prior studies and in this respect extended similar studies by Davila et al. (2003), Gunasekaran and Ngai (2008), Harrigan et al. (2008), Hawking and Stein (2004),

Lefebvre et al. (2005), and Tanner et al. (2008) (see Table 6-1 in section 6.2 for details).

6.4.2.2 Conceptualisation and Operationalisation

Formulated a measure of breadth of e-procurement use accounting for all of the major e-procurement functionalities suggested by the literature.

The study formulated a measure of breadth of e-procurement use that contributed to e-procurement use research by:

1. covering a broader range of e-procurement functionalities, a range of e-procurement functionalities (see Table 4-3 in section 4.3.6.1 for the operationalisation of breadth of e-procurement use) that was complete in terms of covering all forms of e-procurement suggested by the descriptive model (see Figure 2-1 in section 2.3), and

2. having a meaning that is directly interpretable; the measure followed the approach by Al-Khaldi and Wallace (1999) and Thompson et al. (1991) and relied on counting functionalities, rather than on using scores for individual functionalities as reflective items (as in the study by Wu et al., 2007).

The measure was successfully utilised to test a structural model explaining the extent of e-procurement use, which is an evidence of its validity.

Demonstrated the viability of conceptualising the extent of e-procurement use in terms of two dimensions: breadth of e-procurement use and depth of e-procurement use.

My study was the first to conceptualise the extent of e-procurement use in terms of two dimensions: the breadth of e-procurement use (the range of the functionalities used) and the depth of e-procurement use (how much the organisation relies on e-procurement). Arguments supporting the conceptualisation in terms of these two dimensions was presented in section 3.3. Measurement model tests reported in

section 5.8.1.2 supported the conceptualisation, as no discriminant validity issues were found. Finally, the results of the structural model testing (discussed in section 5.8.2.1) suggested that the breadth of e-procurement use and the depth of e-procurement use are affected by different factors, thus, further supporting the conceptualisation.

6.4.2.3 Causal Structure

Validated TOE framework in context of explaining breadth and depth of e-procurement use.

My study formulated a structural model intended to explain the extent of e-procurement use (see Figure 3-1 in section 3.2 for the research model). The model was based on TOE framework and included factors from the technological, organisational, and environmental contexts (see section 2.6.2 for a discussion of TOE framework). Results of testing the model against data collected from SMEs from manufacturing industry in New Zealand suggested that only factors from technological and environmental contexts have effect; therefore, as discussed in section 6.3, my study provided a mixed support for TOE framework. The possible reason why organisational factors had no effect (uniformity of the sample) is discussed in section 6.3.2. When factors are found to have no effect because of the uniformity of the sample, it does not mean that they have no effect. However, to observe the effect in a sample with little variability in a particular factor, a larger sample or a sample with more variability (such as a sample with organisations of all sizes, rather than just SMEs) is required. Therefore, it is desirable that the study (with the same model) is repeated for a much larger sample or for a sample with more variability in the variables for which the predicted effects were not confirmed.

My study was the first explanatory study of the breadth of e-procurement use that tested a model including factors from all three contexts of TOE framework. A detailed comparison of the results of my study with prior studies of the extent of e-procurement use in terms of the support of TOE framework is given at the beginning of section 6.3.

Validated DOI theory in context of explaining breadth and depth of e-procurement use.

In the structural model, the technological context of TOE framework was represented in terms of the three characteristics of innovation from DOI theory (see Figure 3-1 in section 3.2 for the research model) that have been found most consistently to have effect in prior studies of technology adoption (see the discussion in section 2.6.1). Results of testing the model against data collected from SMEs from manufacturing industry in New Zealand suggested that of the three factors from the technological context, only relative advantage and compatibility had effect; therefore, as discussed in section 6.3.1, my study provided a mixed support for DOI theory. The possible reasons why complexity had no effect (uniformity of the sample and problems with the measure) are discussed in section 6.3.1.3.

My study was the first explanatory study of the breadth of e-procurement use that tested the DOI model (see the discussion in section 6.3.1).

Validated the results of prior studies of e-procurement adoption and use by re-testing the effects of factors found to have effect in prior studies.

My study provided a systematic review of prior explanatory studies of e-procurement adoption and use (see section 2.7). The factors included in the structural model covered most of the factors that have been found to have effects in these studies (factors included in my study are explicitly related to factors found to have effect in prior studies in section 2.7.7). The comparisons of the results were made (see Tables 6-2 and 6-3 in section 6.3 for details) and differences with the prior studies were analysed and explained.

Section 2.7.6 highlighted the fragmented body of research of e-procurement adoption and use as a problem. My study addressed this problem by providing the systematic review and by testing a model including factors explicitly based on the results of prior studies of procurement adoption and use (the results of my study are reported in section 5.8.2.1). My study both presented and re-validated the prior studies from a

single point of view. Moreover, the results of qualitative data analysis provided extra insights into the possible reasons behind the outcomes for individual hypotheses.

6.4.2.4 Scope

Conducted the first explanatory study of the extent of e-procurement use focusing explicitly on SMEs.

My study was the first explanatory study of the extent of e-procurement use focusing explicitly on SMEs (see the discussion in section 6.3).

Conducted the first explanatory study of the extent of e-procurement use in New Zealand and, more broadly, the first in Australasia.

My study was the first explanatory study of the extent of e-procurement use conducted in New Zealand (moreover, the first in Australasia).

6.4.3 Implications for Practice

This section discusses the implications of my study to practice, including implications for SME managers, for software vendors, and for regulatory bodies.

6.4.3.1 Implications for SME Managers

The results of my study enable SME managers in manufacturing industry in New Zealand to assess the use of e-procurement functionalities in their industry (presented in section 5.7.3) by comparing the patterns of use within their own organisation with the rest of the industry. Nonetheless, establishing the patterns of use (and hence, description of current practice) was not the main purpose of my study, and the research was not designed to maximise the value of the descriptive data obtained.

Further, the results of the study enable SME managers to make judgements regarding the direction of change in e-procurement use in their industry and within their own organisations. The results of the study suggest that when advantages of e-procurement are promoted or new (and advantageous) e-procurement methods,

products, or infrastructures are discovered, it will result in organisations in the industry using more e-procurement functionalities. Pressure from the suppliers or from the industry bodies to use e-procurement is likely to have a similar effect. Nonetheless, for most organisations, e-procurement will have a deep effect on the organisation's bottom line only when it is compatible with the organisation's culture and the organisation's way of doing things.

The conclusions of the study are based on statistics, and the situation at particular organisations may be very different from the overall trend. For example, for SMEs associated with parent companies, external pressure (from parent companies) may have much deeper effect than for SMEs that are truly independent, as exemplified by the analysis of qualitative data presented in section 5.9.

6.4.3.2 Implications for E-Procurement Software Vendors

The effects of technological factors, relative advantage (on the breadth of e-procurement use) and compatibility (on the depth of e-procurement use), demonstrated in my study have implications for the managers of technology vendor firms developing e-procurement software. E-procurement software should offer clear advantages and should be compatible with the existing business practices and values, as well as with the existing information technology infrastructure of their client firms.

Moreover, the descriptive model of forms of e-procurement proposed in my study (introduced in section 2.3) may offer e-procurement software vendors a new perspective on e-procurement, possibly informing the way e-procurement software vendors present and document their products.

6.4.3.3 Promoting the Use of E-Procurement

The results of the study have implications for industry and government bodies that may wish to promote e-procurement. The results of my study suggest that perceptions of relative advantage and external pressure do cause companies to use a broader range of e-procurement forms and functionalities.

The findings of my study suggest that if the relevant bodies in New Zealand, such as the Institute of IT Professionals New Zealand and the Ministry of Economic Development, create awareness of e-procurement among SMEs and encourage them to use e-procurement in their organisations, such efforts are likely to increase the use of e-procurement. Other measures may involve campaigns, workshops, training seminars, or providing subsidies or incentives to the SME firms engaging in broader use of e-procurement.

Broader use of e-procurement by SMEs induced by such activities may result in efficiency gains in the economy as a whole. Nonetheless, the results of qualitative data analysis conducted in my study suggest that the effects of e-procurement on the organisation's success may depend on the particular situation at each organisation. For example, when maintaining personal relationships with the suppliers is important, over-reliance on e-procurement may be counterproductive. The finding that the depth of e-procurement use is primarily affected by compatibility is consistent with the view that e-procurement is not suitable for all organisations. When promoting e-procurement, the government and the industry bodies should tailor their messages accordingly, and refrain from suggesting that e-procurement is suitable for all organisations.

6.5 Limitations of the Study and Suggestions for Further Research

This section discusses the limitations of the study followed by the suggestions for further research.

6.5.1 Research Design

6.5.1.1 Cross-sectional Design: No Empirical Evidence Allowing Distinguishing Causes from Effects

As discussed in section 4.3.1, the cross-sectional survey approach to collecting empirical data resulted in data that did not allow distinguishing causes from effects, and the direction of effects in the structural model was based solely on theoretical arguments.

Therefore, it is desirable that in future research, the structural model of my study is tested against data obtained in a longitudinal study (see, for example, Devaraj & Kohli, 2003). In longitudinal studies, independent variables are measured at an earlier point in time than dependent variables; because variables hypothesised to be causes are measured before the variables hypothesised to be influenced by the causes, the argument that causation flows in a particular direction is more plausible than in cross-sectional studies.

6.5.1.2 Single Informant

A single individual, a manager, responded on behalf of her organisation. This may have resulted in bias or in inaccurate responses, because the response was provided from a manager's point of view and because a single individual may not be fully informed regarding the situation throughout the organisation.

Therefore, it is desirable that in future research, the findings of my study are validated by using information collected from multiple individuals representing different levels and roles for each of the participating organisations (and, more broadly, by using multiple sources of data such as combining a survey with the analysis of documents or with observations of the actual behaviour with respect to e-procurement use). This can be achieved by using a multiple case study research design.

6.5.1.3 Using the Same Data Set to Validate the Measurement Model and the Structural Model

My study used the same data set to validate (and to adjust) the measurement model and the structural model because it was not feasible to collect sufficient quantities of data to test the measurement model and the structural model separately (as discussed in section 5.2, this is a limitation common in MIS research). This may have artificially increased the chances of discovering statistically significant relationships; nonetheless, the adjustments to the measurement model (dropping three indicators) were very minor (see the discussion in section 5.8.1).

It is desirable that in future research, the findings of my study are re-affirmed by using the same operationalisations of constructs.

6.5.1.4 No Cross Validation

The validity of the conclusions of my study would have been enhanced if different constructs were measured by using different methods. For example, the use of different functionalities could be measured via log analysis or via direct observation. This would reduce the possibility of common method bias (Malhotra, Kim, & Patil, 2006).

Moreover, it would be desirable to conduct the study with several different populations, such as with SMEs in different industries or in different countries, to demonstrate that the same or comparable results are obtained.

For the qualitative part of my study, it would be desirable to triangulate the interview data against company documents or e-mail transcripts of employee communications.

All of these approaches would have resulted in greater validity, but were not possible because of time and resources constraints.

6.5.2 Sample and Data Set

6.5.2.1 Population of the Study

My study was restricted to SME firms in the manufacturing industry in New Zealand only (the sample of my study is described in detail in section 4.3.4 and section 5.2). Care should be taken when generalising the results to other populations.

It is desirable that in future research, the findings of my study are validated in other populations for which the argument supporting the hypotheses of the study and the operationalisations of the variables remain valid, such as SMEs in other industries.

6.5.2.2 Relying on a B2B Database

As discussed in section 4.3.4, because the sample of my study was taken from the Kompass database, there was a bias, with larger organisations better represented in the database than smaller organisations.

It is desirable that in future research, the bias is compensated for by using targeted sampling.

6.5.2.3 Small Size of the Data Set and Low Response Rate

My study obtained a response rate of 15% with 151 usable responses from the manufacturing SME firms in New Zealand. The relatively small data set limited options for statistical analysis, and low response rate may have resulted in bias (as participants self-selected to participate in the study).

It is desirable that in future research, larger data sets are obtained. Even though larger response rates are desirable, it may be not feasible to obtain them.

6.5.3 Operationalisation

6.5.3.1 Complexity

As discussed in section 6.3.1.3, the operationalisation of the complexity construct overemphasised the ease of use aspects, and aspects such as legal issues, implementation cost, and security were covered only implicitly. It is possible that this was the reason for no effect of complexity found in my study.

Therefore, it is desirable that future explanatory studies of the extent of e-procurement use consider alternative, broader operationalisations of complexity.

6.5.3.2 Partner Readiness

As discussed in section 5.3, the indicators of partner readiness had more missing values than other constructs; moreover, some of the respondents explicitly indicated that the items used to measure partner readiness were difficult to interpret. Thus, it is

possible that the operationalisation of partner readiness was not appropriate for the sample of my study. It is possible that no effects of partner readiness were found because the operationalisation of the construct was problematic.

Therefore, it is desirable that future explanatory studies of the extent of e-procurement use consider alternative operationalisations of partner readiness.

6.5.4 Research Model

6.5.4.1 Variance Explained

The model of my study explained 39% of the variance in the breadth of e-procurement use and 32% of the variance in the depth of e-procurement use (see section 5.8.2.2 for a discussion of the amount of variance explained). It may be possible to explain more variance in the dependent variables by adding more factors (although care should be taken to ensure that the model remains parsimonious).

Legal compliance and trust, suggested by the analysis of qualitative data in my study (see section 5.9.5 for details), may be considered as separate factors.

6.5.5 Intervening Circumstances

6.5.5.1 Major Earthquake

Major earthquakes occurred in New Zealand in September 2010 and in February 2011, during data collection; these events slowed down the data collection process and, quite possibly, suppressed the response rate (see section 5.2 for a detailed discussion of the response rate).

6.6 Conclusions

My study explored the factors affecting breadth (the extent to which an organisation takes advantage of the variety of e-procurement functionalities available) and depth (the extent to which an organisation relies on e-procurement) of e-procurement use. The research model was based on TOE framework, on DOI theory, and on prior

research of e-procurement adoption and use (with factors found to have effect in the past included in the model).

My study was the first explanatory study of the extent of e-procurement use to conceptualise e-procurement use in terms of breadth and depth. It was the first to formulate and to test a research model that included breadth and depth of e-procurement use as separate dimensions of the extent of e-procurement use. The research model was tested against empirical data collected in a survey of manufacturing SMEs in New Zealand.

The major finding was that breadth and depth of e-procurement use are affected by different factors, suggesting that simply breadth of e-procurement use or simply the existence of use do not adequately capture the state of e-procurement practice. By conceptualising the extent of e-procurement use as two dimensions, breadth and depth, future studies are likely to reach a better understanding of the determiners of e-procurement practice by organisations.

REFERENCES

Aalst, W.M.P. (2002). Inheritance of interorganisational workflows to enable business-to-business e-commerce. *Electronic Commerce Research, 2*, 195-231.

Abu-Elsamen, A., Chakraborty, G., & Warren, D. (2010). A process-based analysis of e-procurement adoption. *Journal of Internet Commerce*, *9*, 243-259.

Aladwani, A.M. (2003). Key Internet characteristics and e-commerce issues in Arab countries. *Information Technology & People, 16*(1), 9-20.

Alam, S.S., Khatibi, A., Ahmad, M.I.S., & Ismail, H. (2007). Factors affecting e-commerce adoption in the electronic manufacturing companies in Malaysia. *International Journal of Commerce and Management*, *17*(1/2), 125-139.

Al-Khaldi, M.A., & Wallace, R.S.O. (1999). The influence of attitudes on personal computer utilisation among knowledge workers: The case of Saudi Arabia. *Information & Management, 36*, 185-204.

Al-Qirim, N. (2005). An empirical investigation of an e-commerce adoption-capability model in small businesses in New Zealand. *Electronic Markets*, *15*(4), 418-437.

Anderson, J.C., & Gerbing, D.W. (1988). Structural equation modelling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411-423.

Arthur, W.B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal*, *99*, 116-131.

Australian Government: Department of Innovation Industry, Science, and Research. (2012). *Australian small business: Key statistics and analysis.* Retrieved from http://www.innovation.gov.au

Ayyagari, M., Beck, T., & Demirguc-Kunt, A. (2007). Small and medium enterprises across the globe. *Small Business Economics*, *29*, 415-434.

Bajwa, D.S., Lewis, L.F., Pervan, G., Lai, V.S., Munkvold, B.E., & Schwabe, G. (2008). Factors in the global assimilation of collaborative information

technologies: An exploratory investigation in five regions. *Journal of Management Information Systems*, *25*(1), 131-165.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Bartezzaghi, E., & Ronchi, S. (2005). E-sourcing in a buyer-operator-seller perspective: Benefits and criticalities. *Production Planning & Control*, *16*(4), 405-412.

Barua, A., Konana, P., Whinston, A.B., & Yin, F. (2004). An empirical investigation of net-enabled business value. *MIS Quarterly*, *28*(4), 585-620.

Batenburg, R. (2007). E-procurement adoption by European firms: A quantitative analysis. *Journal of Purchasing & Supply Management*, *13*, 182-192.

Beatty, R.C., Shim, J.P., & Jones, M.C. (2001). Factors influencing corporate web site adoption: A time-based assessment. *Information & Management*, *38*, 337-354.

Beck, T., & Demirguc-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & Finance*, *30*, 2931-2943.

Beck, T., Demirguc-Kunt, A., & Levine, R. (2005). SMEs, growth, and poverty: Cross-country evidence. *Journal of Economic Growth*, *10*, 199-229.

Beldona, S., Morrison, A.M., & O'Leary, J. (2005). Online shopping motivations and pleasure travel products: A correspondence analysis. *Tourism Management*, *26*, 561-570.

Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238-246.

Bhattacherjee, A., & Premkumar, G. (2004). Understanding changes in belief and attitude toward information technology usage: A theoretical model and longitudinal test. *MIS Quarterly*, *28*(2), 229-254.

Bland, V. (2003, July). The Internet in action: The ballooning of e-business opportunities. *New Zealand Management*, 51-54.

Boer, L., Harink, J., & Heijboer, G. (2002). A conceptual model for assessing the impact of electronic procurement. *European Journal of Purchasing & Supply Management, 8*, 25-33.

Bordens, K.S., & Abbott, B.B. (2011). *Research design and methods: A process approach* (8th Ed.). New York: McGraw Hill.

Brock, J.K., & Zhou, Y. (2005). Organisational use of the Internet: Scale development and validation. *Internet Research, 15*(1), 67-87.

Brounen, D., Jong, A., & Koedijk, K. (2004). Corporate finance in Europe: Confronting theory with practice. *Financial Management, 33*(4), 71-101.

Carr, N.G. (2000). Hypermediation: Commerce as clickstream. *Harvard Business Review, 78*(1), 46-47.

Chan, S.C.H., & Ngai, E.W.T. (2007). A qualitative study of information technology adoption: How ten organisations adopted web-based training. *Information Systems Journal, 17*, 289-315.

Chang, H., Wang, K., & Chiu, I. (2008). Business-IT fit in e-procurement systems: Evidence from high-technology firms in China. *Information Systems Journal, 18*, 381-404.

Chau, P.Y.K., & Hui, K.L. (2001). Determinants of small business EDI adoption: An empirical investigation. *Journal of Organizational Computing and Electronic Commerce, 11*(4), 229-252.

Cheng, C., Chan, C.H., & Lin, K. (2006). Intelligent agents for e-marketplace: Negotiation with issue trade-offs by fuzzy inference systems. *Decision Support Systems, 42*, 626-638.

Chin, W.W. (1998a). Issues and opinion on structural equation modelling. *MIS Quarterly, 22*(1), vii-xvi.

Chin, W.W. (1998b). The partial least squares approach to structural equation modelling. In G.A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-333). Mahwah, NJ: Lawrence Erlbaum.

Cho, I., & Kim, Y. (2002). Critical factors for assimilation of object-oriented programming languages. *Journal of Management Information Systems, 18*(3), 125-156.

Chong, A.Y., Ooi, K., Lin, B., & Raman, M. (2009). Factors affecting the adoption level of c-commerce: An empirical study. *Journal of Computer Information Systems, 50*, 13-22.

Chong, S. (2008). Success in electronic commerce implementation: A cross-country study of small and medium-sized enterprises. *Journal of Enterprise Information Management, 21*(5), 468-492.

Chwelos, P., Benbasat, I., & Dexter, A.S. (2001). Research report: Empirical test of an EDI adoption model. *Information Systems Research, 12*(3), 304-321.

Clark, L.A., & Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychological Assessment, 3*, 309-319.

Cloete, E., Courtney, S., & Fintz, J. (2002). Small businesses' acceptance and adoption of e-commerce in the Western-Cape province of South-Africa. *The Electronic Journal on Information Systems in Developing Countries, 10*(4), 1-13.

Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd Ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cohen, W.M., & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly, 35*(1), 128-152.

Compeau, D.R., & Higgins, C.A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly, 19*(2), 189-211.

Cooper, R.B., & Zmud, R.W. (1990). Information technology implementation research: A technological diffusion approach. *Management Science, 36*(2), 123-139.

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3rd Ed.). Thousand Oaks, CA: SAGE Publications.

Costello, A.B., & Osborne, J.W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation, 10*(7), 1-9.

Creswell, J.W., Clark, V.L.P., Gutmann, M.L., & Hanson, W.E. (2003). Advanced mixed methods research designs. In A. Tashakkori and C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioural research* (pp. 209-240). Thousand Oaks, CA: SAGE Publications.

Crum, M.R., Premkumar, G., & Ramamurthy, K. (1996). An assessment of motor carrier adoption, use, and satisfaction with EDI. *Transportation Journal, 35*(4), 44-57.

Dalkir, K. (2005). *Knowledge management in theory and practice*. Burlington, MA: Elsevier Butterworth-Heinemann.

Darroch, J. (2003). Developing a measure of knowledge management behaviours and practices. *Journal of Knowledge Management, 7*(5), 41-54.

Davila, A., Gupta, M., & Palmer, R. (2003). Moving procurement systems to the Internet: The adoption and use of e-procurement technology models. *European Management Journal, 21*(1), 11-23.

Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation). MIT Sloan School of Management, Cambridge, MA.

Devaraj, S., & Kohli, R. (2003). Performance impacts of information technology: Is actual usage the missing link? *Management Science, 49*(3), 273-289.

Edenius, M., & Borgerson, J. (2003). To manage knowledge by Internet. *Journal of Knowledge Management, 7*(5), 124-136.

Erlandson, D.A., Harris, E.L., Skipper, B.L., & Allen, S.D. (1993). *Doing naturalistic inquiry: A guide to methods*. Newbury Park, CA: SAGE Publications.

Essig, M., & Arnold, U. (2001). Electronic procurement in supply chain management: An information economics-based analysis of electronic markets. *Journal of Supply Chain Management, 37*(4), 43-49.

Fabrigar, L.R., MacCallum, R.C., Wegener, D.T., & Strahan, E.J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272-299.

Falk, R.F., & Miller, N.B. (1992). *A primer for soft modelling*. Akron, OH: University of Akron Press.

Fink, D. (1998). Guidelines for the successful adoption of information technology in small and medium enterprises. *International Journal of Information Management, 18*(4), 243-253.

Fleming, C.M., & Bowden, M. (2009). Web-based surveys as an alternative to traditional mail methods. *Journal of Environmental Management, 90*, 284-292.

Forman, C. (2005). The corporate digital divide: Determinants of Internet adoption. *Management Science, 51*(4), 641-654.

Fornell, C., & Larcker, D.F. (1981). Evaluating equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50.

Foster, J., & Lin, A. (2004). Collaborative e-business planning: Developing an enterprise learning tool for information management and information systems curricula. *Journal of Electronic Commerce in Organizations, 2*(2), 28-43.

Furneaux, B., & Wade, M. (2011). An exploration of organisational level information systems discontinuance intentions. *MIS Quarterly, 35*(3), 573-598.

Gales, L.M. (2010). Linguistic sensitivity in cross-cultural organisational research: Positivist/post-positivist and grounded theory approaches. *Language and Intercultural Communication, 3*(2), 131-140.

Garrido, M.J., Gutierrez, A., & Jose, R.S. (2008). Organisational and economic consequences of business e-procurement intensity. *Technovation, 28*, 615-629.

Garrido-Samaniego, M.J., Gutierrez-Arranz, A.M., & Jose-Cabezudo, R.S. (2009). Assessing the impact of e-procurement on the structure of the buying centre. *International Journal of Information Management, 30*, 135-143.

Gebauer, J., Haacker, D., & Shaw, M. (2002). Global non-production procurement at Motorola: Managing the evolving enterprise infrastructure. In M.J. Shaw (Ed.), *E-*

business management: Integration of web technologies with business models (pp. 133-154). Boston, MA: Kluwer Academic.

Gebauer, J., & Segev, A. (1998). Assessing Internet-based procurement to support the virtual enterprise. *Electronic Journal of Organizational Virtualness*, *2*(3), 30-43.

Gefen, D., Straub, D.W., & Boudreau, M. (2000). Structural equation modelling and regression: Guidelines for research practice. *Communications of the Association for Information Systems*, *4*(7), 1-77.

Germain, R., & Droge, C. (1995). Just-in-time and context: Predictors of electronic data interchange technology adoption. *International Journal of Physical Distribution & Logistics Management*, *25*(1), 18-33.

Gibbs, J.L., & Kraemer, K.L. (2004). A cross-country investigation of the determinants of scope of e-commerce use: An institutional approach. *Electronic Markets*, *14*(2), 124-137.

Gillis, A., & Jackson, W. (2002). *Research for nurses: Methods and interpretation.* Philadelphia, PA: F.A. Davis Co.

Glandon, T.A. (2003). EDI adoption: Controls in a changing environment. *Advances in Management Accounting*, *11*, 287-317.

Gottschalk, P., & Abrahamsen, A.F. (2002). Plans to utilise electronic marketplaces: The case of B2B procurement markets in Norway. *Industrial Management & Data Systems*, *102*(6), 325-331.

Grandon, E.E., & Pearson, J.M. (2004). Electronic commerce adoption: An empirical study of small and medium US businesses. *Information & Management*, *42*(1), 197-216.

Greenhalgh, T., Robert, G., MacFarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organisations: Systematic review and recommendations. *The Milbank Quarterly*, *82*(4), 581-629.

Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly*, *30*(3), 611-642.

Grover, V. (1993). An empirically derived model for the adoption of customer-based interorganisational systems, *Decision Sciences*, *24*(3), 603-640.

Gunasekaran, A., McGaughey, R.E., Ngai, E.W.T., & Rai, B.K. (2009). E-procurement adoption in the Southcoast SMEs. *International Journal of Production Economics*, *122*, 161-175.

Gunasekaran, A., & Ngai, E.W.T. (2008). Adoption of e-procurement in Hong Kong: An empirical research. *International Journal of Production Economics*, *113*, 159-175.

Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1998). *Multivariate data analysis.* Upper Saddle River, NJ: Prentice-Hall.

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate data analysis: A global perspective* (7th Ed.). Upper Saddle River, NJ: Pearson Education.

Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., & Tatham, R.L. (2005). *Multivariate data analysis* (6th Ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Hair, J.F., Ringle, C.M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139-151.

Hannon, D. (2004, January). Owens Corning plans to go 80% paperless by end-2004. *Purchasing*, 16-18.

Harrigan, P.O., Boyd, M.M., Ramsey, E., & Ibbotson, P. (2008). The development of e-procurement within the ICT manufacturing industry in Ireland. *Management Decision*, *46*(3), 481-500.

Haveman, H.A. (1993). Follow the leader: Mimetic isomorphism and entry into new markets. *Administrative Science Quarterly*, *38*(4), 593-627.

Hawking, P., & Stein, A. (2004). E-procurement: Is the ugly duckling actually a swan down under? *Asia Pacific Journal of Marketing and Logistics*, *16*(1), 3-26.

Henseler, J., Ringle, C.M., & Sinkovics, R.R. (2009). The use of partial least squares path modelling in international marketing. *Advances in International Marketing*, *20*, 277-319.

Heung, V.C.S. (2003). Barriers to implementing e-commerce in the travel industry: A practical perspective. *Hospitality Management*, *22*, 111-118.

Hoe, S.L. (2008). Issues and procedures in adopting structural equation modelling technique. *Journal of Applied Quantitative Methods*, *3*(1), 76-83.

Hofstede, G. (1983). National cultures in four dimensions: A research-based theory of cultural differences among nations. *International Studies of Management and Organization*, *13*, 46-74.

Hofstede, G., & Bond, M.H. (1988). The Confucius connection: From cultural roots to economic growth. *Organizational Dynamics*, *16*(4), 4-21.

Hong, J., & Kuo, C. (1999). Knowledge management in the learning organisation. *Leadership & Organisation Development Journal*, *20*(4), 207-215.

Hsu, P., Kraemer, K.L., & Dunkle, D. (2006). Determinants of e-business use in US firms. *International Journal of Electronic Commerce*, *10*(4), 9-45.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*, 195-204.

Iacovou, C.L., Benbasat, I., & Dexter, A.S. (1995). Electronic data interchange and small organisations: Adoption and impact of technology. *MIS Quarterly*, *19*(4), 465-485.

Igbaria, M., Guimares, T., & Davis, G.B. (1995). Testing the determinants of microcomputer usage via a structural equation model. *Journal of Management Information Systems*, *11*(4), 87-114.

Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye, A.L.M. (1997). Personal computing acceptance factors in small firms: A structural equation model. *MIS Quarterly*, *21*(3), 279-302.

Issa, R.R.A., Flood, I., Caglasin, G. (2003). A survey of e-business implementation in the US construction industry. *Journal of Information Technology in Construction*, *8*, 15-28.

Ivankova, N.V., Creswell, J.W., & Stick, S.L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, *18*(1), 3-20.

Jeon, B.N., Han, K.S., & Lee, M.J. (2006). Determining factors for the adoption of e-business: The case of SMEs in Korea. *Applied Economics*, *38*, 1905-1916.

Johnson, R.K., & Onwuegbuzie, A.J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14-26.

Joo, Y., & Kim, Y. (2004). Determinants of corporate adoption of e-marketplace: An innovation theory perspective. *Journal of Purchasing & Supply Management, 10*, 89-101.

Kanuk, L., & Berenson, C. (1975). Mail surveys and response rates: A literature review. *Journal of Marketing Research*, *12*(4), 440-453.

Karahanna, E., Agarwal, R., & Angst, C.M. (2006). Reconceptualising compatibility beliefs in technology acceptance research. *MIS Quarterly*, *30*(4), 781-804.

Katz, M.L., & Shapiro, C. (1986). Technology adoption in the presence of network externalities. *Journal of Political Economy*, *94*(4), 822-841.

Kaynak, E., Tatoglu, E., & Kula, V. (2005). An analysis of the factors affecting the adoption of electronic commerce by SMEs. *International Marketing Review*, *22*(6), 623-640.

Kendall, J.D., Tung, L.L., Chua, K.H., Hong, C., Ng, D., & Tan, S.M. (2001). Receptivity of Singapore's SMEs to electronic commerce adoption. *Journal of Strategic Information Systems*, *10*, 223-242.

Kheng, C.B., & Al-Hawamdeh, S. (2002). The adoption of electronic procurement in Singapore. *Electronic Commerce Research, 2*, 61-73.

Kline, R. B. (2011). *Principles and practice of structural equation modelling* (3rd Ed.). New York, NY: Guilford Press.

Knudsen, D. (2003). Aligning corporate strategy, procurement strategy and e-procurement tools. *International Journal of Physical Distribution & Logistics Management*, *33*(8), 720-734.

Kotelnikov, V. (2007). *Small and medium enterprises and ICT*. Retrieved from http://www.apdip.net/publications/iespprimers/eprimer-sme.pdf

Kothari, C.R. (1990). *Research methodology: Methods and techniques* (2nd Ed.). New Delhi, India: Vishwaprakashan.

Kothari, T., Hu, C., & Roehl, W.S. (2005). E-procurement: An emerging tool for the hotel supply chain management. *Hospitality Management*, *24*, 369-389.

Krishnaswamy, S., Zaslavzky, A., & Loke, A. (2000). An architecture to support distributed data mining services in e-commerce environments. *Proceedings of the Second International Workshop on Advance Issues of E-Commerce and Web-Based Information Systems* (pp. 239-246), Milpitas, CA. Retrieved from http://www.csse.monash.edu.au/projects/MobileComponents/projects/dame/WECWIS2000.pdf

Krucken, G. (2003). Learning the 'new, new thing': On the role of path dependency in university structures. *Higher Education*, *46*, 315-339.

Kuan, K.K.Y., & Chau, P.Y.K. (2001). A perception-based model for EDI adoption in small businesses using a technology-adoption-environment framework. *Information & Management*, *38*, 507-521.

Kwak, M. (2002). Potential pitfalls of e-auctions. *MIT Sloan Management Review*, *43*(2), 18.

Lai, F., Wang, J., Hsieh, C., & Chen, J. (2007). On network externalities, e-business adoption and information asymmetry. *Industrial Management & Data Systems*, *107*(5), 728-746.

Larsen, T.J., Sorebo, A.M., & Sorebo, O. (2009). The role of task-technology fit as users' motivation to continue information system use. *Computers in Human Behavior*, *25*, 778-784.

Law, C.C.H., & Ngai, E.W.T. (2007). ERP systems adoption: An exploratory study of the organisational factors and impacts of ERP success. *Information & Management*, *44*, 418-432.

Lee, J. (2004). Discriminant analysis of technology adoption behaviour: A case of Internet technologies in small businesses. *Journal of Computer Information Systems*, *44*(4), 57-66.

Lee, M.S. (2009). An empirical study about RFID acceptance: Focus on the employees in Korea. *International Journal of Business, Economics, Finance and Management Sciences*, *1*(2), 78-87.

Lefebvre, L., Lefebvre, E., Elia, E., & Boeck, H. (2005). Exploring B-to-B e-commerce adoption trajectories in manufacturing SMEs. *Technovation*, *25*, 1443-1456.

Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly*, *31*(1), 59-87.

Liang, H., Xue, Y., Byrd, T.A., & Rainer, R.K. (2004). Electronic data interchange usage in China's healthcare organisations: The case of Beijing's hospitals. *International Journal of Information Management*, *24*, 507-522.

Lin, H. (2007). Knowledge sharing and firm innovation capability: An empirical study. *International Journal of Manpower*, *28*(3), 315-332.

Lin, H., & Lin, S. (2008). Determinants of e-business diffusion: A test of the technology diffusion perspective. *Technovation*, *28*, 135-145.

Ling, R.R., & Yen, D.C. (2001). Extranet: A new wave of Internet. *SAM Advanced Management Journal*, *66*, 39-44.

Looi, H.C. (2005). E-commerce adoption in Brunei Darussalam: A quantitative analysis of factors influencing its adoption. *Communications of the Association for Information Systems*, *15*(3), 60-81.

Lu, H., & Wang, S. (2008). The role of Internet addiction in online game loyalty: An exploratory study. *Internet Research*, *18*(5), 499-519.

MacManus, S.A. (2002). Understanding the incremental nature of e-procurement implementation at the state and local levels. *Journal of Public Procurement*, *2*(1), 5-28.

Malhotra, N.K., Kim, S.S., & Patil, A. (2006). Common method variance in IS research: A comparison of alternative approaches and a reanalysis of past research. *Management Science*, *52*(12), 1865-1883.

Maguire, S., Koh, S.C.L., & Magrys, A. (2007). The adoption of e-business and knowledge management in SMEs. *Benchmarking: An International Journal*, *14*(1), 37-58.

March, J.G. (1991). Exploration and exploitation in organisational learning. *Organization Science*, *2*(1), 71-87.

Marcoulides, G.A., Chin, W.W., & Saunders, C. (2009). A critical look at partial least squares modelling. *MIS Quarterly*, *33*(1), 171-175.

Marcoulides, G.A., & Saunders, C. (2006). PLS: A silver bullet? *MIS Quarterly*, *30*(2), iii-ix.

Mata, F.J., Fuerst, W.L., & Barney, J.B. (1995). Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly*, *19*(4), 487-505.

McDonald, R.P., & Ho, M.R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, *7*(1), 64-82.

McGregor, J., & Gomes, C. (1999). Technology uptake in small and medium-sized enterprises: Some evidence from New Zealand. *Journal of Small Business Management*, *37*(3), 94-103.

Milgrom, P. (1989). Auctions and bidding: A primer. *Journal of Economic Perspectives*, *3*(3), 3-22.

Miller, S. (2011). *E-procurement systems*. Retrieved from http://ezinearticles.com/?E-Procurement-Systems&id=407808

Min, H., & Galle, W.P. (2003). E-purchasing: Profiles of adopters and nonadopters. *Industrial Marketing Management*, *32*, 227-233.

Ministry of Economic Development. (2009). *SMEs in New Zealand: Structure and dynamics 2009*. Retrieved from http://www.med.govt.nz/upload/69938/SMEDs_July09.pdf

Ministry of Economic Development. (2011). *SMEs in New Zealand: Structure and dynamics 2011*. Retrieved from http://www.med.govt.nz/business/business-growth-internationalisation/pdf-docs-library/structure-and-dynamics-2011.pdf

Mohd Salleh, N.A. (2009). Firm's capabilities as critical determinants of adoption and utilisation of information systems by small- and medium-sized enterprises. *Asia Pacific Management Review*, *14*(4), 477-498.

Monczka, R., Trent, R., & Handfield, R. (2002). *Purchasing and supply chain management* (2nd Ed.). Cincinnati, OH: South-Western.

Mueller, R.A.E. (2001). E-commerce and entrepreneurship in agricultural markets. *American Agricultural Economics Association*, *83*(5), 1243-1249.

Muffato, M., & Payaro, A. (2004). Implementation of e-procurement and e-fulfilment processes: A comparison of cases in the motorcycle industry. *International Journal of Production Economics*, *89*, 339-351.

Murtaza, M.B., Gupta, V., & Carroll, R.C. (2004). E-marketplaces and the future of supply chain management: Opportunities and challenges. *Business Process Management Journal*, *10*(3), 325-335.

New Zealand Centre for SME Research. (2010). *About SMEs*. Retrieved from http://sme-centre.massey.ac.nz/

Ngai, E.W.T., & Gunasekaran, A. (2004). Implementation of EDI in Hong Kong: An empirical analysis. *Industrial Management & Data Systems*, *104*(1), 88-100.

Nik Abdullah, N.A.H. (2009). *The role of technology attributes, trust and dependency on e-procurement adoptions: An empirical analysis of Malaysian manufacturers* (Doctoral dissertation). Retrieved from http://eprints.usq.edu.au/6532/

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory* (3rd Ed.). New York: McGraw-Hill.

Oliveira, T., & Martins, M.F. (2010a). Understanding e-business adoption across industries in European countries. *Industrial Management & Data Systems*, *110*(9), 1337-1354.

Oliveira, T., & Martins, M.F. (2010b). Firms patterns of e-business adoption: Evidence for the European Union-27. *The Electronic Journal Information Systems Evaluation*, *13*(1), 47-56.

Organisation for Economic Co-operation and Development. (2005). *SME and entrepreneurship outlook*. Retrieved from http://www.camaras.org

Pallant, J. (2011). *SPSS survival manual* (4th Ed.). Crows Nest, NSW: Allen & Unwin.

Pearcy, D.H., Parker, D.B., & Giunipero, L.C. (2008). Using electronic procurement to facilitate supply chain integration: An exploratory study of US-based firms. *American Journal of Business*, *23*(1), 23-35.

Pearson, J.M., & Grandon, E.E. (2005). An empirical study of factors that influence e-commerce adoption/non-adoption in small and medium sized businesses. *Journal of Internet Commerce*, *4*(4), 1-21.

Peteraf, M.A. (1993). The cornerstone of competitive advantage: A resource-based view. *Strategic Management Journal*, *14*, 179-191.

Premkumar, G. (2003). A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce*, *13*(2), 91-121.

Premkumar, G., & Ramamurthy, K. (1995). The role of interorganisational and organisational factors on the decision mode for adoption of interorganisational systems. *Decision Sciences*, *26*(3), 303-336.

Premkumar, G., Ramamurthy, K., & Crum, M. (1997). Determinants of EDI adoption in the transportation industry. *European Journal of Information Systems*, *6*, 107-121.

Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *Omega International Journal of Management Science*, *27*, 467-484.

Prescott, M.B. (1995). Diffusion of innovation theory: Borrowings, extensions, and modifications from IT researchers. *DATA BASE Advances, 26*(2&3), 16-19.

Priem, R.L., & Butler, J.E. (2001). Is the resource-based "view" a useful perspective for strategic management research? *The Academy of Management Review, 26*(1), 22-40.

Rahim, M.M. (2008). Identifying factors affecting acceptance of e-procurement systems: An initial qualitative study at an Australian City Council. *Communications of the IBIMA, 3*, 7-17.

Ramamurthy, K., Premkumar, G., & Crum, M.R. (1999). Organisational and interorganisational determinants of EDI diffusion and organisational performance: A causal model. *Journal of Organizational Computing and Electronic Commerce, 9*(4), 253-285.

Ramaseshan, B. (1997). Attitudes towards use of electronic data interchange in industrial buying: Some Australian evidence. *Supply Chain Management, 2*(4), 149-157.

Ramdani, B., & Kawalek, P. (2007). SME adoption of enterprise systems in the Northwest of England: An environmental, technological, and organisational perspective. In T. McMaster, D. Wastell, E. Femeley, and J. DeGross (Eds.), *Organizational dynamics of technology-based innovation: Diversifying the research agenda* (pp. 409-430). Boston, MA: Springer.

Ray, P. (2003). *Integrated management from e-business perspective: Concepts, architectures, and methodologies*. New York: Kluwer Academic/Plenum Publishers.

Reunis, M.R.B., Van Raaij, E.M., & Santema, S.C. (2004). Actor-to-actor dissemination of electronic procurement (EP) adoption: An exploration of influencing factors. *Journal of Purchasing & Supply Management, 10*, 201-210.

Robinson, P., Wale, D., & Dickson, G. (2010). *Events management*. Cambridge, MA: CABI.

Rogers, E.M. (1962). *Diffusion of innovation*. New York, NY: Free Press.

Rogers, E.M. (2003). *Diffusion of innovations* (5th Ed.). New York, NY: Free Press.

Rolstadas, A., Hetland, P.W., Jergeas, G.F., & Westney, R.E. (2011). *Risk navigation strategies for major capital projects: Beyond the myth of predictability*. London, NY: Springer.

Salisbury, W.D., Pearson, R.A., Pearson, A.W., & Miller, D.W. (2001). Perceived security and World Wide Web purchase intention. *Industrial Management & Data Systems*, *101*(4), 165-176.

Sanchez-Franco, M.J., & Roldan, J.L. (2005). Web acceptance and usage model. *Internet Research*, *15*(1), 21-48.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research methods for business students* (5th Ed.). London, England: Pitman Publishing.

Schoenherr, T., & Tummala, W.M.R. (2007). Electronic procurement: A structured literature review and directions for future research. *International Journal of Procurement Management*, *1*(1/2), 8-37.

Scott, W.R. (1987). The adolescence of institutional theory. *Administrative Science Quarterly*, *32*(4), 493-511.

Seyal, A.H., Abd Rahman, M.N., Awg Mohammad, H.A.Y. (2007). A quantitative analysis of factors contributing electronic data interchange adoption among Bruneian SMEs. *Business Process Management Journal*, *13*(5), 728-746.

Skadberg, Y.X., & Kimmel, J.R. (2004). Visitors flow experience while browsing a web site: Its measurement, contributing factors and consequences. *Computers in Human Behaviour*, *20*, 403-422.

Soares-Aguiar, A., & Palma-dos-Reis, A. (2008). Why do firms adopt e-procurement systems? Using logistic regression to empirically test a conceptual model. *IEEE Transactions on Engineering Management*, *55*(1), 120-133.

Soliman, K.S., & Janz, B.D. (2004). An exploratory study to identify the critical factors affecting the decision to establish Internet-based interorganisational information systems. *Information & Management*, *41*, 697-706.

Srinivasan, R., Lilien, G.L., & Rangaswamy, A. (2002). Technological opportunism and radical technology adoption: An application to e-business. *Journal of Marketing*, *66*, 47-60.

Sriram, R.S., Arunachalam, V., & Ivancevich, D.M. (2000). EDI adoption and implementation: An examination of perceived operational and strategic benefits, and controls. *Journal of Information Systems*, *14*(1), 37-52.

Standing, C., & Lin, C. (2007). Organisational evaluation of the benefits, constraints, and satisfaction of business-to-business electronic commerce. *International Journal of Electronic Commerce*, *11*(3), 107-134.

Statistics New Zealand. (2010). *New Zealand business demography statistics: At February 2010.* Retrieved from http://www.stats.govt.nz/browse_for_stats/businesses/business_characteristics/BusinessDemographyStatistics_HOTPFeb10/Tables.aspx

Stockdale, R., & Standing, C. (2004). Benefits and barriers of electronic marketplace participation: An SME Perspective. *The Journal of Enterprise Information Management*, *17*(4), 301-311.

Tan, G.W., Shaw, M.J., & Fulkerson, B. (2000). Web-based supply chain management. *Information Systems Frontiers*, *2*(1), 41-55.

Tan, K.S., Chong, S.C., Lin, B., & Eze, U.C. (2009). Internet-based ICT adoption: Evidence from Malaysian SMEs. *Industrial Management & Data Systems*, *109*(2), 224-244.

Tanner, C., Wolfle, R., Schubert, P., & Quade, M. (2008). Current trends and challenges in electronic procurement: An empirical study. *Electronic Markets*, *18*(1), 6-18.

Tassabehji, R., Taylor, W.A., Beach, R., & Wood, A. (2006). Reverse e-auctions and supplier-buyer relationships: An exploratory study. *International Journal of Operations & Production Management*, *26*(2), 166-184.

Tatsis, V., Mena, C., Wassenhove, L.N.V., & Whicker, L. (2006). E-procurement in the Greek food and drink industry: Drives and impediments. *Journal of Purchasing & Supply Management*, *12*, 63-74.

Teo, T.S., & Pian, Y. (2003). A contingency perspective on Internet adoption and competitive advantage. *European Journal of Information Systems*, *12*, 78-92.

Teo, T.S.H., Lim, G.S., & Fedric, S.A. (2007). The adoption and diffusion of human resources information systems in Singapore. *Asia Pacific Journal of Human Resources, 45,* 44-62.

Teo, T.S.H., Lin, S., & Lai, K. (2009). Adopters and non-adopters of e-procurement in Singapore: An empirical study. *The International Journal of Management Science, 37,* 972-987.

Teo, T.S.H., & Ranganathan, C. (2004). Adopters and non-adopters of business-to-business electronic commerce in Singapore. *Information & Management, 42,* 89-102.

Teo, T.S.H., Tan, M., & Buk, W.K. (1998). A contingency model of Internet adoption in Singapore. *International Journal of Electronic Commerce, 2*(2), 95-118.

Thompson, R.L., Higgins, C.A., & Howell, J.M. (1991). Personal computing: Toward a conceptual model of utilisation. *MIS Quarterly, 15*(1), 125-143.

Thong, J.Y.L. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems, 15*(4), 187-214.

Thong, J.Y.L., & Yap, C.S. (1995). CEO characteristics, organisational characteristics and information technology adoption in small businesses. *Omega, 23*(4), 429-442.

Timmers, P. (1998). Business models for electronic markets. *Electronic Markets, 8*(2), 3-8.

To, M.L., & Ngai, E.W.T. (2006). Predicting the organisational adoption of B2C e-commerce: An empirical study. *Industrial Management & Data Systems, 106*(8), 1133-1147.

Tornatzky, L.G., & Fleischer, M. (1990). *The process of technological innovation*. Lexington, MA: Lexington Books.

Tornatzky, L.G., & Klein, K.J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management, 29*(1), 28-43.

Trkman, P., & McCormack, K. (2010). Examining the benefits and risks of implementing e-procurement. *IEEE Transactions on Engineering Management, 57*(2), 338-349.

Varmazis, M. (2008, March). Cox uses e-procurement to keep service levels above water. *Purchasing*, 25.

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478.

Verespej, M. (2004, December). Strategic sourcing: Without the right data, your initiatives won't work. *Purchasing*, 17-20.

Vijayasarathy, L.R., & Tyler, M.L. (1997). Adoption factors and electronic data interchange use: A survey of retail companies. *International Journal of Retail & Distribution Management, 25*(9), 286-292.

Wagner, W.P., Chung, Q.B., & Baratz, T. (2002). Implementing corporate intranets: Lessons learned from two high-tech firms. *Industrial Management & Data Systems, 102*(3), 140-145.

Wang, S., & Cheung, W. (2004). E-business adoption by travel agencies: Prime candidates for mobile e-business. *International Journal of Electronic Commerce, 8*(3), 43-63.

Warrts, E., Everdingen, Y.M., & Hillegersberg, J. (2002). The dynamics of factors affecting the adoption of innovations. *The Journal of Product Innovation Management, 19,* 412-423.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171-180.

Wu, F., Mahajan, V., & Balasubramanian, S. (2003). An analysis of e-business adoption and its impact on business performance. *Journal of the Academy of Marketing Science, 31*(4), 425-447.

Wu, F., Zsidisin, G.A., & Ross, A.D. (2007). Antecedents and outcomes of e-procurement adoption: An integrative model. *IEEE Transactions on Engineering Management, 54*(3), 576-587.

Xu, S., Zhu, K., & Gibbs, J. (2004). Global technology, local adoption: A cross-country investigation of Internet adoption by companies in the United States and China. *Electronic Markets*, *14*(1), 13-24.

Yao, D., Yue, X., & Liu, J. (2008). Vertical cost information sharing in a supply chain with value-adding retailers. *The International Journal of Management Science*, *36*, 838-851.

Zhao, J., Wang, S., & Huang, W.V. (2008). A study of B2B e-market in China: E-commerce process perspective. *Information & Management*, *45*, 242-248.

Zhu, K., Dong, S., Xu, S.X., & Kraemer, K.L. (2006). Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems*, *15*, 601-616.

Zhu, K., & Kraemer, K.L. (2005). Post-adoption variations in usage and value of e-business by organisations: Cross-country evidence from the retail industry. *Information Systems Research*, *16*(1), 61-84.

Zhu, K., Kraemer, K.L., & Xu, S. (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems*, *12*, 251-268.

Zhu, K., Kraemer, K.L., Gurbaxani, V., & Xu, S.X. (2006). Migration to open-standard interorganisational systems: Network effects, switching costs, and path dependency. *MIS Quarterly*, *30*, 515-539.

Zhu, K., Kraemer, K.L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science*, *52*(10), 1557-1576.

APPENDICES

Appendix A Survey Questionnaire

MASSEY UNIVERSITY
COLLEGE OF BUSINESS
KAUPAPA WHAI PAKIHI

USING INFORMATION TECHNOLOGY IN PURCHASING:
A SURVEY OF NEW ZEALAND SMEs

This survey is being conducted to study the attitudes towards the use of information technology in purchasing (a practice known as ***e-procurement***) and the extent of e-procurement adoption in small and medium enterprises (SMEs) in New Zealand.

E-procurement is the use of Internet-based technologies to facilitate an organisation's purchasing activities. In particular, it is a business-to-business (B2B) purchasing practice that utilises Internet-based technologies to identify potential sources of supply, purchase goods and services, transfer payments, and interact with suppliers.

A. INFORMATION SEARCH AND EXCHANGE

In this section, we ask you about the extent to which your organisation takes advantage of e-procurement functionalities related to information search and exchange.

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
A1.	Search for suppliers of goods electronically.	☐	☐	☐	☐	☐	☐	☐
A2.	Search for suppliers of services electronically.	☐	☐	☐	☐	☐	☐	☐
A3.	Check availability of goods electronically.	☐	☐	☐	☐	☐	☐	☐
A4.	Check availability of services electronically.	☐	☐	☐	☐	☐	☐	☐
A5.	Check prices of goods electronically.	☐	☐	☐	☐	☐	☐	☐
A6.	Check prices of services electronically.	☐	☐	☐	☐	☐	☐	☐
A7.	Exchange purchasing information with external parties electronically.	☐	☐	☐	☐	☐	☐	☐
A8.	Exchange purchasing information with internal parties electronically.	☐	☐	☐	☐	☐	☐	☐

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
A9.	Provide online specific information about product specifications that our suppliers must meet.	☐	☐	☐	☐	☐	☐	☐
A10.	Send suppliers regular updates about new developments in our organisation (such as product plans) electronically.	☐	☐	☐	☐	☐	☐	☐
A11.	Share inventory planning information with our suppliers electronically.	☐	☐	☐	☐	☐	☐	☐

A12. Please comment on your answers in this section and/or suggest any other e-procurement functionalities related to "information search and exchange" used in your organisation.

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B. SIMPLE E-PROCUREMENT TRANSACTIONS

In this section, we ask you about the extent to which your organisation takes advantage of e-procurement functionalities related to simple e-procurement transactions.

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
B1.	Purchase goods using electronic catalogues.	☐	☐	☐	☐	☐	☐	☐
B2.	Purchase services using electronic catalogues.	☐	☐	☐	☐	☐	☐	☐
B3.	Create purchase requisitions electronically.	☐	☐	☐	☐	☐	☐	☐
B4.	Approve purchase requisitions electronically.	☐	☐	☐	☐	☐	☐	☐
B5.	Track orders electronically.	☐	☐	☐	☐	☐	☐	☐

B6. Please comment on your answers in this section and/or suggest any other e-procurement functionalities related to "simple e-procurement transactions" used in your organisation.

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C. COMPLEX E-PROCUREMENT TRANSACTIONS

In this section, we ask you about the extent to which your organisation takes advantage of e-procurement functionalities related to complex e-procurement transactions.

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
C1.	Purchase goods at electronic auctions (conventional auctions, with buyers bidding for goods).	☐	☐	☐	☐	☐	☐	☐
C2.	Purchase services at electronic auctions (conventional auctions, with buyers bidding for services).	☐	☐	☐	☐	☐	☐	☐
C3.	Purchase goods via electronic reverse auctions (with sellers bidding to provide goods).	☐	☐	☐	☐	☐	☐	☐
C4.	Purchase services via electronic reverse auctions (with sellers bidding to provide services).	☐	☐	☐	☐	☐	☐	☐
C5.	Purchase goods by issuing electronic calls for tenders.	☐	☐	☐	☐	☐	☐	☐
C6.	Purchase services by issuing electronic calls for tenders.	☐	☐	☐	☐	☐	☐	☐
C7.	Make payments to suppliers of goods electronically.	☐	☐	☐	☐	☐	☐	☐
C8.	Make payments to suppliers of services electronically.	☐	☐	☐	☐	☐	☐	☐
C9.	Negotiate contracts (price, volume, etc.) with suppliers electronically (via e-mail, instant messaging, etc.).	☐	☐	☐	☐	☐	☐	☐

C10. Please comment on your answers in this section and/or suggest any other e-procurement functionalities related to "complex e-procurement transactions" used in your organisation.

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D. ELECTRONIC COLLABORATION

In this section, we ask you about the extent to which your organisation relies on electronic collaboration in procurement practice.

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
D1.	Electronic communications with suppliers via e-mail.	☐	☐	☐	☐	☐	☐	☐
D2.	Electronic communications with suppliers using technologies other than e-mail (such as instant messaging, video conferencing etc.).	☐	☐	☐	☐	☐	☐	☐

		Please tick (√) where appropriate						
		Not used at all						**Used very extensively**
		1						**7**
D3.	Internal electronic communications on issues related to procurement via e-mail.	☐	☐	☐	☐	☐	☐	☐
D4.	Internal electronic communications on issues related to procurement using technologies other than e-mail (such as instant messaging, video conferencing etc.).	☐	☐	☐	☐	☐	☐	☐
D5.	Technology integration of the e-procurement system with other internal systems.	☐	☐	☐	☐	☐	☐	☐
D6.	Permitting the suppliers to directly access our internal systems (e.g., Enterprise Resource Planning/ERP systems).	☐	☐	☐	☐	☐	☐	☐

D7. Please comment on your answers in this section and/or suggest any other activities related to "electronic collaboration in procurement practice" occurring in your organisation.

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E. MONETARY VALUE OF GOODS OR SERVICES PURCHASED ONLINE

Please indicate the **approximate** percentage of the total monetary value of goods and services purchased online (involving transactions initiated electronically) in each of the following categories **over the last 12 months**.

E1. Percentage of **"direct goods"** (i.e., goods used in manufacturing/production, e.g., raw materials) purchased online, with respect to the total monetary value of direct goods purchased—in % (0-100 range). ☐

E2. Percentage of **"indirect goods"** (i.e., goods used in managing the business, e.g., office supplies) purchased online, with respect to the total monetary value of indirect goods purchased—in % (0-100 range). ☐

E3. Percentage of **"direct services"** (i.e., services which are directly related to the main business activity, e.g., transportation of finished goods) purchased online, with respect to the total monetary value of direct services purchased—in % (0-100 range). ☐

E4. Percentage of **"indirect services"** (i.e., services which are not directly related to the main business activity, e.g., cleaning the premises) purchased online, with respect to the total monetary value of indirect services purchased—in % (0-100 range). ☐

E5. Please comment on your answers in this section.

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F. RELATIVE ADVANTAGE OF E-PROCUREMENT

In this section, we ask you about the degree to which the use of e-procurement is perceived by your organisation to offer advantages.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
F1.	E-procurement makes the purchasing process faster.	☐	☐	☐	☐	☐	☐	☐
F2.	E-procurement facilitates better management of our purchasing activities.	☐	☐	☐	☐	☐	☐	☐
F3.	E-procurement improves relationships with our business partners.	☐	☐	☐	☐	☐	☐	☐
F4.	E-procurement reduces the price of procured goods.	☐	☐	☐	☐	☐	☐	☐
F5.	E-procurement reduces the price of procured services.	☐	☐	☐	☐	☐	☐	☐
F6.	E-procurement reduces operational costs.	☐	☐	☐	☐	☐	☐	☐
F7.	E-procurement improves competitive advantage.	☐	☐	☐	☐	☐	☐	☐
F8.	Please comment on your answers in this section.							

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G. COMPATIBILITY OF E-PROCUREMENT

In this section, we ask you about the degree to which e-procurement is perceived by your organisation as being consistent with your organisation's preferred work style, existing work practices, prior experience, and values.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
G1.	E-procurement adoption fits our organisation's preferred way for conducting our purchasing activities.	☐	☐	☐	☐	☐	☐	☐
G2.	E-procurement adoption is compatible with our organisation's current purchasing process.	☐	☐	☐	☐	☐	☐	☐
G3.	E-procurement adoption is consistent with the way our purchasing activities should be conducted.	☐	☐	☐	☐	☐	☐	☐
G4.	E-procurement adoption is consistent with our business strategy.	☐	☐	☐	☐	☐	☐	☐
G5.	E-procurement adoption is consistent with our organisational beliefs and values.	☐	☐	☐	☐	☐	☐	☐

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
G6.	E-procurement adoption is compatible with our information technology infrastructure.	☐	☐	☐	☐	☐	☐	☐
G7.	E-procurement is a new business experience for our organisation.	☐	☐	☐	☐	☐	☐	☐

G8. Please comment on your answers in this section.

_____

_____

_____

H. COMPLEXITY OF E-PROCUREMENT

In this section, we ask you about the degree to which e-procurement is perceived by your organisation as relatively difficult to understand and use.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
H1.	Learning to operate e-procurement is easy.	☐	☐	☐	☐	☐	☐	☐
H2.	It is easy to get e-procurement to do what our organisation wants it to do.	☐	☐	☐	☐	☐	☐	☐
H3.	E-procurement is flexible to interact with.	☐	☐	☐	☐	☐	☐	☐
H4.	Interactions with e-procurement are clear and understandable.	☐	☐	☐	☐	☐	☐	☐
H5.	It is easy to become skilful at using e-procurement.	☐	☐	☐	☐	☐	☐	☐
H6.	E-procurement is easy to use.	☐	☐	☐	☐	☐	☐	☐

H7. Please comment on your answers in this section.

_____

_____

_____

I. TOP MANAGEMENT SUPPORT

In this section, we ask you about the extent of commitment and resource support given by the top management of your organisation to usage of e-procurement.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
I1.	Top management is interested in the adoption of e-procurement.	☐	☐	☐	☐	☐	☐	☐

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
I2.	Top management considers e-procurement adoption as important to the organisation.	☐	☐	☐	☐	☐	☐	☐
I3.	Top management has effectively communicated its support for e-procurement adoption to employees.	☐	☐	☐	☐	☐	☐	☐
I4.	Top management is committed to the use of e-procurement.	☐	☐	☐	☐	☐	☐	☐
I5.	Top management is likely to invest funds in e-procurement.	☐	☐	☐	☐	☐	☐	☐
I6.	Top management is willing to take risks involved in the adoption of e-procurement.	☐	☐	☐	☐	☐	☐	☐
I7.	Please comment on your answers in this section.							

_____

_____

_____

J. EMPLOYEE KNOWLEDGE

In this section, we ask you about the extent of your employees' knowledge about e-procurement.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
J1.	Our employees have very little knowledge about how e-procurement can help improve our business.	☐	☐	☐	☐	☐	☐	☐
J2.	Our employees have the technical knowledge to start using e-procurement.	☐	☐	☐	☐	☐	☐	☐
J3.	Our employees would use e-procurement more if they knew more about what it can do for our organisation.	☐	☐	☐	☐	☐	☐	☐
J4.	Our employees have the ability to use e-procurement.	☐	☐	☐	☐	☐	☐	☐
J5.	Our employees have an overall knowledge about e-procurement.	☐	☐	☐	☐	☐	☐	☐
J6.	Please comment on your answers in this section.							

_____

_____

_____

K. PARTNER READINESS

In this section, we ask you to rate the importance of the following trading partner related issues in influencing your organisation's decisions on e-procurement adoption.

		Please tick (√) where appropriate						
		Not at all important						**Extremely important**
		1						**7**
K1.	Trading partner(s) reluctance to change.	☐	☐	☐	☐	☐	☐	☐
K2.	Lack of trust in trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K3.	Training trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K4.	Educating trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K5.	Non automated/non sophisticated trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K6.	Poor reputation of trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K7.	Lack of financial controls.	☐	☐	☐	☐	☐	☐	☐
K8.	Lack of legal controls.	☐	☐	☐	☐	☐	☐	☐
K9.	Inadequate trading volume to justify e-procurement.	☐	☐	☐	☐	☐	☐	☐
K10.	Difficulty in achieving “critical mass” of trading partner(s).	☐	☐	☐	☐	☐	☐	☐
K11.	Please comment on your answers in this section.							

_____

_____

_____

L. EXTERNAL PRESSURE

In this section, we ask you about the degree to which the actions of your organisation in adopting e-procurement are influenced by your trading partners and other organisations in the market.

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
L1.	There is a pressure to use e-procurement to meet suppliers' requirements.	☐	☐	☐	☐	☐	☐	☐
L2.	There is a pressure from the industry to use e-procurement as a standard purchasing practice.	☐	☐	☐	☐	☐	☐	☐
L3.	An e-procurement link to our suppliers is necessary to maintain our competitive edge.	☐	☐	☐	☐	☐	☐	☐

		Please tick (√) where appropriate						
		Strongly disagree						**Strongly agree**
		1						**7**
L4.	We believe we will lose our suppliers if we do not use e-procurement.	☐	☐	☐	☐	☐	☐	☐
L5.	We feel it is a strategic necessity to use e-procurement to compete in the marketplace.	☐	☐	☐	☐	☐	☐	☐

L6. Please comment on your answers in this section.

_____

_____

_____

M. YOUR ORGANISATION AND YOU

In this section, we ask you about your organisation and you.

M1. In what year was your organisation established? _____

M2. What is the legal form of your organisation?

- ☐ Limited liability company
- ☐ Partnership
- ☐ Sole trader

M3. Which type of manufacturing sector is your organisation involved in? (Choose the best match)

- ☐ Food Product Manufacturing
- ☐ Beverage and Tobacco Product Manufacturing
- ☐ Textile, Leather, Clothing and Footwear Manufacturing
- ☐ Wood Product Manufacturing
- ☐ Pulp, Paper and Converted Paper Product Manufacturing
- ☐ Printing
- ☐ Petroleum and Coal Product Manufacturing
- ☐ Basic Chemical and Chemical Product Manufacturing
- ☐ Polymer Product and Rubber Product Manufacturing
- ☐ Non-Metallic Mineral Product Manufacturing
- ☐ Primary Metal and Metal Product Manufacturing
- ☐ Fabricated Metal Product Manufacturing
- ☐ Transport Equipment Manufacturing
- ☐ Machinery and Equipment Manufacturing
- ☐ Furniture and Other Manufacturing

M4. In which region is your organisation located?

☐ Northland	☐ Wellington
☐ Auckland	☐ West-Coast
☐ Waikato	☐ Canterbury
☐ Bay of Plenty	☐ Otago
☐ Gisborne	☐ Southland
☐ Hawkes Bay	☐ Tasman
☐ Taranaki	☐ Nelson
☐ Manawatu-Wanganui	☐ Marlborough

M5. Approximately, how many people are employed in your organisation?

Full-time employees _____

Part-time employees _____

M6. Approximately, what was your turnover (in NZD) for the last 12 months? _____

M7. What is your gender?

☐ Male ☐ Female

M8. How old are you now? _____

M9. What is your present job position in your organisation? _____

M10. How many years have you (as an individual) been employed in your organisation's industry? _____

M11. How many years have you been employed by your present organisation? _____

M12. What is your highest educational attainment? _____

N. FURTHER STUDY

Further study of this area requires that we actually visit manufacturing firms and talk to the senior management. May we contact you for further research?

☐ Yes ☐ No

If the answer is **Yes**, please specify your company's name below:

*(**Note:** We will treat your answer as confidential information and will use it solely for the purpose of contacting you to arrange an interview)*

_____

THANK YOU VERY MUCH FOR YOUR VALUABLE TIME AND SUPPORT.

Appendix B Cover Letter

Online Survey:

Dear <title>,

Project Title: Using Information Technology in Purchasing: A Survey of New Zealand SMEs

I'm a doctoral student in the School of Management at Massey University, Palmerston North.

As discussed over the phone this afternoon, I would like to invite you to complete a survey devoted to the use of information technology in purchasing (a practice known as "e-procurement") by New Zealand SMEs. The survey is part of my PhD project. My supervisors are Dr. Alexei Tretiakov and Dr. Dick Whiddett.

I am certain that you will find this survey quite informative, no matter what is your current degree of reliance on using information technology in purchasing. Survey questions are based on a comprehensive literature review, and reflect the current state of knowledge regarding how organizations use information technology in purchasing, and regarding various issues organizations encounter in connection with using e-procurement.

I will treat the data you are going to provide in accordance with Massey University regulations: the data will be used for the purposes of this study only, and only aggregated results will be published. Your individual identity and responses will be strictly confidential.

The survey is available at:

http://is-research.massey.ac.nz/ep (It should take about 10 minutes to complete)

Please use **31** as your token number to participate in this survey.

I contacted you regarding this survey because you are an owner and/or manager of the firm. If you are not an appropriate respondent to this survey, I would be grateful if you could pass it to the right person.

I appreciate that you are busy and so I thank you for your commitment and your time.

I look forward to receiving your completed survey.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North
E-mail: H.hassan@massey.ac.nz

P.S. For more information about my research, please refer to the information sheet provided in the attachment.

Paper-based Survey:

Massey University

04 November 2010

<Address>
<Address>
<Address>

Dear <title>,

Re: "Using Information Technology in Purchasing: A Survey of New Zealand SMEs"

The purpose of this letter is to introduce myself and invite you to consider participating in a research project I am conducting for my doctoral thesis at Massey University, Palmerston North, New Zealand.

The purpose of the survey is to investigate the attitudes towards the use of information technology in purchasing (a practice known as "e-procurement") and the extent of e-procurement adoption in your organization.

I am certain that you will find this survey quite informative, no matter what is your current degree of reliance on using information technology in purchasing. Survey questions are based on a comprehensive literature review, and reflect the current state of knowledge regarding how organizations use information technology in purchasing, and regarding various issues organizations encounter in connection with using e-procurement.

The research is conducted using a questionnaire-based survey, which you can respond via online survey or hard copies that may take you only around 10 minutes.

Ethics Committee approval has been granted for the research.

I have enclosed an information sheet about my research, questionnaire, and return envelope. If you are interested in participating, please complete the questionnaire and return it in the pre-paid, addressed, return envelope. The number on the enclosed return envelope allows us to cross your name off once you have responded and ensures that I do not send you a reminder.

If you prefer to respond via online survey, you can use the following token number to access the online survey at URL: http://is-research.massey.ac.nz/ep

Token number: 21

I will treat the data you are going to provide in accordance with Massey University regulations: the data will be used for the purposes of this study only, and only aggregated results will be published. Your individual identity and responses will be strictly confidential.

I contacted you regarding this survey because you are an owner and/or manager of the firm. If you are not an appropriate respondent to this survey, I would be most grateful if you could pass it to the right person.

I appreciate that you are busy and so I once again thank you for your commitment and your time.

I look forward to receiving your completed questionnaire as soon as possible.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North

Appendix C Information Sheet

Massey University

School of Management
Massey University, Private Bag 11 222
Palmerston North, New Zealand.

"Using Information Technology in Purchasing: A Survey of New Zealand SMEs"
QUESTIONNAIRE INFORMATION SHEET

Dear Respondent,

I have identified you as the owner and/or manager of the Small and Medium Enterprises (SMEs) in New Zealand. You are invited to take part in the survey I am conducting as part of my doctoral study. My study is to investigate the attitudes towards the use of information technology in purchasing (a practice known as "*e-procurement*") and the extent of e-procurement adoption in New Zealand SMEs. You are under no obligation to accept this invitation. However, your contribution will be valuable and much appreciated.

Researcher Introduction

I am Haslinda Hassan, and I am currently pursuing my doctoral degree at Massey University, Palmerston North, New Zealand. My supervisors are Dr. Alexei Tretiakov and Dr. Dick Whiddett. My area of interest is in studying the "use of information technology in purchasing" in New Zealand SMEs. I am conducting this study as a partial fulfillment of the requirements for the PhD in Information Systems from Massey University.

Project Description and Invitation

The purpose of this study is to gather the data on the perceptions of SMEs owners and/or managers on the extent of e-procurement adoption and on the factors that may influence the extent of e-procurement adoption in SMEs. I formulated the model based on an extensive literature review covering the adoption and the extent of information technologies adoption in various areas like e-commerce, online shopping, website, e-marketplace, electronic data interchange, Internet, e-business, and e-procurement. The findings of this study will benefit both researchers and practitioners on e-procurement area and provide a better understanding of the extent of e-procurement usage in New Zealand SMEs. Your input and feedback are very important to ensure the success of this study.

Participant Identification and Recruitment

Your name and address have been obtained from the Kompass directory.

Data Management

All information provided by you will be kept strictly confidential. The information gathered will be stored securely, according to Massey University regulations and results will be used only for the purposes of this study. Your responses will be aggregated with the responses of all other respondents and no individual can be identified.

Participant's Rights

You have the right to:

- decline to participate,
- refuse to answer any particular question,
- ask any questions about the study at any time during participation,
- be given access to a summary of the findings of the study when it is concluded,
- withdraw from the research project at any stage.

Committee Approval Statement

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by the University's Human Ethics Committees. The researcher(s) named below are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 3505249, e-mail humanethics@massey.ac.nz.

Project Procedures

I would greatly appreciate if you could contribute to this study by completing the attached questionnaire. The estimated completion time for this questionnaire is approximately 10 minutes. Your completion and return of the questionnaire implies consent. The results of this study will also be published at conferences and journals.

Project Contacts

Please do not hesitate to contact myself or my supervisors if you have any questions about this study at the addresses below:

Doctoral Research Student

Haslinda Hassan

School of Management

PN241

Massey University Private Bag 11 222

Palmerston North, New Zealand.

Office phone: +64 6 356 9099 ext 3567

E-mail: H.hassan@massey.ac.nz

Alternatively, you may contact one of my supervisors as in the following:

Main Doctoral Supervisor

Dr. Alexei Tretiakov

School of Management

Massey University

Private Bag 11 222

Palmerston North, New Zealand.

E-mail : A.Tretiakov@massey.ac.nz

Co Doctoral Supervisor

Dr. Dick Whiddett

School of Management

Massey University

Private Bag 11 222

Palmerston North, New Zealand.

E-mail : R.J.Whiddett@massey.ac.nz

Appendix D Reminder Letters

First Reminder Letter

Online Survey:

Dear <title>,

Recently we invited you to participate in a survey about the use of information technology in purchasing (a practice known as "e-procurement") in New Zealand SMEs. We realize that this is a very busy time of year for you and you may have overlooked responding to it.

However, the survey is still available and may be accessed by clicking on the link below:

http://is-research.massey.ac.nz/ep

Please use 70 as your token number to participate in this survey.

The survey should take you about 10 minutes to complete.

You have been chosen for this survey because you are an owner and/or manager of the firm and your responses are vital to helping us gain an understanding of the use of information technology in purchasing in New Zealand SMEs.

I will treat the data you are going to provide in accordance with Massey University regulations: the data will be used for the purposes of this study only, and only aggregated results will be published. Your individual identity and responses will be strictly confidential.

I appreciate that you are busy and so I thank you for your commitment and your time.

I look forward to receiving your completed survey as soon as possible.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North
E-mail: H.hassan@massey.ac.nz

Paper-based Survey:

Massey University

26 November 2010

<Address1>
<Address1>
<Address1>

Dear <title>,

Re: Reminder to complete and return research survey: "Using Information Technology in Purchasing: A Survey of New Zealand SMEs"

Recently, I invited you to participate in a survey about the use of information technology in purchasing (a practice known as "e-procurement") in New Zealand SMEs.

At the time of sending this letter, I have not yet received your response. If you have already returned your questionnaire, thank you. Please accept our apologies for sending you this reminder. If you have not yet completed the questionnaire, I would appreciate if you could do so as soon as possible and return it in the return envelope included in my earlier mail to you.

The survey is part of my research project I am conducting for my doctoral thesis at Massey University, Palmerston North.

The research is conducted using a questionnaire-based survey, which you can respond via online survey or hard copies that may take you only around 10 minutes.

Ethics Committee approval has been granted for the research.

If you prefer to respond via online survey, you can use the following token number to access the online survey at URL:

http://is-research.massey.ac.nz/ep

Token number: 19

I will treat the data you are going to provide in accordance with Massey University regulations: the data will be used for the purposes of this study only, and only aggregated results will be published. Your individual identity and responses will be strictly confidential.

I contacted you regarding this survey because you are an owner and/or manager of the firm. If you are not an appropriate respondent to this survey, I would be most grateful if you could pass it to the right person.

I appreciate that you are busy and so I once again thank you for your commitment and your time.

I look forward to receiving your completed questionnaire as soon as possible.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North
E-mail: H.hassan@massey.ac.nz

Second Reminder Letter:

Massey University

12 December 2010

<Address1>
<Address2>
<Address3>

Dear <title>,

Re: Reminder to complete and return research survey: "Using Information Technology in Purchasing: A Survey of New Zealand SMEs"

You may recall receiving a questionnaire from us one month ago, asking you to take part in the survey for the above study.

At the time of sending this letter, I have not yet received your response. If you have already returned your questionnaire, thank you. Please accept our apologies for sending you this reminder. If you have not yet completed the questionnaire, I would appreciate if you could do so as soon as possible and return it in the return envelope enclosed here.

The research is conducted using a questionnaire-based survey, which you can respond via online survey or hard copies that may take you only around 10 minutes.

Ethics Committee approval has been granted for the research.

If you prefer to respond via online survey, you can use the following token number to access the online survey at URL: http://is-research.massey.ac.nz/ep

Token number: 19

I will treat the data you are going to provide in accordance with Massey University regulations: the data will be used for the purposes of this study only, and only aggregated results will be published. Your individual identity and responses will be strictly confidential.

I contacted you regarding this survey because you are an owner and/or manager of the firm. If you are not an appropriate respondent to this survey, I would be most grateful if you could pass it to the right person.

I appreciate that you are busy and so I once again thank you for your commitment and your time.

I look forward to receiving your completed questionnaire as soon as possible.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North
E-mail: H.hassan@massey.ac.nz

Appendix E Interview Arrangement E-Mail

Dear <title>,

Re: Using Information Technology in Purchasing: A Survey of New Zealand SMEs

Thank you very much for completing the survey for this project. Your interest in this matter is very much appreciated. Now, I have completed the survey and I am sending you a summary of the results for your information.

Thank you also for offering to participate in a follow-up interview. The purpose of the interview is to acquire an in-depth understanding on the current state of knowledge regarding how the organization uses information technology in purchasing (a practice known as "*e-procurement*") and regarding various issues the organization encounters in connection with using e-procurement.

In relation to this, I would like to arrange the date and time for the interview session. The interview will be conducted via phone and will take about 10 – 15 minutes. Thus, I appreciate if you could give some times on certain dates that you might be available to talk over the phone.

Your responses will be tape-recorded. However, if you don't want our conversation to be recorded, please let me know in advance.

The questions of the interview will be sent to you a few days prior the interview session.

All your answers will be completely confidential and the results will be used for the purposes of this study only. Neither your name nor your organization's name will be associated with your answers and made public.

I appreciate that you are busy and so I thank you for your commitment and your time.

I look forward to hearing from you soon.

Yours sincerely,

Haslinda Hassan
Doctoral Research Student
School of Management
Massey University
Palmerston North
E-mail: H.hassan@massey.ac.nz

Appendix F Acknowledgement of the Low Risk Notification

MASSEY UNIVERSITY

17 August 2010

Haslinda Hassan
142A College Street
Awapuni
PALMERSTON NORTH 4412

Dear Haslinda

Re: A Study of the Breadth of e-Procurement Adoption

Thank you for your Low Risk Notification which was received on 12 August 2010.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J. O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

cc Dr Alexei Tretiakov
School of Management
PN214

Dr Dick Whiddett
School of Management
PN214

Prof Claire Massey, HoS
School of Management
PN214

Appendix G Post-Hoc Analyses

This section presents variations of the main analysis presented in section 5.8, conducted to confirm the robustness of the results of the main analysis.

G.1 Variations of PLS Analysis

Variations of the main analyses using PLS SEM (the same statistical technique as used in the main analysis) are presented in this section.

G.1.1 All Missing Values Retained

In the main analysis, 14 cases were removed as containing uncharacteristically large numbers of missing values (as discussed in section 5.3). To explore the robustness of the results of the main analysis, an analysis with all the 165 responses obtained in the survey retained was also conducted (see section 5.2 for a discussion of the number of responses and the response rate).

The results were very similar to the results of the main analysis. In measurement model analysis, the same items as in the main analysis were removed to ensure item reliability (item CMP7 of the compatibility construct, item EK3 of the employee knowledge construct, and item PR9 of the partner readiness construct; see section 5.8.1.1 for a discussion of item removal in the main analysis). As in testing the measurement model in the main analysis (see section 5.8.1), the adjusted measurement model had no convergent or discriminant validity problems.

The results of structural model testing are summarised and compared with the results of the main analysis in Table G-1. In terms of levels of statistical significance and effect sizes, the results were consistent with the results of the main analysis presented in section 5.8.2.1.

Table G-1 *Outcomes of Hypotheses Testing: All Missing Values Retained*

	Hypothesis	Analysis with all missing values retained		Main analysis	
		β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.24	.029	.26	.024
H1b	Relative advantage → Depth	.07	.570	.11	.344
H2a	Compatibility → Breadth	.15	.249	.16	.314
H2b	Compatibility → Depth	.29	.018	.33	.024
H3a	Complexity → Breadth	.01	.938	.00	.988
H3b	Complexity → Depth	.11	.211	.08	.425
Organisation					
H4a	Top management support → Breadth	-.13	.278	-.13	.322
H4b	Top management support → Depth	.02	.890	.04	.728
H5a	Employee knowledge → Breadth	.09	.266	.08	.325
H5b	Employee knowledge → Depth	.08	.280	.05	.593
Environment					
H6a	Partner readiness → Breadth	-.04	.545	-.07	.342
H6b	Partner readiness → Depth	.06	.418	.06	.433
H7a	External pressure → Breadth	.40	<.001	.37	<.001
H7b	External pressure → Depth	.08	.382	.01	.918

G.1.2 Varying the Threshold for Counting Functionality as in Use

In the main analysis, the number of functionalities rated at 4 (the mid-point of a semantic differential scale ranging from 1 to 7) or higher was used as the sole indicator of breadth of e-procurement use (see section 4.3.6.1 for a discussion of the operationalisation of breadth in the main analysis). To explore the robustness of the results of the main analysis, analyses with alternative threshold values, 3, 5, and 6, were also conducted.

Table G-2 *Outcomes of Hypotheses Testing: Varying the Threshold for Counting Functionality as in Use*

		Threshold value							
		3		4[a]		5		6	
	Hypothesis	β	*p* value	β	*p* value	β	*p* value	β	*p* value
Technology									
H1a	Relative advantage → Breadth	.19	.088	.26	.024	.26	.018	.31	.002
H1b	Relative advantage → Depth	.12	.307	.11	.344	.12	.352	.12	.336
H2a	Compatibility → Breadth	.14	.387	.16	.314	.26	.075	.17	.175
H2b	Compatibility → Depth	.33	.020	.33	.024	.33	.021	.33	.024
H3a	Complexity → Breadth	.03	.757	.00	.988	-.04	.696	-.03	.755
H3b	Complexity → Depth	.08	.414	.08	.425	.07	.427	.07	.411
Organisation									
H4a	Top management support → Breadth	-.06	.665	-.13	.322	-.14	.247	-.08	.545
H4b	Top management support → Depth	.04	.731	.04	.728	.04	.743	.04	.716
H5a	Employee knowledge → Breadth	.03	.675	.08	.325	.13	.102	.09	.222
H5b	Employee knowledge → Depth	.05	.553	.05	.593	.05	.578	.05	.573
Environment									
H6a	Partner readiness → Breadth	-.09	.189	-.07	.342	-.03	.664	-.03	.559
H6b	Partner readiness → Depth	.06	.421	.06	.433	.06	.417	.06	.333
H7a	External pressure → Breadth	.41	<.001	.37	<.001	.29	<.001	.30	<.001
H7b	External pressure → Depth	.01	.916	.01	.918	.01	.926	.01	.924

[a]Main analysis.

As seen in Table G-2, for all of the alternative threshold values, the results were very similar to the results of the main analysis. In the measurement model analysis, the same items as in the main analysis were removed to ensure item reliability (item CMP7 of the compatibility construct, item EK3 of the employee knowledge construct, and item PR9 of the partner readiness construct; see section 5.8.1.1 for a discussion of item removal in the main analysis). As in testing the measurement model in the main analysis (see section 5.8.1), the adjusted measurement model had no convergent or discriminant validity problems.

The results of structural model testing are summarised and compared with the results of the main analysis in Table G-2. In terms of levels of statistical significance and effect sizes, the results were consistent with the results of the main analysis presented in section 5.8.2.1. The only exception was the result for hypothesis H1a (relative advantage → breadth of e-procurement use) in the analysis with the threshold value of 3; the *p* value (.088) was clearly lower than the *p* values for the hypotheses that were not confirmed in the main analysis, but above the widely accepted statistical significance threshold of .05.

G.1.3 Items of Partner Readiness with Large Numbers of Missing Values Removed

As discussed in section 5.3, items used to measure the partner readiness construct had uncharacteristically large numbers of missing values, suggesting that the respondents found these items problematic. In the main analysis, no action was taken to address this problem. This section presents a variation of the analysis in which the items of partner readiness that had particularly large numbers of missing values were removed before testing the measurement and the structural model.

The items removed were PR4 (educating trading partners), PR6 (poor reputation of trading partners), PR7 (lack of financial controls), and PR8 (lack of legal controls), the items with more than 10% of the missing values (see Table G-3 for a full list of the items of the partner readiness construct). The threshold was chosen to remove items with particularly large numbers of missing values, but to retain enough items to

maintain a reasonable coverage of the content of the construct. (It has to be noted that the remaining items still had more missing values than most of the items measuring other constructs; most of the items belonging to the other constructs had less than 5% of missing values.)

Table G-3 *Items of Partner Readiness*

	Item	% missing values
PR1	Trading partner(s) reluctance to change	7
PR2	Lack of trust in trading partner(s)	9
PR3	Training trading partner(s)	9
PR4[a]	Educating trading partner(s)	12
PR5	Non automated/non sophisticated trading partner(s)	10
PR6[a]	Poor reputation of trading partner(s)	13
PR7[a]	Lack of financial controls	12
PR8[a]	Lack of legal controls	12
PR9[a]	Inadequate trading volume to justify e-procurement	7
PR10	Difficulty in achieving "critical mass" of trading partner(s)	10

Note. Operationalisations of all constructs used in my study, including partner readiness, are introduced in section 4.3.6.2.

[a]Items removed as having particularly large numbers of missing values.

The results were very similar to the results of the main analysis. In the measurement model analysis, the same items as in the main analysis were removed to ensure item reliability (item CMP7 of the compatibility construct, item EK3 of the employee knowledge construct, and one more item of the partner readiness construct, PR9; see section 5.8.1.1 for a discussion of item removal in the main analysis). As in testing the measurement model in the main analysis (see section 5.8.1), the adjusted measurement model had no convergent or discriminant validity problems.

The results of structural model testing are summarised and compared with the results of the main analysis in Table G-4. In terms of levels of statistical significance and effect sizes, the results were overall consistent with the results of the main analysis presented in section 5.8.2.1.

Table G-4 *Outcomes of Hypotheses Testing: Items of Partner Readiness with Large Numbers of Missing Values Removed*

	Hypothesis	Analysis with items of partner readiness with large numbers of missing values removed		Main analysis	
		β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.27	.015	.26	.024
H1b	Relative advantage → Depth	.11	.374	.11	.344
H2a	Compatibility → Breadth	.15	.310	.16	.314
H2b	Compatibility → Depth	.33	.021	.33	.024
H3a	Complexity → Breadth	.00	.957	.00	.988
H3b	Complexity → Depth	.08	.416	.08	.425
Organisation					
H4a	Top management support → Breadth	-.13	.308	-.13	.322
H4b	Top management support → Depth	.04	.735	.04	.728
H5a	Employee knowledge → Breadth	.09	.280	.08	.325
H5b	Employee knowledge → Depth	.04	.621	.05	.593
Environment					
H6a	Partner readiness → Breadth	-.09	.173	-.07	.342
H6b	Partner readiness → Depth	.07	.399	.06	.433
H7a	External pressure → Breadth	.38	<.001	.37	<.001
H7b	External pressure → Depth	.01	.910	.01	.918

G.1.4 Organisation Size Included as a Factor

Organisation size was found to have effect on e-procurement adoption and use in studies by Batenburg (2007), Min and Galle (2003), Soares-Aguiar and Palma-dos-Reis (2008), and Teo et al. (2009) (see Table 2-9 in section 2.7 for a summary of the outcomes of prior explanatory studies of e-procurement adoption and use). It may be argued that the argument by Batenburg, Min and Galle, Soares-Aguiar and Palma-dos-Reis, and by Teo et al. (2009) that larger organisations are more likely to adopt e-procurement because they have more resources is applicable to my study. Resources most relevant to e-procurement adoption and use, employee knowledge

and technology infrastructure (via compatibility), were accounted for in the research model; it still made sense to consider the direct effects of organisation size because other resources correlated with organisation size, such as management expertise or availability of manager's time, may have been relevant.

A variation of the main analysis with organisation size (operationalised as the number of full-time employees) added as an organisational factor (hypothesised to affect the breadth and the depth of e-procurement use) was conducted. No effects of organisation size were discovered.

The results were very similar to the results of the main analysis. In the measurement model analysis, the same items as in the main analysis were removed to ensure item reliability (item CMP7 of the compatibility construct, item EK3 of the employee knowledge construct, and item PR9 of the partner readiness construct; see section 5.8.1.1 for a discussion of item removal in the main analysis). As in testing the measurement model in the main analysis (see section 5.8.1), the adjusted measurement model had no convergent or discriminant validity problems.

The results of structural model testing are summarised and compared with the results of the main analysis in Table G-5. For hypotheses not involving organisation size, in terms of levels of statistical significance and effect sizes, the results were consistent with the results of the main analysis presented in section 5.8.2.1. The hypotheses involving organisation size, H8a (organisation size → breadth of e-procurement use) and H8b (organisation size → depth of e-procurement use), were not confirmed, with *p* values rather large.

Table G-5 *Outcomes of Hypotheses Testing: Organisation Size Included as a Factor*

	Hypothesis	Analysis with organisation size included as a factor		Main analysis	
		β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.26	.018	.26	.024
H1b	Relative advantage → Depth	.11	.323	.11	.344
H2a	Compatibility → Breadth	.15	.342	.16	.314
H2b	Compatibility → Depth	.32	.030	.33	.024
H3a	Complexity → Breadth	.00	.963	.00	.988
H3b	Complexity → Depth	.08	.425	.08	.425
Organisation					
H4a	Top management support → Breadth	-.13	.374	-.13	.322
H4b	Top management support → Depth	.04	.731	.04	.728
H5a	Employee knowledge → Breadth	.08	.350	.08	.325
H5b	Employee knowledge → Depth	.05	.583	.05	.593
H8a	Organisation size → Breadth	.03	.627		
H8b	Organisation size → Depth	.01	.884		
Environment					
H6a	Partner readiness → Breadth	-.07	.331	-.07	.342
H6b	Partner readiness → Depth	.06	.426	.06	.433
H7a	External pressure → Breadth	.38	<.001	.37	<.001
H7b	External pressure → Depth	.01	.903	.01	.918

G.2 Analysis Using EFA and Covariance-Based SEM

In my study, the breadth of e-procurement use was operationalised by using a single indicator, the number of functionalities rated equal to or higher than a threshold value (see section 4.3.6.1 for a discussion of the operationalisation of breadth in the main analysis). Wu et al. (2007), in their explanatory study of intensity of e-procurement use (reviewed in detail in section 2.7.4), operationalised the intensity of e-procurement use by using the extent of use for each functionality as a separate indicator, resulting in a multiple-indicator measure.

The reason for using a different operationalisation in my study was that a count of e-procurement functionalities better reflects my conceptualisation of the breadth of e-procurement use. As argued in section 2.7.4, the construct of intensity of e-procurement use in the study by Wu et al. (2007) reflected both the breadth and the depth of e-procurement use.

Also, Wu et al. (2007) used covariance-based SEM; it was desirable to repeat the analysis by using an approach similar to Wu et al. (2007) to compare the two studies, which is done in this section.

To better compare the results of my study with the results reported by Wu et al. (2007), an analysis similar to the analysis by Wu et al. (2007) was conducted, using a construct operationalised similarly to intensity of e-procurement use by Wu et al. (2007) as a dependent variable. Similarly to the study by Wu et al. (2007), indicators relevant to the extent of e-procurement use were subjected to exploratory factor analysis (EFA) to uncover the underlying latent variables. Then, covariance-based confirmatory factor analysis (CFA) was used to confirm the structure uncovered by EFA. Finally, covariance-based SEM (as in the study by Wu et al., 2007) was used to test a structural model (see Figure G-1) with latent variables uncovered in the EFA analysis as dependent variables and the same independent variables as in the main research model of my study (see Figure 3-1 in section 3.2 for the main research model of my study). In addition, to ensure that any differences between the results of the covariance-based SEM analysis and the results of the main analysis (reported in section 5.8.2.1) were because of different approaches to the conceptualisation of the extent of e-procurement use rather than because of different approaches to SEM analysis, the SEM analysis for the research model in Figure G-1 was repeated by using PLS.

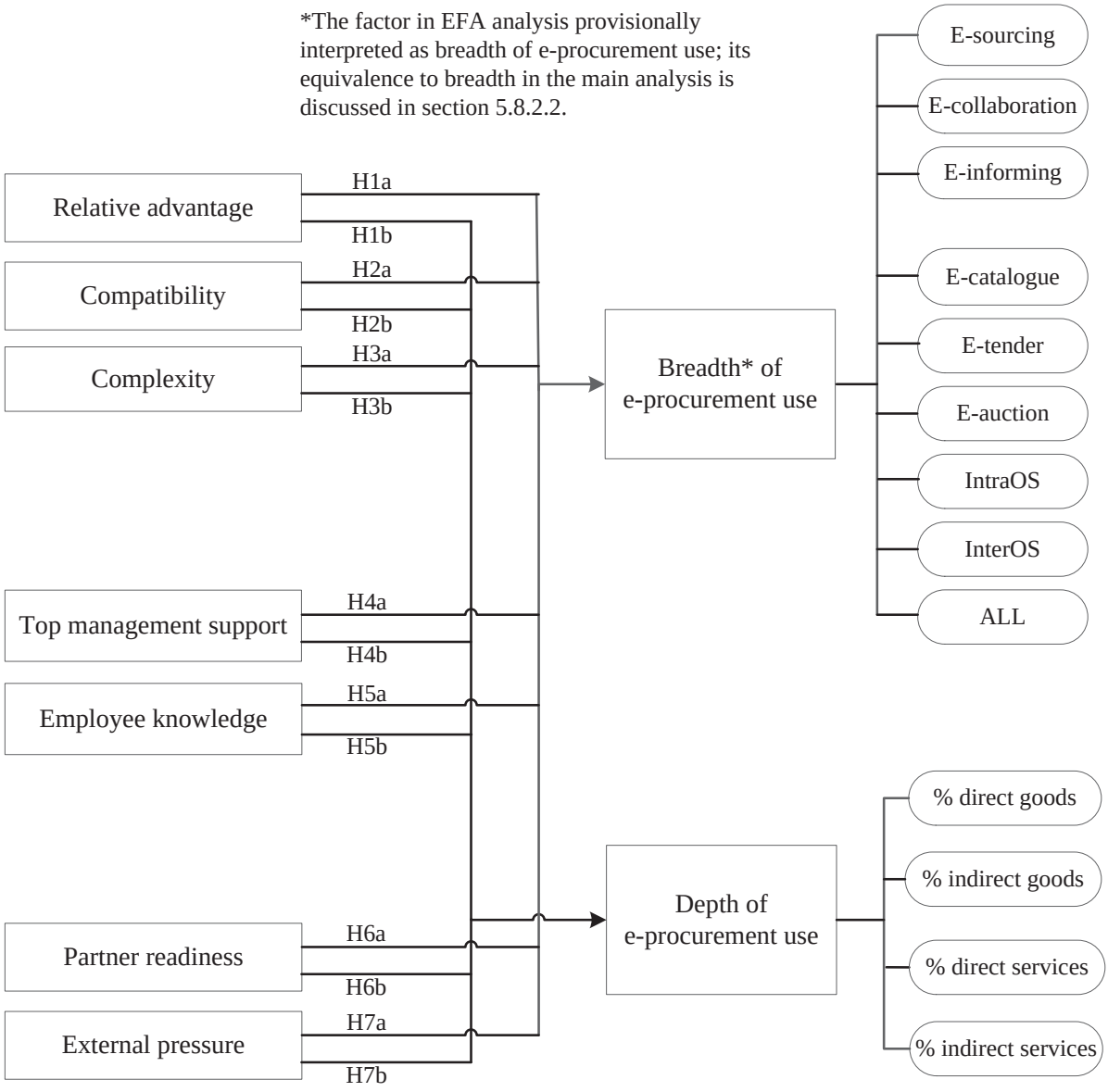

Figure G-1. Modified research model.

G.2.1 Conceptualisation and Operationalisation of Extent of E-Procurement Use

Following Wu et al. (2007), a pool of indicators of the extent of e-procurement use was formulated for EFA analysis. It was not feasible to use ratings for individual functionalities as indicators, because that would result in too many indicators for the data size available in my study (see Table 4-3 for a list of the functionalities). Therefore, following the approach suggested by Fabrigar et al. (1999), the ratings were aggregated to obtain a smaller number of indicators. Ratings for individual e-

procurement functionalities were aggregated according to e-procurement forms, resulting in a separate indicator for each e-procurement form in the descriptive model in Figure 2-1. In addition, e-procurement functionalities that related to multiple e-procurement forms (listed under ALL in Table 4-3) were aggregated as a separate indicator labelled ALL.

Items reflecting the percentage of the total monetary value of goods and services procured electronically were also added to the pool of indicators of the extent of e-procurement use. Thus, the pool of indicators for EFA analysis in my study was broader than the one used by Wu et al. (2007), who included ratings of extent of use for individual functionalities only. A full list of the indicators included in the pool is given in Table G-6. There were 13 indicators in the pool; therefore, the size of the data set (144 cases after removing outliers, see section 5.3) was sufficient for the EFA analysis according to the commonly used rule of thumb of ten cases per indicator (see Costello & Osborne, 2005). Normality checks were conducted as described in section 5.3; all of the indicators had skewness and kurtosis within the suggested limits.

G.2.2. Uncovering the Underlying Latent Variables: EFA Analysis

For the pool of indicators of extent of e-procurement use listed in Table G-6, EFA analysis was conducted by using Mplus version 6.1. Mean replacement was used for missing values.

A scree test was used to determine the number of factors. As seen in the scree plot in Figure G-2, the last substantial drop was between eigenvalue two and eigenvalue three, suggesting that there were two latent variables underlying the data (Fabrigar et al., 1999).

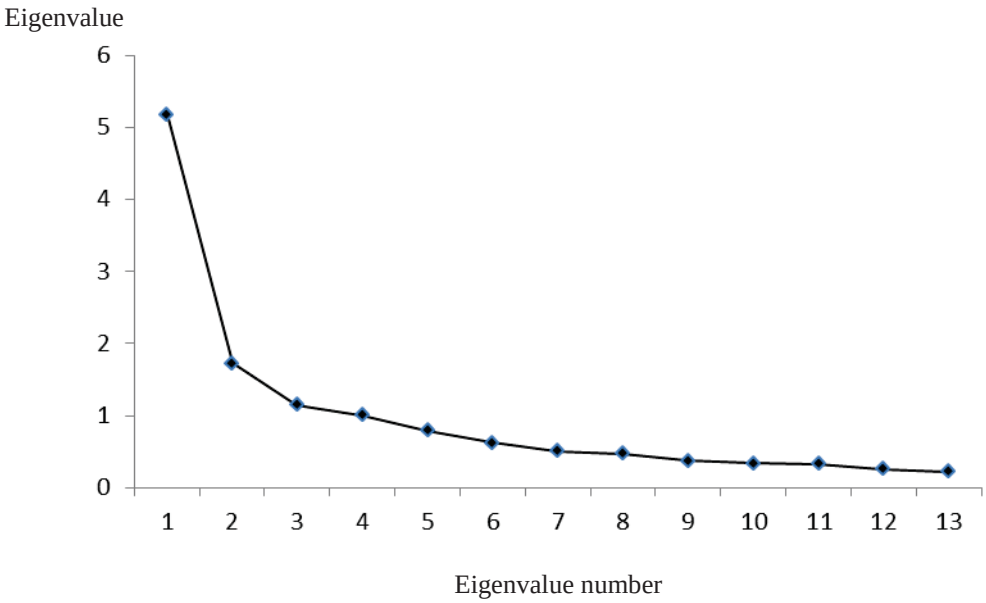

Figure G-2. Scree plot.

Factor loadings obtained by EFA analysis (with an ML estimator and geomin rotation) with the number of factors set to two are given in Table G-6.

Indicators corresponding to the extent of use of different e-procurement forms (obtained by aggregating extent of use ratings of individual e-procurement functionalities, as described in section G.2.1) clearly loaded stronger on Factor 1; indicators corresponding to the percentages of the total monetary value of goods and services procured online clearly loaded stronger on Factor 2. Therefore, Factor 1 was interpreted as breadth of e-procurement use, and Factor 2 was provisionally interpreted as depth of e-procurement use.

Indicators corresponding to e-tender, e-auction, and InterOS e-procurement forms loaded on Factor 1 (interpreted as breadth of e-procurement use) somewhat lower than the threshold of .40 recommended for convergent validity in EFA analysis by Hair, Anderson, Tatham, and Black (1998). This was noted, but to retain content validity, the indicators were retained for further analysis.

Table G-6 *Indicator Pool for EFA and the Resulting Factor Loadings*

Indicator	Description	Geomin rotated loadings	
		Factor 1[a]	Factor 2[b]
IISE	E-sourcing	**.665**	.061
IEC	E-collaboration	**.841**	-.003
IIF	E-informing	**.728**	-.064
TECAT	E-catalogue	**.702**	-.014
TTENDER	E-tender	**.305**	.217
TEAUCT	E-auction	**.373**	.039
TINTRA	IntraOS	**.727**	.097
TINTER	InterOS	**.360**	-.092
TOTALL	ALL	**.498**	.100
DEPDG	Percentage of direct goods procured electronically	.228	**.570**
DEPIDG	Percentage of indirect goods procured electronically	-.002	**.796**
DEPDS	Percentage of direct services procured electronically	.056	**.786**
DEPIDS	Percentage of indirect services procured electronically	-.033	**.817**

[a]Provisionally interpreted as breadth of e-procurement use. [b]Interpreted as depth of e-procurement use.

G.2.3 Confirming the Structure Uncovered by EFA: CFA Analysis

As discussed in section G.2.2, EFA analysis suggested that extent of e-procurement use has two underlying latent variables, which were interpreted as breadth and depth of e-procurement use. Following the approach by Wu et al. (2007), the outcome of the EFA analysis was confirmed by testing a CFA model for latent variables suggested by EFA. The CFA model is given in Figure G-3. According to the commonly used heuristics (at least ten cases per indicator, Bentler, 1990), the size of the data set was sufficient for using covariance-based CFA analysis. Mplus, version 6.1, was used.

The following global indices of fit were used to estimate the fit of the model: root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardised root mean square residual (SRMR) (thus, covering all of the global fit indices assessed by the Mplus software). For cut-off points for acceptable fit, I relied on the recommendations provided based on synthesis of literature by McDonald and Ho (2002) and Kline (2011). Following

McDonald and Ho, RMSEA values of less than .08, and CFI and TLI values of greater than .90 were interpreted as corresponding to acceptable fit. Following Kline, SRMR values of less than .08 were interpreted as corresponding to acceptable fit.

The CFA model as given in Figure G-3 (see also the formal specification in Mplus language given in Appendix I) did not fit the data (RMSEA .094, CFI .892, TLI .868, and SRMR .065). Modification indices suggested that the fit should improve if the errors for *e-auction* and *e-tender* and for *e-sourcing* and *e-catalogue* are allowed to correlate.

E-auction and e-tender e-procurement forms are very similar: both involve the use of sophisticated functionality (normally provided at e-marketplaces) to procure goods or services as inexpensively as possible, and both suggest the absence of strong relationships with suppliers. Therefore, it is quite natural to expect that both would be affected together by factors other than the overall technological sophistication with respect to e-procurement (captured by the breadth of e-procurement use construct). Based on this argument, it was concluded that allowing errors for e-auction and e-tender would capture substantive relationships, rather than reflect the unique features of the data set. Therefore, correlation between errors for e-auction and e-tender was added to the model.

Similarly, e-sourcing and e-catalogue e-procurement forms are related. E-sourcing covers searching for goods and services offered at low enough prices over the Internet, and e-catalogue covers buying goods and services over the Internet, and both rely on commonly available skills and suggest relatively casual approach to procurement. Based on this argument, it was concluded that allowing errors for e-sourcing and e-catalogue would capture substantive relationships, rather than reflect the unique features of the data set. Therefore, correlation between errors for e-sourcing and e-catalogue was added to the model.

The resulting model (the CFA model as given in Figure G-3), enhanced to allow errors for e-auction and e-tender and for e-sourcing and e-catalogue to correlate (see

the formal specification in Mplus language given in Appendix J), did fit the data well (RMSEA .073, CFI .937, TLI .920, and SRMR .059).

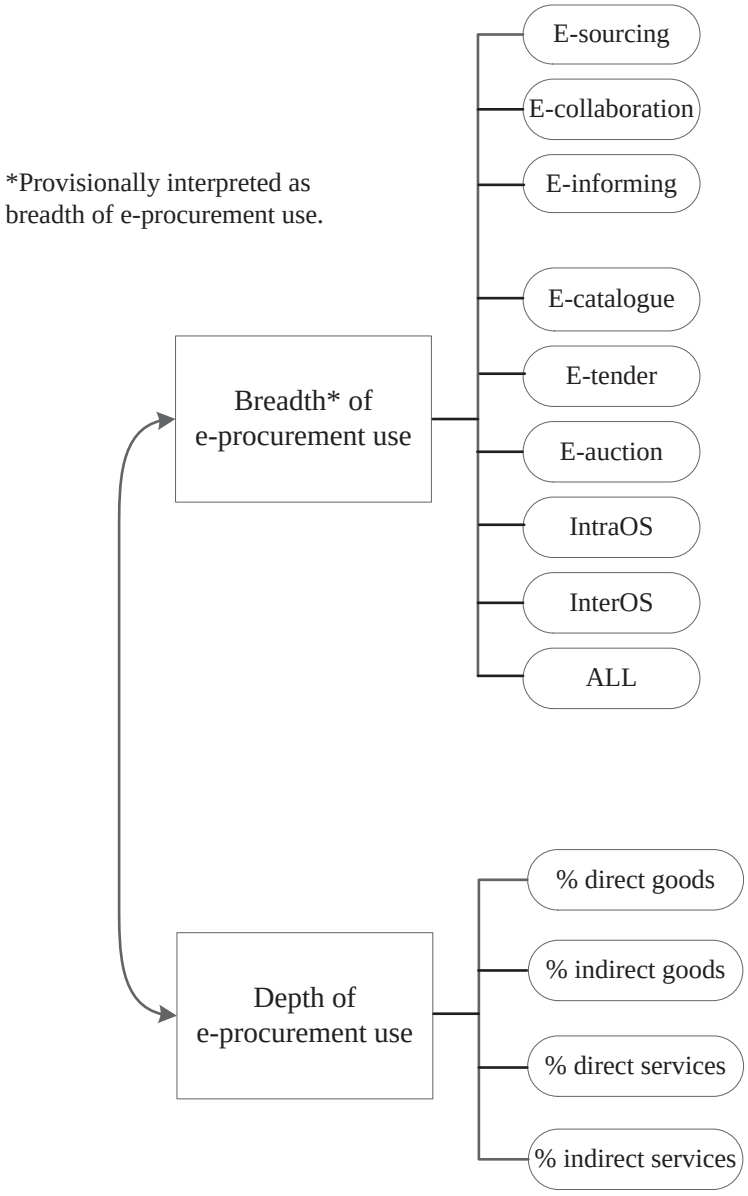

Figure G-3. CFA model.

Factor loadings (listed in Table G-7) were also inspected, and consistently with the results of EFA analysis reported in section G.2.2, factor loadings for e-tender, e-auction, and InterOS were rather low (.403, .358, and .313, respectively). The rest of the factor loadings were above .60 (apart from ALL, which loaded at .564, still quite close to the threshold value of .60; the ALL indicator corresponded to functionalities relevant to all e-procurement forms from the transaction perspective, see section

4.3.6.1). (For a discussion of using .60 as a threshold value for factor loadings, see section 4.3.7.2.) Low factor loadings suggested low convergent validity for the breadth of e-procurement use construct; nonetheless, to retain content validity, and based on the overall fit of the CFA model (and thus, of the measurement model), all indicators were retained for further analysis.

Table G-7 *CFA Factor Loadings*

		Extent of e-procurement use	
Indicator	Description	Breadth[a]	Depth
IISE	E-sourcing	**.655**	
IEC	E-collaboration	**.855**	
IIF	E-informing	**.686**	
TECAT	E-catalogue	**.653**	
TTENDER	E-tender	**.403**	
TEAUCT	E-auction	**.358**	
TINTRA	IntraOS	**.792**	
TINTER	InterOS	**.313**	
TOTALL	ALL	**.564**	
DEPDG	Percentage of direct goods procured electronically		**.710**
DEPIDG	Percentage of indirect goods procured electronically		**.785**
DEPDS	Percentage of direct services procured electronically		**.822**
DEPIDS	Percentage of indirect services procured electronically		**.778**

[a]Provisionally interpreted as breadth of e-procurement use.

Overall, the results of testing the CFA model suggested that breadth of e-procurement use and depth of e-procurement use, operationalised according to the outcome of EFA analysis presented in Table G-7, can be used as latent variables in SEM analysis.

G.2.4 Testing the Structural Model: SEM Analysis

The structural model was similar to the main research model of my study (see Figure 3-1 for the main research model). The model is depicted in Figure G-4 (and the formal specification of the model in Mplus language is given in Appendix K). One important difference was the content of the breadth of e-procurement use (and,

correspondingly, the operationalisation of the construct of breadth of e-procurement use). In the structural model in Figure G-4, the extent of e-procurement use is represented by the two latent variables discovered via EFA analysis in section G.2.2. One of the variables is exactly the same as depth of e-procurement use in Figure 3-1, operationalised as in the main analysis (see Table 4-3 in section 4.3.6.1 for the operationalisation of breadth of e-procurement use in the main analysis).

The breadth of e-procurement use in the model in Figure G-4 is conceptualised and operationalised similarly to the intensity of e-procurement use by Wu et al. (2007) and reflects both the number of functionalities in use and how much particular functionalities are used. Therefore, its content subtly differs from the content of the breadth of e-procurement use construct in the main analysis in section 5.8. Nonetheless, the argument used to justify the hypotheses for the main research model (presented in Chapter 3) still applies (with the breadth of e-procurement use in the model in Figure G-4 having content similar to breadth of e-procurement use in the main analysis, but also incorporating some of the content of depth of e-procurement use). Therefore, the hypotheses for factors affecting breadth and depth of e-procurement use in the model in Figure G-4 remain the same as in the main research model.

Arches connecting indicators of breadth in the model in Figure G-4 denote correlations between errors, added based on the CFA model analysis presented in section G.2.3.

If the independent variables were operationalised as latent variables, the models would be too big to be analysed using covariance-based SEM. Therefore, the model was simplified by treating independent variables as manifest variables, with values estimated by adding up the scales of the items used to measure them. The resulting model was small enough to be analysed by covariance-based SEM (the same calculation applies as discussed for the CFA model in section G.2.3).

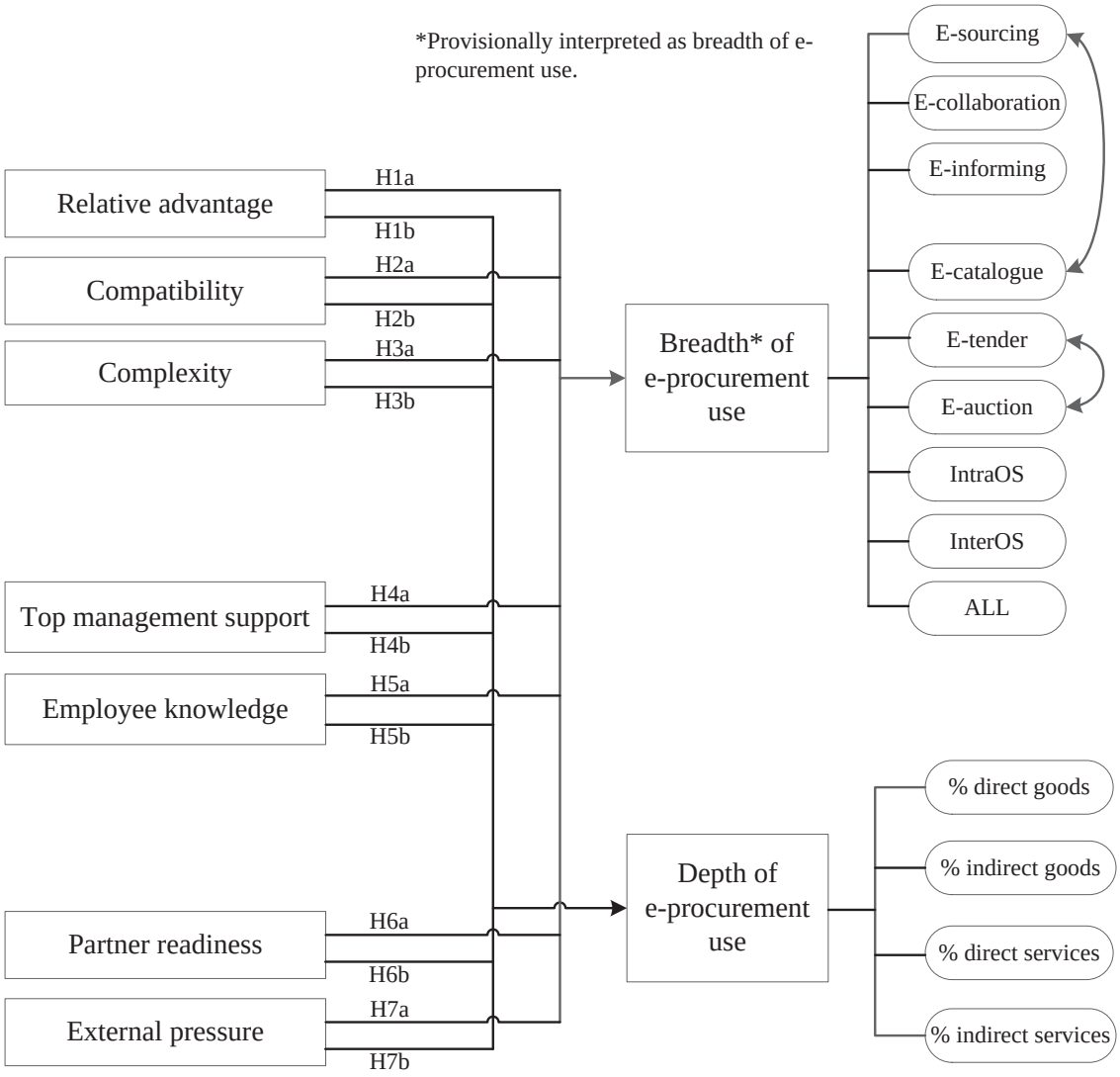

Figure G-4. Structural model.

The model fitted the data well (RMSEA .057, CFI .926, TLI .910, and SRMR .053). The normed chi-square was 1.48, below the threshold of 3 suggested by Hair et al. (2010).

The results of structural model testing are summarised and compared with the results of the main analysis in Table G-8. In terms of levels of statistical significance and effect sizes, with one important exception: although the hypothesis H2a (compatibility → breadth of e-procurement use) was not confirmed in the main analysis, it was confirmed for the model in Figure G-4. The construct of breadth of e-procurement use in the model in Figure G-4 had somewhat different content from the construct of breadth of e-procurement use in the main research model; the content of

the construct incorporated some of the content of the depth of e-procurement use construct. Compatibility was found to affect depth of e-procurement use (in both of the analyses); therefore, it is not entirely surprising that it affected breadth of e-procurement use when breadth is conceptualised and operationalised to include some of the content of depth of e-procurement use. As seen in Table G-8, the rest of the hypotheses confirmed in covariance-based SEM analysis of the model in Figure G-4 matched the hypotheses confirmed in the main analysis, with the values of path coefficients very similar.

Table G-8 *Outcomes of Hypotheses Testing: Covariance-Based SEM*

		Analysis using covariance-based SEM		Main analysis	
	Hypothesis	β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.24	.022	.26	.024
H1b	Relative advantage → Depth	.14	.266	.11	.344
H2a	Compatibility → Breadth	.30	.020	.16	.314
H2b	Compatibility → Depth	.38	.011	.33	.024
H3a	Complexity → Breadth	.03	.754	.00	.988
H3b	Complexity → Depth	.04	.719	.08	.425
Organisation					
H4a	Top management support → Breadth	-.08	.519	-.13	.322
H4b	Top management support → Depth	.09	.535	.04	.728
H5a	Employee knowledge → Breadth	.01	.935	.08	.325
H5b	Employee knowledge → Depth	-.06	.599	.05	.593
Environment					
H6a	Partner readiness → Breadth	-.04	.598	-.07	.342
H6b	Partner readiness → Depth	.10	.215	.06	.433
H7a	External pressure → Breadth	.36	<.001	.37	<.001
H7b	External pressure → Depth	-.05	.681	.01	.918

Note. Conceptualisations and operationalisations of breadth of e-procurement use subtly differed between the two analyses; see the in-depth discussion in section G.2.3.

G.2.5 Alternative Test of the Structural Model: PLS Analysis

To confirm that the discrepancies between the results of the model in Figure G-4 using covariance-based SEM analysis and of the main analysis were not purely because of the use of different SEM techniques, the model in Figure G-4 (with constructs operationalised the same as in covariance-based SEM analysis reported in section G.2.4) was also tested using PLS SEM. The same procedure as in the main analysis was used, which resulted in removing the e-tender, e-auction, and InterOS indicators of breadth to meet the convergent validity criteria. The updated measurement model met all of the convergent and discriminant validity criteria.

Table G-9 *Outcomes of Hypotheses Testing: PLS Analysis for the Model in Figure G-4*

		Analysis using PLS		Main analysis	
	Hypothesis	β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.21	.028	.26	.024
H1b	Relative advantage → Depth	.11	.323	.11	.344
H2a	Compatibility → Breadth	.29	.024	.16	.314
H2b	Compatibility → Depth	.37	.004	.33	.024
H3a	Complexity → Breadth	.03	.727	.00	.988
H3b	Complexity → Depth	.03	.772	.08	.425
Organisation					
H4a	Top management support → Breadth	-.10	.418	-.13	.322
H4b	Top management support → Depth	.10	.416	.04	.728
H5a	Employee knowledge → Breadth	.01	.870	.08	.325
H5b	Employee knowledge → Depth	-.06	.492	.05	.593
Environment					
H6a	Partner readiness → Breadth	-.04	.441	-.07	.342
H6b	Partner readiness → Depth	.09	.176	.06	.433
H7a	External pressure → Breadth	.36	<.001	.37	<.001
H7b	External pressure → Depth	-.03	.753	.01	.918

The results were highly consistent with the results of covariance-based SEM analysis presented in section G.2.4; in particular, unlike in the main analysis, compatibility was found to affect breadth (see Table G-9 for details). The results of the PLS analysis of the model in Figure G-4 suggest that the discrepancy with the results of the main analysis was not because of the use of different SEM techniques.

G.3 Analysis Using Linear Regression

To further explore the robustness of the results of the main analysis, analysis using linear regression was also conducted (SPSS, version 18, was used). Mean replacement was used for missing values.

Linear regression does not allow to model latent constructs explicitly and does not allow to assess the quality of the measurement model. Therefore, only the results for the structural model could be compared. Constructs were treated as linear regression variables, operationalised by adding up the item scores. The breadth of e-procurement use was operationalised the same as in the main analysis.

The results (summarised in Table G-10) were very similar to the results of the main analysis. In particular, in terms of levels of statistical significance and effect sizes, the results were consistent with the results of the main analysis presented in section 5.8.2.1.

Table G-10 *Outcomes of Hypotheses Testing: Linear Regression*

	Hypothesis	Analysis using linear regression		Main analysis	
		β	*p* value	β	*p* value
Technology					
H1a	Relative advantage → Breadth	.24	.027	.26	.024
H1b	Relative advantage → Depth	.12	.290	.11	.344
H2a	Compatibility → Breadth	.21	.107	.16	.314
H2b	Compatibility → Depth	.37	.009	.33	.024
H3a	Complexity → Breadth	.02	.824	.00	.988
H3b	Complexity → Depth	.08	.435	.08	.425
Organisation					
H4a	Top management support → Breadth	-.14	.285	-.13	.322
H4b	Top management support → Depth	.04	.767	.04	.728
H5a	Employee knowledge → Breadth	.03	.742	.08	.325
H5b	Employee knowledge → Depth	.01	.908	.05	.593
Environment					
H6a	Partner readiness → Breadth	-.06	.406	-.07	.342
H6b	Partner readiness → Depth	.05	.480	.06	.433
H7a	External pressure → Breadth	.37	<.001	.37	<.001
H7b	External pressure → Depth	-.01	.969	.01	.918

G.4 Discussion of Post-Hoc Analyses Results

All of the post-hoc analyses conducted supported the main conclusions of the main analysis, that relative advantage and external pressure affect breadth of e-procurement use and that compatibility affects depth of e-procurement use, and that factors affecting breadth are not the same as factors affecting depth.

For hypothesis H2a (compatibility → breadth), the results were inconsistent. Overall, to achieve greater certainty for the hypotheses that were not confirmed, further research involving considerably larger data sets and improved operationalisations of constructs is desirable (but, in view of the costs of data collection, not necessarily feasible).

Appendix H Mplus Source Code for Exploratory Factor Analysis Described in Section 5.6

```
DATA:
    FILE IS BreadthDepth.csv;

VARIABLE:
    NAMES ARE InfoISE, InfoEC, InfoIF, TranEcat, Trantder,
    TranAuct, TranItra, TranIter;

    USEVARIABLES InfoISE, InfoEC, InfoIF, TranEcat, Trantder,
    TranAuct, TranItra, TranIter;

ANALYSIS:
    TYPE = EFA 2 2;
```

Appendix I Mplus Source Code for Exploratory Factor Analysis of the Indicators of Extent of E-Procurement Use

```
DATA:
    FILE IS BreadthDepth.csv;

VARIABLE:
    NAMES ARE IISE, IEC, IIF, TEcat, Ttender,
     TEauct, Tintra, Tinter, TotALL,
     DepDG, DepIDG, DepDS, DepIDS;

    USEVARIABLES IISE, IEC, IIF, TEcat, Ttender,
    TEauct, Tintra, Tinter, TotALL,
    DepDG, DepIDG, DepDS, DepIDS;

ANALYSIS:
    TYPE = EFA 2 2;

OUTPUT:
    STANDARDIZED MODINDICES;
```

Appendix J Mplus Source Code for Confirmatory Factor Analysis Corresponding to the Model in Figure G-3

```
DATA:
    FILE IS BreadthDepth.csv;

VARIABLE:
    NAMES ARE IISE, IEC, IIF, TEcat, Ttender,
    TEauct, Tintra, Tinter, TotALL,
    DepDG, DepIDG, DepDS, DepIDS;

    USEVARIABLES IISE, IEC, IIF, TEcat, Ttender,
    TEauct, Tintra, Tinter, TotALL,
    DepDG, DepIDG, DepDS, DepIDS;

MODEL:
    Breadth BY IISE, IEC, IIF, TEcat, Ttender, TEauct,
    Tintra, Tinter, TotALL;
    Depth BY DepDG, DepIDG, DepDS, DepIDS;

    TEauct WITH Ttender;
    TEcat WITH IISE;

OUTPUT:
    STANDARDIZED MODINDICES;
```

Appendix K Mplus Source Code for Covariance-Based SEM Analysis Corresponding to the Model in Figure G-4

```
DATA:
    FILE IS AllVariables.csv;

VARIABLE:
    NAMES ARE IISE, IEC, IIF, TEcat, Ttender,
    TEauct, Tintra, Tinter, TotALL,
    DepDG, DepIDG, DepDS, DepIDS,
    TotRA, TotCMP, TotCPX, TotTMS, TotEK,
    TotPR, TotEP;

    USEVARIABLES IISE, IEC, IIF, TEcat,
    Ttender, TEauct,
    Tintra, Tinter, TotALL,
    DepDG, DepIDG, DepDS, DepIDS,
    TotRA, TotCMP, TotCPX, TotTMS, TotEK,
    TotPR, TotEP;

MODEL:
    Breadth BY IISE, IEC, IIF, TEcat, Ttender, TEauct,
      Tintra, Tinter, TotALL;
    Depth BY DepDG, DepIDG, DepDS, DepIDS;

    TEauct WITH Ttender;
    TEcat WITH IISE;

    Breadth ON TotRA, TotCMP, TotCPX, TotTMS, TotEK,
      TotPR, TotEP;
    Depth ON TotRA, TotCMP, TotCPX, TotTMS, TotEK,
      TotPR, TotEP;

OUTPUT:
    STANDARDIZED MODINDICES;
```