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Entitled

A Study of eProcurement Technologies, Procurement Practices, Procurement Performance and their Relationship

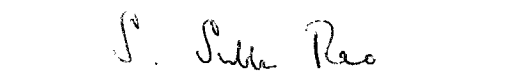
By

Gioconda Quesada

Submitted as partial fulfillment of the requirements for

The Doctor of Philosophy Degree in

Manufacturing Management and Engineering



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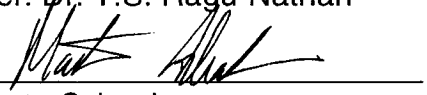

Graduate School

The University of Toledo

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An Abstract of

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Supply chain management involves all approaches used to efficiently integrate all participants of a supply chain so that products/services are delivered to the customer in the right quantities, to the right location, at the right time, and at optimal cost. Advances in information systems technology have had a huge impact on the evolution of supply chain management (Lee and Whang, 2000). As a result of such technological advances as e-Commerce, supply chain partners in a B2B environment can now work in tight coordination to optimize the chain-wide performance, and the realized return may be shared among the partners to improve individual firm performance. Eprocurement has shown to be the start point for many companies' overall e-Commerce strategy, since procurement is a

critical link between members of the supply chain (Novack and Simco, 1991). Procurement and supply chain management practices provide the single greatest opportunity to control costs, manage quality and improve responsiveness (Berger and Gattorna, 2001).

The researcher developed valid and reliable measures for procurement practices, eprocurement technology usage and procurement performance. The instrument development process included interviews, a pre-test and a large-scale survey. The large-scale survey yielded to a response rate of 14% from ISM members. Rigorous statistical methods were used to assess and validate constructs using structural equation modeling.

The theoretical implications of the research findings include supporting the hypotheses that higher procurement practices lead to higher levels of procurement performance; higher levels of eprocurement technology usage achieve higher procurement practices and higher procurement performance, higher procurement performance positively impacts supply chain performance and finally, supply chain performance have a positive impact on firm performance. The findings did not support the hypothesis of eprocurement technology usage as a moderator variable in the relationship between procurement practices and procurement performance. The data did not support the hypothesis that procurement performance directly affects firm performance.

The results from this study have several implications for practitioners. First, it helps understanding the procurement process and its relationship with eprocurement technology usage. It showed that eprocurement facilitates the

development of operational tasks in the procurement area. Second, the research provides valid and reliable measures for benchmarking in procurement. Third, the fact that procurement performance impacts indirectly firm performance by means of procurement perception of supply chain performance is a motivational factor for firms to work with their supply chains, instead of just working for increasing their own performance. Guidelines for future research include refinement of the procurement practices construct by adding the strategic view, when organizations have experienced higher levels of eprocurement technology usage.

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This dissertation would not be possible without the guidance and support from God and The Virgin Mary. Our visits to Her sanctuaries in Cartago, Fatima and Lourdes impacted me and gave me strength in this journey.

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It would be impossible to achieve this dream without the love and support from my family. My husband, best friend and co-worker, Marvin, and my wonderful daughter, Pamela, had to drive with me through difficult paths of sacrifice and dedication. Without them, it would have been unfeasible to achieve this meaningful goal of my life. We keep growing together full of love and understanding! Two extraordinary supporters, teachers, and guides throughout my life are my parents, Federico and Libia. Nothing would have been possible without their love and sacrifices. They are the best parents God could have ever given me and my sisters. I have learned from them how to be a believer, a hard worker, an independent person and a goal seeker. I followed and keep following their examples and my dream is that my daughter gets to love me as much as I love my parents, which I consider the best sign of excellent parenthood. I don't forget my sisters, who are with me all the time. Their uniqueness makes them so special in each of their ways. I can't imagine my life without their company. Vanessa and Adriana are an essential part of my life and I always thank God for having them as my sisters. My love to my wonderful niece Francesca and my newborn nephew Federico! Thank you God for all your love!

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1. Introduction

Information technology in the current decade is showing dramatic changes on the way firms are doing business. Small, medium and large firms can not ignore the impact of information networks into their strategies, operations and performance results (Pollalis, 2003). Scholars along with practitioners are continuously developing philosophies and tools to overcome the possible risks of this rapid changing environment. A few decades ago, total quality management arose as a philosophy that proposed the integration of functional areas in the organization for a common goal: the customer satisfaction (Quesada, Rao et al., 1999). Firms started to think about their suppliers as more strategic alliances and they started to involve suppliers into their firms (Ellram and Carr, 1994). Just a few years ago, both academic and practitioner communities were shifting paradigms with supply chain management that dealt not only with the organization as a firm itself, but with the network of suppliers and customers as a whole supply chain (Choon Tan, Lyman et al., 2002; Harland, 1996; Leenders, Nollet et al., 1994). This kind of integration can only be accomplished by different technologies available for firms to use (New, 1996). The importance of studies that will help understand the eprocurement process is supported by recent statistics saying that B2B electronic commerce will be $7.29 trillion by the end of 2004 (study by GernterGroup's e-Business Intelligence Services, Brunelli, 2000a). The global

management consulting firm A.T. Kearney (Plano, 2002) shows an empirical study in which companies reported savings 13 times greater than their investments in eprocurement technologies, and also, global 500 companies could save $330 billion annually by capturing eprocurement's full potential. Moozakis, 2001 show projected sales for software in different enterprise applications categories, and eprocurement gets priority (53%), followed by CRM (41%), SCM (31%) and ERP (8%).

Organizations need to create value to the end customer (Porter, 1980) by exceeding their expectations in terms of quality, time, cost, flexibility and functionality in both products and services (Gonzalez, Quesada, Mueller et al., 2004). In this study, the researcher focuses on the supply side of the supply chain since the quality of a final product or service can only be as good as the quality of the inputs they receive from suppliers (Forker, 1997). Despite the attention paid to eprocurement, there is a lack of literature regarding the measurement of the impact of eprocurement technologies on the relationship between procurement practices and procurement performance. This study addresses how emerging network technologies will affect the procurement function and then, it will analyze its impact on supply chain and firm performance.

After supply chain management principles have enforced the change of procurement from a separate strategy to integrating procurement into corporate strategy (Ellram and Carr, 1994), procurement managers have struggled in developing better ways to not only improve their procurement performance, but

to improve their firm's performance by means of improving the supply chain performance.

This strategic change has come along with a new set of technologies that are forcing firms to be agile and fast while keeping their costs down. The importance of B2B e-commerce in any industry is no doubt significant. All these changes and challenges that firms and supply chains are facing have motivated the researcher to analyze the effect of eprocurement technologies usage on procurement practices to improve procurement performance. The researcher defines eprocurement as the usage of information networks to connect buyers with suppliers to facilitate the procurement of goods and services focusing on business-to-business transactions. A theoretical model is developed and resulting hypotheses will be tested empirically.

1.1. Problem Statement

Recently, scholars and practitioners are giving considerable attention to the impact of information technologies and information systems on procurement practices (Kocabasoglu, 2002b). Recognizing the challenges and risks resulting from the implementation of these technologies, firms are asking the following question: What is the effect of these technologies in the relationship between procurement practices and procurement performance and its final impact on supply chain performance? The current study attempts to answer this question through a large-scale empirical study that investigates the different procurement practices and performance (both procurement and supply chain performance) when dealing with eprocurement technologies.

In this study the researcher conceptualizes the term eprocurement technologies usage to the extend of usage of electronic network technologies and practices (i.e. interorganizational systems such as EDI or, even beyond that, internet which could provide e-marketplaces, e-auctions, etc.) that facilitate electronic communication, information exchange and transaction support through either public or private networks (Min and Galle, 1999). Previous literature have used the term eprocurement for the use of internet on procurement tasks (Davila, Gupta et al., 2003a; Group, 2001; Presutti, 2003). However, in this study, the researcher also includes in eprocurement technologies private or public networks that could be designed for specific firms (like EDI, and other interorganizational systems).

The mistaken emphasis on internet only could lead academicians and practitioners to narrow their understanding of the capabilities, benefits and limitations of eprocurement, which is not internet procurement, but electronic procurement (Neef, 2001). Other researchers have cleared this misunderstanding by naming web-based B2B procurement to specific procurement activities done through the internet (Candrasekar and Shaw, 2002, Lindskog and Wennberg, 2002). It is undoubtful the fact that the internet provides a solution to firms that wanted to start eprocurement but did not have enough resources available for adopting information technologies such as EDI that were financially infeasible. The Boston-based Aberdeen Group said some of the benefits companies have recognized through the use of eprocurement technologies include 73% reduction in transaction costs, 70 to 80% reduction in

purchase order processing cycles, and 5 to 10% reduction in prices paid; an average mid-sized organization would save almost $2 million per year through eprocurement technologies. Due to the great impact of eprocurement on business and supply chain performance, it is the purpose of the researcher to provide a broad understanding of the impact of all kinds of electronic technologies (public or private networks) that facilitate the procurement practices, namely information gathering, supplier contact, requisitioning, contracting and intelligence/analysis between organizations (Berger and Gattorna, 2001). The researcher decided to focus on B2B since B2B sales are predicted to be $2.7 trillion in 2004 (Blackmon, 2000) and B2B activities are expected to be six times as large as B2C activities (Cohn, Brady et al., 2000).

1.2. Research Objectives and Contributions

This study is aimed at advancing procurement and information technology literature, by providing answers to the following questions:

1. What is the impact of eprocurement technologies usage on the relationship between procurement practices and procurement performance?
2. What is the impact of procurement performance on procurement perception of supply chain performance?
3. What is the impact of procurement perception of supply chain performance on firm performance?
4. What is the impact of procurement performance on firm performance?

In order to provide answers to these research questions, a theoretical framework of the relationships mentioned is developed and empirically assessed. However,

to correctly test these relationships, the researcher needs valid and reliable measurement instruments for the constructs in study. Therefore, the researcher will adapt and modify previous validated constructs in the literature when possible, and develop valid and reliable measurement instruments for the constructs that have not been validated in literature, namely: eprocurement technology usage, procurement practices and procurement performance.

The contribution for practitioners is to provide important guidelines for firms using or planning to use eprocurement technologies and to show them the impact on procurement and supply chain performance (measured as procurement perception), and finally on firm performance. The measurement instruments developed in this study should be a valuable tool for firms to evaluate and compare their current practices.

1.3. Dissertation Structure

The dissertation is organized as follows. Chapter 2 provides the theoretical foundation for the study. In this section, conceptual and empirical research literature on procurement practices, eprocurement technologies, procurement performance, procurement perception of supply chain performance and firm performance is reviewed. Based on the extensive literature review, the theoretical model is presented and the research hypotheses are stated.

Chapter 3 covers the early stages of the empirical study such as the instrument development and identification of research sample. The researcher shows the results of the Q-Sort and prepare the final items for the large scale instrument.

Chapter 4 contains the large scale study results. The measurement models are evaluated by assessing the validity and reliability of the instrument in the empirical study.

Chapter 5 focuses on the structural equation model analyzed through hypothesis testing. The chapter concludes with a discussion of the structural equation model and hypotheses testing results.

Chapter 6 shows dimension-level analyses for deeply understanding individual effects of different eprocurement technologies on different dimensions of procurement practices and procurement performance.

Implications, future research guidelines and conclusions reached through the empirical study are discussed in Chapter 7.

2. Literature Review and Hypotheses

This study addresses how emerging network technologies affect the procurement function. After providing an overview of procurement literature, the researcher reviews previous conceptual and empirical work on B2B eprocurement technology, procurement performance, procurement perception of supply chain performance and firm performance.

Leenders, Fearon et al., 2002 briefly summarize the history of procurement since the late 1800s in which it was important to use procurement as a clerical function. They describe how the procurement trained people started to increase during the 1950s and 1960s. Ellram and Carr, 1994 present an important contribution on the development of procurement in the literature. They describe the early 1970s as a more administrative role of procurement as stated by Ammer, 1974. Later, Porter, 1980 initiates the shift from an administrative to a strategic function of procurement within the firm. He proposed the five forces model that includes supplier and buyer power as two critical forces for competitiveness. This is the beginning of the explosion of procurement as an important function in the business environment. In the 1990s there is a great shift in perceived importance of procurement for the organizations. It switched from a merely

process for buying goods and services for a firm, to being defined as all activities necessary to acquire goods and services that achieve user requirements (Novack and Simco, 1991). The definition of procurement practices has not been the only unclear issue in the literature. Previous literature have focused on different planning and strategic aspects of procurement (Ellram and Carr, 1994), rather than operational aspects.

Rink and Fox, 1999 classified the procurement literature by using the same taxonomy they used to categorize the procurement practices: (1) environment (including personnel and leadership, procurement planning/policies/organization, strategic procurement planning, professionalism in procurement, legal aspects of procurement, ethical aspects of procurement, industrial buyer behavior), (2) planning (from identification of the need to evaluation of supplier base), (3) implementation (selecting a supplier and delivering product/service) and (4) control (post-purchase activities and performance evaluations). Ellram and Carr, 1994 classify the literature in three categories: (1) strategies that the procurement function may pursue, (2) procurement's role in supporting the strategy of the firm and (3) the evolution of the procurement function to a strategic level.

In this section, the researcher creates a simple taxonomy that supported the development of the research framework presented in Figure 1. The research framework depicts the relationship among procurement practices, eprocurement technology usage, procurement performance, procurement perception of supply chain performance and firm performance. eProcurement technology usage is

presented as a moderating variable that influences the strength of the relationship between procurement practices and procurement performance. Procurement performance, in turn, influences both procurement perception of supply chain performance and firm performance. Finally, procurement perception of supply chain performance impacts firm performance. This theoretical framework will help practitioners and academicians in understanding eprocurement technology usage, procurement practices and performance and their relationship; it also lays a foundation for future research.

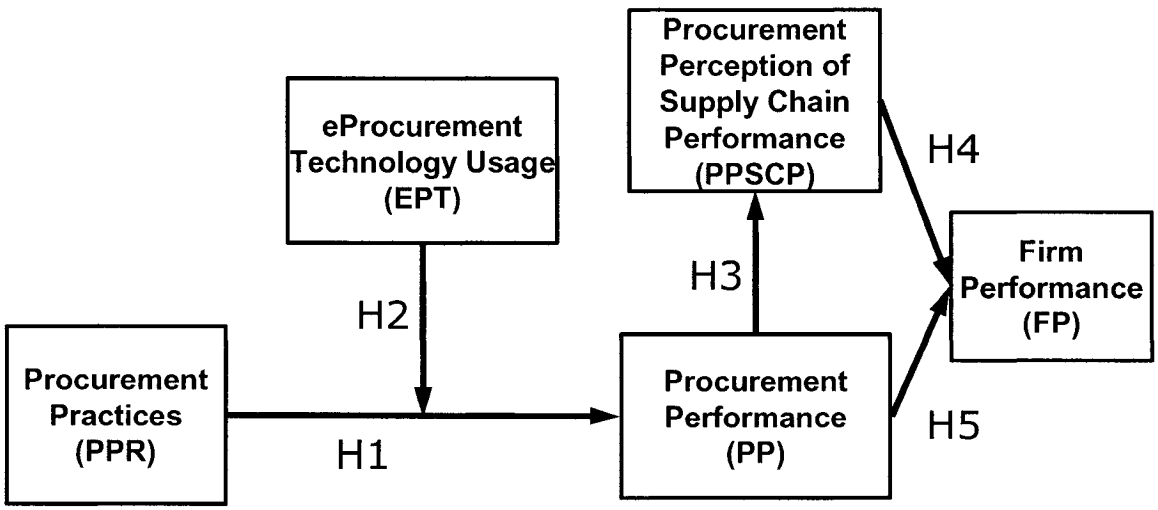


Figure 1. Research Framework

As an initial step before developing the research framework, the researcher classified the procurement literature into seven research streams: (1) time-based procurement, (2) procurement role within the firm, (3) international procurement, (4) procurement management (supplier involvement/development, supplier selection, strategic sourcing, supplier partnering/relationships), (5) procurement performance, (6) eprocurement and (7) procurement practices (information

gathering, supplier contact, contracting, requisitioning and intelligence/analysis). A summary of the literature for each of the first four streams is shown in Table 1 and a summary of the literature for the last three streams is shown in Table 2.

STREAM 1. TIME-BASED PROCUREMENT
Aull-hyde, Gempesaw II et al., 1994, Billesbach, Harrison et al., 1991, Chang and Lee, 1996, Del Grande and Satir, 1994, Fawcett and Birou, 1992, Garg and Deshmukh, 1999, Garg and Deshmukh, 1999, Giunipero, 1990, Golhar and Stamm, 1993, Golhar, Stamm et al., 1993, Gonzales-Benito and Suarez-Gonzales, 2000, Gonzalez-Benito, 2002, Hum and Ng, 1995, Lawrence and Lewis, 1996, Lee and Ansari, 1985, Srinivasan and Kekre, 1994, Vonderembse and Tracey, 1995, Waters-Fuller, 1995, Waters-Fuller, 1996, De Toni and Nassimbeni, 2000
STREAM 2. PROCUREMENT ROLE WITHIN THE FIRM
Aull-hyde, Gempesaw II et al., 1994, Bowen, Cousins et al., 2001, Caddick and Dale, 1987, Cammish and Keough, 1991, Carter and Narasimhan, 1996b, Corey, 1978, Das and Narasimhan, 2000, Ellram and Carr, 1994, Ellram and Pearson, 1993, Ferguson and Hartley, 1996, Freeman and Cavinato, 1990, Narasimhan and Das, 1999, Narasimhan and Das, 2000, Narasimhan and Das, 2001, Pearson and Ellram, 1996, Pearson and Gritzmacher, 1990, Pooley and SDunn, 1994, Porter, 1980, Stock, 2001, Stock and Luhrsen, 1993, Sutton, 1989, Sweetman, 1996, Tracey, 1996
STREAM 3. INTERNATIONAL PROCUREMENT
Bozarth, Handfield et al., 1998, Carter and Narasimhan, 1990, Herbig and O'Hara, 1996, Motwani and Ahuja, 2000, Narasimhan and Carter, 1990, Waters-Fuller, 1996, Zhang, Quesada et al., 2000, Robertson, Gibson et al., 2002, Kohn, 1993
STREAM 4. PROCUREMENT MANAGEMENT
Supplier Involvement/Development: Brown and Eisenhardt, 1995; Primo and Amundson, 2002; Clark, 1989; Hartley, Zirger et al., 1997; Clark and Fujimoto, 1991; Ragatz, Handfield et al., 1997; Wasti and Liker, 1997; Liker, Kamath et al., 1996; Cusumano and Takeishi, 1991; Maylor, 1997, Moody, 1992, **Supplier Selection:** Ellram, 1990, Leenders, Fearon et al., 2002, Pearson and Ellram, 1995, Pearson and Ellram, 1995, Gonzalez, Quesada and Mora, 2004, Lee, Ha et al., 2001 **Strategic Sourcing:** Burt, 1989, Cammish and Keough, 1991, Carr and Smeltzer, 1999, Carter and Narasimhan, 1996b, Carter and Narasimhan, 1996a, Carter and Narasimhan, 1996b, Ellram and Carr, 1994, Kocabasoglu, 2002a, Narasimhan and Das, 1999, Rajagopal and Bernard, 1993b, Rajagopal and Bernard, 1993a, Scannell, Vickery et al., 2000 **Supplier Partnering/Relationships:** Archer and Yuan, 2000, Blancero and Ellram, 1997, Carr and Pearson, 1999, Carr and Smeltzer, 2002, Cherrett, 1994, Ellram, 1991, Ellram, 1995, Ellram and Edis, 1996, Ellram and Hendrick, 1995, Kalwani and Narayandas, 1995, Laseter, 1998, Noordewier and Johnson, 1990, Olsen and Ellram, 1997, Scannell, Vickery et al., 2000, Smith and Ross, 1997, Thomas, Zhaohui et al., 2002, Zsidisin and Ellram, 2001

Table 1. Research Streams in Procurement Literature (Part I)

STREAM 5. PROCUREMENT PERFORMANCE
Ammer, 1961, Artz, 1999, Billesbach, Harrison et al., 1991, Bussard, 1966, Buvik and John, 2000, Carter and Narasimhan, 1996a, Cavinato, 1987, Chao and Scheuing, 1993, Cohen, 1998, Croell, 1977, Dion and Banting, 1987, Dobson and Shorrock, 1980, Dumond, 1991, Easton, Murphy et al., 2002, Gee, 1976, Giunipero, 1990, Harrington and Lambert, 1991, Hult, M. et al., 1998, Janda and Seshadri, 2001, Kennedy, 1967, Kudrna, 1972, Lenartowicz and Roth, 2001, Lewis, 1936, McCampbell and Slaich, 1995, Mendlesson, 1969, Monczka and Carter, 1978, Moody, 1992, Murphy, Pearson et al., 1996, Ng and Ferrin, 1997, Noordewier and Johnson, 1990, Pooler, 1973, Pooley and SDunn, 1994, Stanley, 1993, Tisone, 1969, Van Weewlw, 1984, Young and Varble, 1997
STREAM 6. ePROCUREMENT
Ageshin, 2001, Allard and Holsapple, 2002, Alt and Fleisch, 2000, Atkinson, 2001, Attaran, 2001, Attaran and Attaran, 2002, Bakos, 1991, Bakos, 1997, Banerjee and Sriram, 1995, Bannan, 2003, Baumgartner, Kajuter et al., 2001, Bichler and Segev, 2001, Blackmon, 2000, Brunelli, 2000b, Candrasekar and Shaw, 2002, Carr and Smeltzer, 2002, Chang-tseh, Y. et al., 2002, Chircu and Kauffman, 2001, Chou, 2001, Cleveland, 2001, Cohn, Brady et al., 2000, Davila, Gupta et al., 2003a, Eyholzer and Hunziker, 2000, Feeny, 2001, Ferguson, 2001, Group, 2001, Holsapple and Singh, 2000, Kennedy and Deeter-Schmelz, 2001, Kocabasoglu, 2002a, Laseter, 1998, Lee and Clark, 1996, Lee and Clark, 1999, Levary and Mathieu, 2000, Lin and Chang-tseh, 2000, Lindskog and Wennberg, 2002, Massetti and Zmud, 1996, Mathews, Mosconi et al., 2001, Meehan, 2001, Min and Galle, 1999, Min and Galle, 2001, Min and Galle, 2003, Moozakis, 2001, Morrison, 2000, Neef, 2001, Orr, 2002, Peleg, 2001, Plano, 2002, Presutti, 2003, Rabinovich, 2001, Ramdeen, 2001, Ramsdell, 2000, Rogers, 2002, Ruzicka, 2000, Schoch, 1998, Sprano and Zakak, 2000, Srinivasan and Kekre, 1994, Subramaniam and Shaw, 2002, Weil, 2000, Weil, 2001
STREAM 7. PROCUREMENT PRACTICES
Information Gathering Alt and Fleisch, 2000, Archer and Yuan, 2000; Burt, 1989, Baldwin and Orr, 1997, Carr and Smeltzer, 2002, Cavinato, 1991, Gonzalez and Medrano, 2002, Herberling, 1993, Kennedy and Deeter-Schmelz, 2001, Keough, 1993, Kong and Li, 2001, Leenders, Fearon et al., 2002, Novack and Simco, 1991, Rajagopal and Bernard, 1993b, Segev, 2001, Subramaniam and Shaw, 2002, Sutton, 1989 **Supplier Contact** Archer and Yuan, 2000, Cammish and Keough, 1991, Gonzalez and Medrano, 2002, Keough, 1993, Kong and Li, 2001, Leenders, Fearon et al., 2002, Missouri, 2001, Segev, 2001, Subramaniam and Shaw, 2002 **Contracting, Requisitioning and Intelligence/Analysis** Alt and Fleisch, 2000, Archer and Yuan, 2000, Baldwin and Orr, 1997, Berger and Gattorna, 2001, Burt, 1989,Cammish and Keough, 1991, Carr and Smeltzer, 2002, Cavinato, 1991, Ellram and Siferd, 1993, Gonzalez and Medrano, 2002, Herberling, 1993, Kennedy and Deeter-Schmelz, 2001, Kong and Li, 2001, Laios and Xideas, 1994, Laseter, 1998, Leenders, Fearon et al., 2002, Lindskog and Wennberg, 2002, Min and Galle, 2001, Missouri, 2001, Neef, 2001, Novack and Simco, 1991, PopulationReports, 2002, Rajagopal and Bernard, 1993b, Segev, 2001, Subramaniam and Shaw, 2002, Sutton, 1989

Table 2. Research Streams in Procurement Literature (Part II)

2.1. Time-Based Procurement

Time-to-market, reliability and on-time delivery are indicators of performance that have achieved greater importance with the new competitive and ever changing environment. JIT procurement helps firms to achieve these goals while keeping their costs down. Previous literature approach JIT procurement from many different perspectives. As stated by Gonzalez-Benito, 2002, some authors focus on JIT as a delivery control system, others take a broader perspective and focus on identifying characteristics of JIT procurement and finally, some other authors think of JIT procurement as the consequence of some basic principles promoting cooperation, benefit and risk sharing between purchasers and suppliers.

The logistics discipline started with analysis of cost tradeoffs between manufacturing, storing and transporting raw materials, component parts and finished goods; but it has evolved to include behavioral dimensions including customer satisfaction, integration collaboration, partnerships and the development of logistics personnel (Keller, Savitskie et al., 2002). Novack, Rinehart et al., 1993 argue the importance of integrating manufacturing operations, transportation, procurement and warehousing for achieving improvements in the buying, movement, storage and transformation of materials and products along the supply chain.

2.2. Procurement Role within the Firm

Procurement is not only an operational function within the firm; it has become a strategic source for firms to compete. Most corporations spend between 50 to 80 percent of sales on outside goods and services (Cammish and Keough, 1991).

Burt, 1984 in the early eighties proposed a well-accepted model that place procurement in the center of the strategic design for achieving high customer satisfaction. In this model, procurement is directly related to production planning and inventory control, engineering, quality assurance and operations, and indirectly related to marketing that will be the direct connection with the customer. Firms need to strategically acquire the materials and services that will enhance their ability to achieve high quality levels, fast delivery and cost savings for the ultimate goal: exceeding customer requirements (Carr and Pearson, 2002). The objective of procurement as a strategic function is to support the organization's activities to achieve its long term goals (Ellram and Carr, 1994). Procurement can be defined as a strategic function if it has an integrative active role in the organization's strategic planning process (Ammer, 1989). Research in this stream focus on achieving the strategic definition of procurement by evaluating best procurement strategic practices that achieve higher performance standards.

2.3. International Procurement

Internationalization of the marketplace, global competition, and changes in the business environment have contributed to the increase in international procurement (Carter and Narasimhan, 1990). The value of using international procurement is increasing along with the importance of the overall organizational function of procurement. According to Robertson, Gibson et al., 2002 researchers are focusing on management of strategic logistical process linkages within the supply chain as means of achieving sustainable competitive advantage that is difficult for competitors to emulate. The emergence of supply chain

management is forcing firms to go global not only in their marketing and sales efforts but also in their supply and production efforts. International procurement can provide several cost saving strategies (Kohn, 1993) that include but are not limited to lower priced goods from foreign suppliers due to their lower labor costs; increase technology and manufacturing flexibility capable of lowering production costs and achieve better quality and advanced technology which are able to improve the competitiveness of a firm's products, reduce R&D costs, switch among suppliers as circumstances change and secure more orders from a country through the user of offsets (Zhang, Quesada et al., 2000).

2.4. Procurement Management

Frohlich and Westbrook, 2001 stress the strategic importance of integrating operations with suppliers and customers in supply chains by providing empirical evidence of the impact of upstream and downstream supply chain integration on performance. Strategic alliances are no longer a strategic option but a necessity in many markets and industries (Parise and Henderson, 2001). Four elements of a more cooperative relationship discussed in the literature are supply base reduction, single sourcing, strategic partnerships and early supplier involvement in product design (Stanley and Wisner, 2002). Stanley and Wisner, 2001 empirically test the relationship between cooperative procurement/supplier partnerships and service quality to external customers by analyzing the mediating effect of procurement's service quality performance. Fynes and Voss, 2002 provide further empirical evidence of the impact of buyer-supplier

relationships on performance, by analyzing it as a moderating variable in the relationship between quality practices and performance.

Another aspect discussed in the procurement management literature is supplier selection. Research results indicate that the supplier selection process appears to be the most significant variable in the supplier development process as it helps in achieving high quality products and customer satisfaction (Gonzalez, Quesada and Mora, 2004). Lee, Ha et al., 2001 suggest using information retrieved from the supplier selection process to improve the supplier management process.

2.5. Procurement Practices

Procurement practices are defined as the practices of an organization in gathering information, contacting suppliers, contracting, requisitioning and implementing intelligence/analysis. There is a lack of literature providing a validated measure for the operational view of procurement practices.

The few studies that attempt to measure procurement practices do it from a policy and strategic view. Since eprocurement is in very early stages (Gebauer, Beam et al., 1998), the impact of eprocurement on procurement practices could be measured only at the operational level. This is because it behaves as other information technologies, in which their impact at the strategic level is at a long-term (Laudon and Laudon, 2004). Carr, Leong et al., 2000 present an empirical research that evaluates procurement practices in Taiwan and their construct strategic procurement includes items such as formally written long-range plans, review and adjustment of long-range plan to match changes in the firm's strategic plans on a regular basis and development of comprehensive procurement

strategies to support the firm's strategies. Segev, Beam et al., 1997 present a study about the impact of internet on procurement practices; however, they do not show validity and reliability of the construct procurement practices. In fact, it is a descriptive report showing statistics of implementations of procurement by using internet. Under procurement process, they consider procurement policies and procedures.

The studies that describe the procurement process are conceptual in nature, without developing any empirical testing of the constructs. The researcher bases the development of procurement practices construct in those conceptual studies that are described in the following sections, after reviewing the procurement process in the literature.

Cammish and Keough, 1991 and Keough, 1993 emphasize on the importance of giving procurement a strategic role in the organization, and they agree that achieving world-class status in procurement requires many efforts in leadership, recognition of procurement's importance and new metrics for procurement performance. They describe the procurement process in six stages: (1) develop/challenge specifications, (2) develop sourcing strategies, (3) analyze future needs/influence delivery schedule, (4) negotiate contracts, (5) obtain quotes and place orders and (6) monitor vendor and procurement performance. Moreover, Cammish and Keough, 1991 present a development model for procurement in four stages: factory support, lowest unit cost procurement, coordinated procurement effort and strategic procurement. The shift from

operating procurement to strategic procurement must be done in evolutionary states as presented in their study.

Ellram and Siferd, 1993 describe the procurement activities contributing to the total cost of ownership including: management, delivery, service, communications, price and quality. They show the total cost of ownership (TCO) approach in procurement which could provide an improvement in procurement and firm performance. The main philosophy of TCO is to analyze all activities that make firms incur in costs and to further identify which of those activities really add value. It is very similar to lean manufacturing in the sense that the final objective is to eliminate waste and focus only on those activities that add final value.

Laios and Xideas, 1994 empirically study the differences in the procurement function structure between institutional and industrial organizations. Their findings suggest that in general, both types of organizations follow similar procedures during the procurement cycle but they employ them in different amounts (depth of analysis) and degrees (articulation). They reported that there is no standard agreement on the description of the procurement cycle, and they propose to divide it into four phases: (1) definition (issue purchase requisitions, design of specifications, price and lead time estimations, budgeting and procurement planning), (2) search (screening of potential suppliers, make-or-buy investigations, revision of approved suppliers' lists, supplier surveys), (3) selection (selection of pricing methods, setting of source selection criteria, application of competitive bidding, negotiation with suppliers) and (4) completion

(order expediting, contract administration, inspection and receiving, warehousing and auditing, issuing to users).

Baldwin and Orr, 1997 present an empirical research in which they focus on the first four of the seven key areas of procurement identified by the literature (Cavinato, 1991, Novack and Simco, 1991, Rajagopal and Bernard, 1993b, Herberling, 1993, Sutton, 1989): (1) fit of procurement strategy with business strategy, (2) supplier research (make or buy analysis, market supply studies and alternative materials analysis), (3) procurement policies (long-term contracts, single sourcing, JIT), (4) procurement strategy, (5) procurement information systems, (6) procurement operations (define service levels, buyer control over stocks, value analysis, quality checks, preparation of specification, supplier cost analysis, in depth evaluation of bids and tenders) and (7) procurement control systems (supplier certification, audit of buying performance, purchase order routines throughout the company, independent invoice checking).

Archer and Yuan, 2000 present the business procurement life cycle as: (1) information gathering, (2) supplier contact (requests for quotes –RFQ-, requests for proposals –RFP-, requests for information –RFI-, requests for bids –RFB-), (3) background review (references for product/service quality are consulted, requirements for follow-up services -installation, maintenance, warranty- are investigated, samples of the P/S (product/service) being considered may be examined or trials undertaken), (4) negotiation (price, availability and customization possibilities, delivery schedules, complete contract to acquire P/S), (5) fulfillment (supplier preparation, shipment, delivery, payment, installation and

training may also be included), (6) consumption, maintenance and disposal (evaluate performance of the P/S and any accompanying service support) and (7) renewal.

Leenders, Fearon et al., 2002 determine nine steps in procurement: (1) recognition of need, (2) accurate description of desired commodity or service (requests for quotes –RFQ-, requests for proposals –RFP-, requests for bids – RFB-), (3) selection of possible sources of supply, (4) determination of price and terms, (5) preparation of purchase order, (6) follow-up and expediting, (7) receipt and inspection of goods/services, (8) clearing the invoice and payment and (9) maintenance of records. They also describe six steps in setting up an eprocurement system: (1) select a solutions provider and determine the type of relationship (purchase a software package, use a third party, or join an e-marketplace), (2) the buyer determines how many suppliers and which suppliers to keep in its supply base, (3) the buyer negotiates terms and conditions with the chosen suppliers, including deeply discounted prices in return of volume, (4) search for catalogs of designated suppliers, select items for purchase and create requisitions and a purchase order, (5) invoice and (6) payment.

Missouri, 2001 describes the procurement cycle as: (1) recognition of the need, (2) development of requisition, (3) procurement reviews requisition for accuracy and completeness, (4) procurement checks if available in stock or excess (surplus), (5) procurement determines method of purchase, (6) procurement requests quotation through IFM, RFP, RFQ, (7) procurement receives and tabulates bid quotations, (8) procurement evaluates bids and make awards, (9)

purchase order is processed, (10) order is received and delivered to requisition department, (11) order is checked and delivered to requisitioning department, (12) procurement administer contract and (13) surplus, salvage, or scrap is either recalculated or disposed of.

Gebauer and Segev, 2001 present a figure showing strategic and transactional levels of procurement activities (Figure 2). They show in the figure the procurement practices as they occur at the strategic and transactional levels. Strategic-level activities include identifying sourcing opportunities, negotiating and contracting. Transactional-level activities include information searching, requisitioning, purchase order, delivery and tracking, payment and after-sale support.

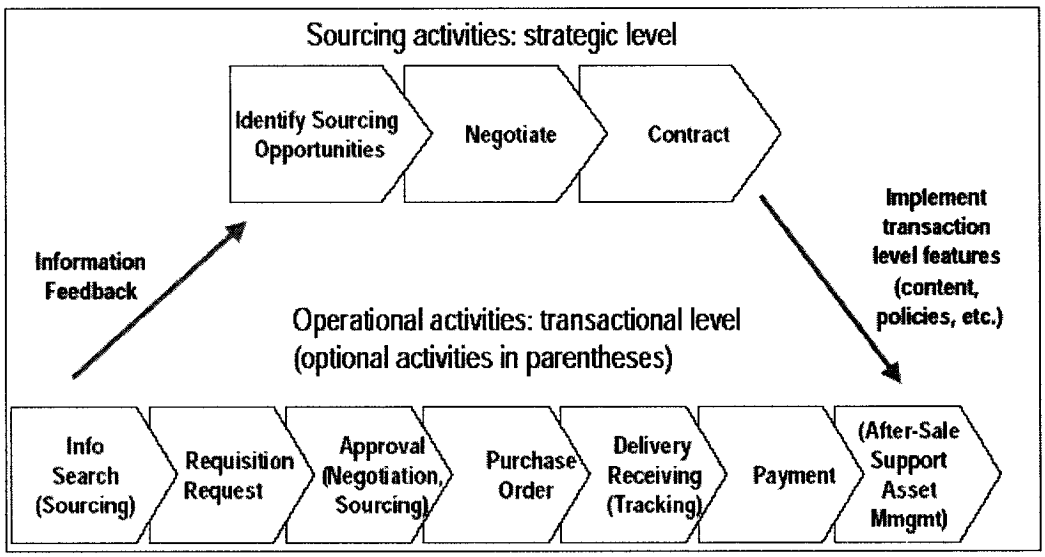


Figure 2. Strategic and transactional levels of procurement activities (Gebauer, J. and Segev, A., 2001).

Based on previous literature, the researcher classifies procurement practices into: information gathering, supplier contact, contracting, requisitioning and intelligence/analysis (Kong and Li, 2001; Novack and Simco, 1991; Rink and

Fox, 1999; Segev, 2001; Berger and Gattorna, 2001; Subramaniam and Shaw, 2002; Neef, 2001; Alt and Fleisch, 2000; Presutti, 2003; Tracey, 1996; Gonzalez and Medrano, 2002).

- ***Information Gathering***

Webster and Wind, 1996 specify the buying tasks as: (1) identification of need, (2) establishment of specifications, (3) identification of alternatives, (4) evaluation of alternatives and (5) selection of suppliers. All of these steps are done in the procurement stage of information gathering. As stated by Segev, Beam et al., 1998, in information gathering, prospective buyers identify their needs and evaluate potential sources to fulfill them. This process is done by gathering information about market conditions, products and sellers. Novack and Simco, 1991 explain the information gathering process as conducting market analysis, depending upon if it is a competitive market (many suppliers), an oligopolistic market (a few large suppliers) or a monopolistic market (one supplier).

- ***Supplier Contact***

As part of the supplier contact, the buyers request for quotes (RFQ), proposals (RFP), information (RFI) and bids (RFB). Segev, Beam et al., 1998 study the usage of RFP as one of the negotiation techniques, which was rated as third in usage, after face-to-face and bids. Rink and Fox, 1999 include supplier contact as part of the procurement activities in any stage of a product-life cycle, from requesting for quotes, to requesting for volume discounts and bids.

- ***Contracting***

Segev, Beam et al., 1998 includes as part of negotiation, the interaction of partners to determine prices and availability of goods and services, as well as delivery times. They state that only those successful negotiations are translated into a contract. Anderson, Chu et al., 1987 shows how the contracting process would be different if it is a new buy, a modified rebuy or a straight rebuy.

- ***Requisitioning***

Segev, Beam et al., 1998 name this stage as settlement, in which the terms of the contracts are carried out and goods and services are transferred in exchange of money or other forms of compensation. Novack and Simco, 1991 name this stage as delivery of products and performance service, which ends with the generation of performance data for the following stage.

- ***Intelligence and Analysis***

Berger and Gattorna, 2001 define intelligence and analysis as the identification, collection and use of internal and external data to enable procurement to make smart sourcing decisions. Narasimhan and Carter, 1998 specify procurement practices as: (1) supplier certification, (2) supplier development, (3) supplier qualification, (4) Just-In-Time procurement and (5) supply base rationalization. Novack and Simco, 1991 includes intelligence and analysis as a postpurchase/make performance evaluation for control purposes. Intelligence is more than just a control of performance, but a tool for developing strategies based on high quality information (Gonzalez, Quesada, Mueller et al., 2004).

2.6. Procurement Performance

The procurement practices identified earlier should help firms to realize some or all of the benefits in procurement. The need for performance measurement in procurement has long been recognized. Many traditional procurement organizations do not measure their performance (Cammish and Keough, 1991). Most of the managers' decisions are based on performance measures, and therefore, correct metrics are critical for the firm's performance and strategic decisions. Easton, Murphy et al., 2002 present a summarized history of the procurement performance measurement in the literature, supporting mainly short-term gains until the late 1980s and early 1990s. Another problem with those traditional metrics where that they worked to improve the procurement performance at the expense of other departments' performance. Therefore, not achieving a global organizational measure of performance, but a local measure working alone. This philosophy is opposite to that proposed by total quality management (TQM) which was to work for balancing intraorganizational benefits in order to achieve greater organizational benefits. Similarly, but in a broader picture, supply chain management (SCM) looks for balancing interorganizational benefits in order to achieve greater supply chain benefits. Therefore, the idea to improve only one unit's performance in the traditional way of measuring procurement performance was heavily criticized by the literature (Bourne, Neely et al., 2002; Neely, Mills et al., 2000; Ghalayini and Noble, 1996; Ghalayini and Noble, 1997). Furthermore, traditional measures of procurement performance were either based too much on financial aspects, unidimensional or incomplete,

contradictory to continuous improvement, inflexible, with no strategic focus and even invalid (Easton, Murphy et al., 2002). Cammish and Keough, 1991 and Keough, 1993 emphasize on the importance of giving procurement a strategic role in the organization, and they agree that achieving world-class status in procurement requires many efforts in leadership, recognition of procurement's importance and new metrics for procurement performance. Gebauer, Beam et al., 1998 describe procurement practices and how they impact procurement performance in terms of cost, time, satisfaction, quality, stock and value. Lindskog and Wennberg, 2002 state that as firms are improving their procurement practices with all the new technologies available, they will be achieving higher firm performance by increasing the efficiency of its entire procurement process. Based on the previous literature, the researcher suggests:

Hypothesis 1: The higher the procurement practices in a firm, the higher the procurement performance.

2.7. eprocurement Technology Usage

The implementation and usage of information technologies have a strong impact on business processes. eProcurement technology usage is defined as the extend of usage of electronic network technologies and practices (i.e. interorganizational systems such as EDI or, even beyond that, internet which could provide e-marketplaces, e-auctions, etc.) that facilitate electronic communication, information exchange and transaction support through either public or private networks (Min and Galle, 1999). In this context, it becomes critical to understand

and know the effects of changing information technologies on business performance and the achievement of business goals.

Previous literature have used the term eprocurement for the use of internet on procurement tasks (Davila, Gupta et al., 2003a; Group, 2001; Presutti, 2003). However, in this study, the researcher also includes in eprocurement technologies private or public networks that could be designed for specific firms (like EDI, and other interorganizational systems).

The mistaken emphasis on internet only could lead academicians and practitioners to narrow their understanding of the capabilities, benefits and limitations of eprocurement, which is not internet procurement, but electronic procurement (Neef, 2001). Other researchers have cleared this misunderstanding by naming web-based B2B procurement to specific procurement activities done through the internet (Candrasekar and Shaw, 2002, Lindskog and Wennberg, 2002). It is undoubtful the fact that the internet provides a solution to firms that wanted to start eprocurement but did not have enough resources available for adopting information technologies such as EDI that were financially infeasible. The Boston-based Aberdeen Group said some of the benefits companies have recognized through the use of eprocurement technologies include 73% reduction in transaction costs, 70 to 80% reduction in purchase order processing cycles, and 5 to 10% reduction in prices paid; an average mid-sized organization would save almost $2 million per year through eprocurement technologies. Due to the great impact of eprocurement on business and supply chain performance, it is the purpose of the researcher to

provide a broad understanding of the impact of all kinds of electronic technologies (public or private networks) that facilitate the procurement practices, namely information gathering, supplier contact, requisitioning, contracting and intelligence/analysis between organizations (Berger and Gattorna, 2001).

Eakin, 2002 categorizes the benefits of eprocurement into transactional (automation of processes), compliance (reduce maverick effect), price (better negotiations with reduced transaction costs), management of information (reduce errors and improve availability) and payment (improve payment systems). Reducing cycle times and order processing costs are not the only benefits of eprocurement. In fact, empowering self-service requisitioning, achieving integration with back-office systems, and positioning procurement to a strategic importance within the organization are other benefits of eprocurement (Attaran and Attaran, 2002). Dell Computer has reported savings of $50 million and a reduction of suppliers by 50% after using eprocurement; Mercedes-Bens Spain has reported savings of up to $3 million and a reduction of suppliers by 65%; Emerson reported savings of $30 million while American West Airlines and Eastman Kodak Co. have reported price breaks of 40% and 20%, respectively (Attaran and Attaran, 2002).

The relevance of these advantages suggested a rapid migration from traditional to e-based procurement models. Accordingly, just a few years back, market analysts predicted that Internet B2B transactions — a subset of e-procurement technologies — would increase from approximately $600 billion in 2000 to over $7.29 trillion by the end of 2004 (Brunelli, 2000a). Unfortunately, this tremendous

expected growth rate has been revised downwards. Recent market observations indicate that the adoption and integration of e-procurement technologies into the business mainstream is occurring at a much slower than expected pace due to technology related issues (Davila, Gupta et al., 2003b). Companies were jumping onto the e-procurement bandwagon without fully understanding the inter-organizational collaboration and network effects underlying these technology models, the investment required to move the right information from suppliers to employees, and the complexities of integrating these technologies with existing enterprise resource planning systems (Gilbert, 2000).

Emerging internet technologies are raising high hopes of changing the picture of costly, time-consuming, and inefficient procurement processes by enabling major improvements in terms of lower administrative overhead, better service quality, more timely location and receiving of products, and increased flexibility (Segev, Beam et al., 1998). As stated earlier, procurement holds a significant value within the firm, with most organizations spending at least one third of their overall budget on procurement products and services (Killen and Kamauff, 1995).

Segev, 2000 presented a road for e-business transformation (Figure 3). In his conceptual framework, he shows how most firms must use a non-linear transformation from stage 1 (static information posting, self-service information intranets, no management strategy or commitment) to stage 4 and beyond (no business but "e-business", collaborative real-time commerce, micro-level dynamic customization, radical business process and organizational change, e-management). He argues that firms following a linear transformation throughout

the stages won't be able to gain competitive advantage of the e-business strategy.

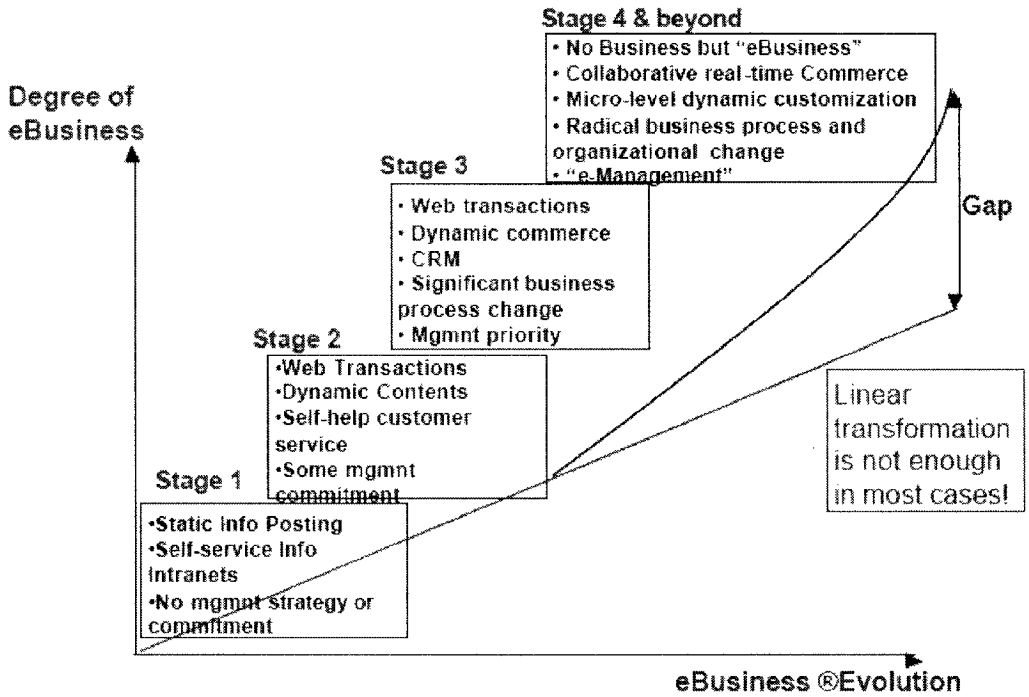


Figure 3. Road for e-Business Transformation (Segev, 2000)

eProcurement technologies are still in their early stages of the traditional technology S-curve, in which alternative technology models are rapidly evolving and users are still sorting out the winning model (Davila, Gupta et al., 2003b). There are many strategies to initiate eprocurement implementation, including aggressive versus conservative adopters. Aggressive adopters are investing significant resources to experiment with alternative solutions with the expectation of identifying the technological winner and translating this leadership position into competitive advantage. Conservative adopters are taking a 'wait and see' approach. These companies are investing selectively in a reduced set of technology alternatives with the expectation of learning enough to be ready to

move as soon as a winner emerges. Regardless of the current strategy of a company, the overall consensus is that e-procurement technologies will become an important management tool to enhance the performance of supply chains (Gebauer, Beam et al., 1998).

eProcurement Technologies

There are several information technologies used for eprocurement. The researcher describes the most used technologies for eprocurement in current practices:

- Internet search engines: search tools for locating specific sites or information on the internet. Because search engines do not always overlap, sellers may miss a page on one engine but pick it up on another (Laudon and Laudon, 2004).
- Extranet: private intranet (internal network based on the internet and world wide web technology and standards) that is accessible to authorized outsiders. Firms use such networks to coordinate their activities with other firms for electronic commerce and electronic business (Laudon and Laudon, 2004).
- Electronic data interchange (EDI): traditional approach for electronic cooperation between business partners. A structured, standardized data format is used to exchange common business documents (e.g. invoices and shipping orders) between trading partners, it supports the exchange of repetitive, routine business transactions (Watson, Berthon et al., 2000).

- Email: facilitates communication within and between organizations. It is an internet application that combines the benefits of telephone and traditional mail with the advantage of relatively instant communication and asynchronous (the parties do not have to exchange information at the same time). One of the features mainly used among organizations is the ability to attach documents to e-mail messages, saving the need to copy and mail or fax documents (Oz, 2002).
- Electronic catalogs: special form of electronic supply chain management. It is a web page set up to display and sell products and/or services. At a minimum, it should have a detailed description of the item for sale enough to make a procurement decision and information on how to purchase it (Segev, Beam et al., 1997).
- File transferring protocol (FTP): used to access a remote computer and retrieve files from it (Laudon and Laudon, 2004). It is a quick and easy method for retrieving and transferring files if you know the remote computer site where the file is stored (like a buyer or seller computer).
- Video conferencing: teleconferencing in which participants see each other over video screens (Laudon and Laudon, 2004). It is very helpful in the negotiation states, it replaces the face-to-face meetings saving cost and time.
- Electronic markets: web sites that bring multiple buyers and sellers together in one central virtual marketplace and enable them to buy and sell from each other at a dynamic price that is determined in accordance with the rules of the exchanges (Davila, Gupta et al., 2003b).

- Internet auctions/reverse auctions: multiple buyers place bids to acquire goods or services at an internet site. In internet auctions sellers control the minimum bid and prices move upward from the minimum bid. In reverse auctions buyers post "requests for quotations" and sellers bid the price down (Davila, Gupta et al., 2003b)

Measuring eprocurement technology usage

Previous literature is either descriptive when measuring eprocurement technology usage, or is focused on internet procurement only. Kennedy and Deeter-Schmelz, 2001 describe the internet use activities as: (1) information gathering activities (gathering product/component information, searching for new suppliers, gathering information regarding current suppliers, gathering competitive information for your company, gathering external customer information for your company), (2) interorganizational information exchange activities (e-mail, providing information to suppliers -specifications, order policies, accessing supplier documents -blueprints, layouts, specifications-, electronic data interchange, discussion groups with other customers, JIT inventory planning), (3) online ordering activities (online ordering, online order status checks, online customer support) and (4) bidding and payment activities (online payments, conducting reverse auctions). Lindskog and Wennberg, 2002 briefly describe eprocurement as the use of web-based technology to support key procurement processes: (1) requisitioning, (2) sourcing, (3) contracting, (4) ordering and (5) payment. Min and Galle, 2001 describes the frequency of electronic commerce usage for the following procurement applications: (1)

purchase orders, (2) shipment tracing, (3) electronic funds transfer, (4) invoicing, (5) advanced shipping notice and (6) cash management.

Stein and Hawking, 2002 present a report on eprocurement practices in Australia, measuring eprocurement practices as the percentage of procurement purchases conducted using various mediums such as mail, fax, telephone, EDI, email and internet.

Hoffman, Keedy et al., 2002 classify electronic procurement by means of public e-markets (owners are third parties, and there are one-off/sporadic relationships with trading partners), consortia (owners are two or more industry incumbents and typically, the relationships with trading partners are one-off/sporadic) and private exchanges (owned by one company and the relationships with trading partners is long-term and committed). Segev, Beam et al., 1998 includes as eprocurement technology those internet search engines, electronic catalogs, EDI, online auctions and bidding systems.

As stated by Kocabasoglu, 2002b, the potential benefits of eprocurement have been cited extensively in both practitioners and academic journals. However, relatively few studies have analyzed this phenomenon and its impact on different functional, firm or supply chain performance objectives. Croom and Johnston, 2003 address the impact of e-business on internal customer service, focusing on eprocurement. Gebauer, Beam et al., 1998 analyze the effect of eprocurement on procurement practices and how they influence procurement performance. Frohlich and Westbrook, 2002 measure the impact of web-based procurement in

operational performance (delivery time, transaction cost, profitability and inventory turnover). Based on the previous literature, the researcher states:

Hypothesis 2: The higher the eprocurement technology usage of the firm, the higher the effect of procurement practices on procurement performance.

2.8. Procurement Perception of Supply Chain Performance

The literature on supply chain performance has been extensive and it has validated and tested for reliability different indicators. Therefore the researcher will heavily rely on previous indicators stated in previous studies (Li, 2002, Kocabasoglu, 2002b, Beamon, 1999; Holmberg, 2000; Gunasekaran, Patel et al., 2001; Pagell and Chwen, 2001). As stated in previous research, the procurement performance impacts supply chain performance (Beamon, 1999; Berger and Gattorna, 2001; Gunasekaran, Patel et al., 2001). However, the literature lacks of empirical studies that support this relationship. Kocabasoglu, 2002b is provides an important contribution presenting an empirical study that links eprocurement with supply chain performance, by means of flexibility. Croom and Johnston, 2003 states that the potential of e-business comes from applications both within (internal performance) and between (supply chain performance) businesses. Ageshin, 2001 recalls the results of eprocurement at General Motors, and includes supply chain optimization as one of the outcomes. Hoffman, Keedy et al., 2002 present benefits provided by eprocurement in the companies they analyzed, achieving internal benefits such as reduction in product cycle times and also, external benefits that accrue across the supply chain (Tan, Kannan et al., 1999). Previous literature supports the statement of the following hypothesis:

Hypothesis 3: Procurement performance has a direct impact on procurement perception of supply chain performance.

2.9. Firm Performance

Firm performance is the ultimate organization's goals measurement. It measures how well an organization fulfilled its market and financial goals (Yamin, Gunasekruan et al., 1999). Li, 2002 presented an empirical study testing for the positive relationship between supply chain performance and firm performance. Therefore, based on the literature, the researcher states:

Hypothesis 4: Procurement perception of supply chain performance has a direct impact on firm performance.

Porter, 1980 states that procurement, as one of the functions of the firm, impacts the ability of the firm to achieve its goals, and therefore, it impacts the firm performance. Further studies (Carr and Smeltzer, 2000) suggest the importance of achieving higher levels of procurement performance in order to improve the firm's performance. The impact of procurement performance on firm performance is widely supported also from the practitioner's point of view. As companies are seeking ways of reducing costs, speeding time-to-market and improving product quality, supplier performance plays a critical role in maintaining the competitiveness of value chains (Fitzgerald, 1997). The quality of a final product can only be as good as the quality of the inputs they receive from suppliers (Forker, 1997). Lindskog and Wennberg, 2002 state that eprocurement initiatives worldwide are a way to remain competitive in the global marketplace. Novack and Simco, 1991 state that the effective management of the procurement

process is an integral part of the success of any organization, since inputs to the firm provide the basis for its output. Sanchez-Rodriguez, Martinez-Lorente et al., 2003 provide evidence of a significant positive relationship between procurement performance and firm performance using a structural equation model. Based on the literature, the researcher states:

Hypothesis 5: Procurement performance has a direct impact on firm performance

After a vast literature review, the researcher requires the correct methodologies to gather data and do the confirmatory analysis of the model. Previous tests are required before initiating the large-scale instrument development and data gathering. These tests are explained in the following chapter.

3. Item Generation and Pre-Test

The items used to measure procurement perception of supply chain performance and firm performance had been developed and tested for reliability and validity by Li, 2002. Therefore, in the first stages of this research, which includes item generation and Q-Sort, the researcher developed instruments to measure eProcurement technology usage, procurement practices and procurement performance.

3.1. Instrument Development

A large-scale survey approach was used to test the hypotheses derived for the research model (Figure 2.1.). The constructs for this research were developed with a strong theoretical foundation based on a review of available literature. The rigorous literature review included theoretical models as well as reliable and validated measures that have been used in the past research for procurement practices and performance. Possible items were drawn from major literature items related to procurement practices, procurement performance and eProcurement technology usage displayed in Table 2.1. The researcher also conducted open-ended interviews with procurement managers from a list of the Toledo ISM chapter and the Toledo APICS chapter in Ohio. A set of items were generated for each of the three constructs using a five-point Likert scale where 1= not at all, 2= to a small extent, 3= to a moderate extent, 4= to a considerable

extent, and 5= to a great extent. A sixth classification was provided for reducing missing values, 6= do not know.

A rigorous procedure must be followed to ensure brevity, understandability and content validity of the measurement items. The first step was to allow experts in the business and academic fields to review the items for clarity and content. Four professors of the College of Business Administration at the University of Toledo checked the items for the three constructs. The same procedure was followed by three practitioners in the procurement area and by three Ph.D. students in Manufacturing Management at the University of Toledo. The items were modified, deleted and added as necessary by incorporating their feedback and analysis.

3.2. Pre-Test: Q-sort Methodology

Q-sort methodology was created by Stephenson, 1953 and it is most commonly associated with qualitative analysis but also in quantitative analysis due to its involvement with factor analysis (Brown, 1996). Items created based on the literature and practitioners interviews, were placed in a common pool. Practitioners were asked to sort out the items into several groups, each group corresponding to a construct or sub-construct. The final objective is to pre-test the convergent and discriminant validity of the scales. Also, Q-sort ensures content validity and clarification of the items and dimensions of the different constructs.

The procedure followed was to show interviewees the conceptual model and definitions of each construct. Practitioners sorted the items in the pool into

separate envelopes with the names of the constructs and one of them with the title "not available" to minimize forcing the judges to place any items into a particular category. Judges were allowed to ask any questions related to the model, definitions and procedures to ensure that they understood the process correctly. Items were subjected to two sorting rounds by two independent judges per round and minor modifications were made to the wording of the items. The judges were selected from the Toledo ISM chapter, including procurement managers from Dana Corporation, Exothermics, Promedica and Honeywell.

The criteria for evaluating the Q-sort results are based on the inter-judge agreement level; Cohen's Kappa (Cohen, 1960) and Moore and Benbasat's "hit ratio" (Moore and Benbasat, 1991). The inter-judge agreement level is calculated by counting the number of items that both judges agree to place into certain category, even though the category into which items are sorted by both judges may not be the intended one. Then, the percentage of total items agreed is computed to obtain the rate of inter-judge raw agreement scores. The second criterion is the Cohen's Kappa, which is a measure of agreement. It can be interpreted as the proportion of joint judgment in which there is agreement after chance agreement is excluded. Finally, the Moore and Benbasat's "hit ratio" are calculated by counting all items that are correctly sorted into the intended theoretical construct by each of the judges, and divide them by twice the total number of items. The process for developing and evaluating a Q-sort is explained in detail in Nahm, Solis-Galvan et al., 2000.

Table 3 contains the number of items for the constructs (EPT and PP) and the sub-constructs for procurement practices (PPR): information gathering (ig), supplier contact (sc), requisitioning (rnf), contracting (cnf) and intelligence and analysis (ianf). The construct ID presented in Table 3 will be used to identify the constructs in the Q-sort results.

Construct ID	Description	# Items
1	eprocurement technology usage (EPT)	9
2	Information gathering (ig)	4
3	Supplier contact (sc)	4
4	Requisitioning (rnf)	4
5	Contracting (cnf)	6
6	Intelligence and analysis (ianf)	8
7	Procurement performance (PP)	21

Table 3. Number of Items per Construct for Q-Sort Methodology

The criteria for determining acceptance is met. The inter-judge agreement is 89% (Table 4), the initial overall placement ratio of items within the target constructs - hit rate is 95% (Table 5) and the Cohen's Kappa score is 0.889 (Table 6).

Inter-Judge Raw Agreement Scores

		Judge 1								
		1	2	3	4	5	6	7		
Judge 2	1	9								
	2		4							
	3			4						
	4				4					
	5					4				
	6						6			
	7							19		
	Tot. Items		56				Hits:	50	%:	89%

Table 4. Inter-Judge Raw Agreement Scores. First Round.

Moore and Benbasat "Hit Ratio"

		Actual									
		1	2	3	4	5	6	7	NA	T	TG%
Theory	1	18	0	0	0	0	0	0	0	18	100%
	2	0	8	0	0	0	0	0	0	8	100%
	3	0	0	8	0	0	0	0	0	8	100%
	4	0	0	0	8	0	0	0	0	8	100%
	5	0	0	0	2	10	0	0	0	12	83%
	6	0	0	0	0	0	14	2	0	16	88%
	7	0	0	0	0	0	0	40	2	42	95%
	Tot. Items		112					Hits:	106	Hit%:	95%

Table 5. Moore and Benbasat Hit Ratio. First Round.

		JUDGE 1		
		Acc	Rej	Tot
JUDGE 2	Acc	50	3	53
	Rej	3	0	3
	Tot	53	3	56

X_{i+}	53
X_{+i}	53
Sum	106

Cohen's Kappa
k=0.889
$k=((N_i*X_{ii})-SUM(X_{i+},X_{+i}))/(N_i^2-SUM(X_{i+},X_{+i}))$
$k=((56*50)-106)/(56^2-(106)$

Table 6. Computations for Cohen's Kappa (k). First Round.

It is important to emphasize that a value of Cohen's Kappa greater than 0.76 is considered excellent (Nahm, Solis-Galvan et al., 2000). Analyzing the three measures for reliability and validity for the first round, 89% of the time the judges agreed, 95% of the items were placed in the intended category by the judges and finally, 0.889 Cohen's Kappa shows an excellent degree of agreement beyond chance. These results are acceptable, but the researcher decides to perform a

second round in order to confirm the results. The researcher revised and reworded some of the items before initiating the second round of the Q-sort.

The results from the second round support the changes done to the rewording of the items. All measures improved: inter-judge agreement increased to 93% (Table 7), the initial overall placement ratio of items within the target constructs - hit rate increased to 96% (Table 8) and the Cohen's Kappa is now 0.926 (Table 9). Therefore, the results indicate an excellent level, based on the guidelines from Landis and Koch, 1977.

Inter-Judge Raw Agreement Scores

		Judge 1						
		1	2	3	4	5	6	7
Judge 2	1	9						
	2		4					
	3			4				
	4				3			
	5				1	5		
	6						8	
	7							19
	Tot. Items		56				Hits:	52
							%:	93%

Table 7. Inter-Judge Raw Agreement Scores. Second Round.

Moore and Benbasat "Hit Ratio"

		Actual									
		1	2	3	4	5	6	7	NA	T	TG%
Theory	1	18	0	0	0	0	0	0	0	18	100%
	2	0	8	0	0	0	0	0	0	8	100%
	3	0	0	8	0	0	0	0	0	8	100%
	4	0	0	0	7	0	0	0	1	8	88%
	5	0	0	0	2	10	0	0	0	12	83%
	6	0	0	0	0	0	16	0	0	16	100%
	7	0	0	2	0	0	0	40	0	42	95%
	Tot. Items	112						Hits:	107	Hit%:	96%

Table 8. Moore and Benbasat Hit Ratio. Second Round.

		JUDGE 1		
JUDGE 2		Acc	Rej	Tot
	Acc	52	1	53
	Rej	2	1	3
	Tot	54	2	56

X_{i+}	53
X_{+i}	54
Sum	107

Cohen's Kappa
k=0.926
$k=((N_i*X_{ii})-SUM(X_{i+},X_{+i}))/(N_i^2-SUM(X_{i+},X_{+i}))$
$k=((56*52)-107)/(56^2-(107)$
0.926048201

Table 9. Computations for Cohen's Kappa (k). Second Round.

4. Large-Scale Survey and Instrument Validation

A large-scale survey was the instrument for data gathering. The focus of the study is procurement specialists, since they are the most appropriate to answer questions related to procurement practices, procurement performance and eprocurement technology usage. The following is a detail of the process followed for selecting the sample, collecting the data and confirming the measurement models for the new constructs.

4.1. Data Collection Methodology

The selection of the respondents is very important when designing a large-scale survey. The respondents are expected to have detailed knowledge on the areas of the survey. In the case of this study, the respondents are expected to have experience in the procurement area, as well as a general knowledge about the supply chain performance and the firm's performance indicators. It is also desirable to have a sample representative of different geographical areas, industries and firm sizes to achieve greater generalizability and minimize respondent bias.

The Institute for Supply Management (ISM) was selected as the source for the mailing list. ISM is the largest supply management association in the world with nearly 43,000 members. It is a prestigious association of professionals in the area of procurement from diverse industries around the nation. The mailing list

contained 5,000 names randomly selected from the ISM United States membership database. Priorities were given to members in the following SIC classifications: 28 "chemicals and allied products", 33 "primary metal industries", 34 "fabricated metal products, 35 "industrial and commercial machinery and computer equipment", 36 "electrical equipment and components" and 37 "transportation equipment". Respondents included procurement/materials/supply chain vice-presidents, directors and managers. The mailing list was further refined. Since the large-scale survey was going to be implemented using online data gathering, those names with no email addresses were deleted from the initial contact database. From the 5,000 names, a total of 3,532 contained email addresses, and therefore, passed the first screening.

The way for administering the survey was an issue to consider. The focus of this study includes the usage of eprocurement technologies. The researcher is mostly interested in those organizations that use technologies for their procurement practices. Internet has allowed people and organizations not only to increases richness of information but to increase reach of people (Laudon and Laudon, 2004). It was the purpose of the researcher to reach as much corporations as possible but also to retrieve the adequate amount of information required for the survey. Since this is the main objective of new information technologies, the researcher decided to do the questionnaire on-line for specific targets. Three methods for filling out the questionnaire were available for the respondent.

The method for data collection is described as follows. First, an email was sent to the 3,532 names inviting them to participate in the study with a brief description

of the research, stating that all data collected would be for academic purposes and handled confidentially. In the email, the researcher facilitated three ways of responding to the survey: (1) on-line by clicking on the link that would take them to the online questionnaire (http://www.cofc.edu/~quesadag/eprocurement/), (2) send it by fax by clicking on the link that would take them to the pdf format of the questionnaire in the following site:

http://www.cofc.edu/~quesadag/images/Gioconda_Quesada_Questionnaire_9_15_03.pdf or by asking the researcher to send them the word format (in case they did not have adobe acrobat installed); and (3) send it by regular mail once they have completed the pdf or the word format of the survey. Also, the researcher received a few emails asking for the survey to be faxed to them since the firewalls in their corporations did not allow them to download any file or navigate in internet.

The day the first email was sent, the researcher did a second refinement of the database for the following reasons: (1) the emails were rejected, (2) the researcher received an email saying that they no longer work for the company and/or (3) the researcher received an email saying they are no longer in the procurement area. This resulted in the removal of another 720 names. Therefore, the final mailing list contained 3,012 names.

During the first two weeks after the first email, a total of 413 responses were obtained on-line. Then, a second email was sent expressing gratitude to those who have already responded and asking to respond to those who have not yet responded. A total of 236 on-line questionnaires were received after the second

email. A third purification of the database was performed using the remote address (IP) which was retrieved from the on-line questionnaires. This address is unique and addresses with the same first three sets of digits (out of four) were investigated further to see if they came from the same company and location. Out of these respondents, a total of 180 from the first round and 120 from the second round were eliminated due to the doubt that they were coming from the same unit of analysis. Also, aside from the online responses, a total of 28 hard copies, adding faxes and regular mail submissions, were received. Finally, the total usable sample of 377 was compiled for a satisfactory response rate of 14%. It is considered a very good response rate for email surveys (Dillman, 2000).

A chi-square test is conducted to check non-response bias. The results (see Table 10) show that there is no significant difference between the sample of 2712 and the respondents of 377 when considering the percentages in SIC codes at 0.05 level of significance (Critical $\chi^2 = 12.592$ and computed $\chi^2 = 9.5$).

SIC Codes	Sample Size (%)	Respondents fe	Respondents fo	$\frac{(fo-fe)^2}{fe}$
28	436 (16.09)	61	54	0.8
33	48 (1.78)	7	5	0.6
34	398 (11.66)	44	55	2.8
35	324 (11.93)	45	50	0.6
36	851 (19.38)	73	85	2
37	167 (6.16)	23	18	1.1
Other	488 (33)	124	110	1.6
Total	2712 (100)	377	377	9.5

Table 10. Comparison of SIC codes distribution for non-respondent bias

Another non-respondent bias analysis was done using the first round of the respondents (those who responded to the first email) as the expected frequency

and the second round of the respondents (those who responded to the second email) as the observed frequency for the different SIC codes. Since there were 233 responses in the first round and 116 responses in the second round, an adjustment was made to the frequencies, based on the original percentages. For instance, the SIC code 36 showed a frequency of 38 (16.31%) out of the total of 233 respondents. To make the adjustment, the researcher used the percentage and obtained the frequency based on the total of the second round (233*0.1631) to obtain the expected frequency. The adjustment is necessary since the chi-squared test requires both frequencies to show equal sums.

SIC Codes	Respondents fe	Respondents fo	$(fo-fe)^2$ fe
28	15	15	0.0
33	2	1	0.5
34	13	15	0.3
35	14	14	0.0
36	19	27	3.4
37	5	6	0.2
Other	33	28	0.8
Missing	15	10	1.7
Total	116	116	0.0
		χ^2 =	6.8

Table 11. Comparison of SIC codes distribution for non-respondent bias (round1 vs round2)

The results in Table 11 support the results from Table 10. The critical chi-squared for 7 degrees of freedom (α = 0.05) is 14.07 and the computed chi-squared is less than this value (6.8), therefore, the researcher can conclude that the differences in frequencies are not statistically significant. Both tests exhibit that the respondents represent an unbiased sample. For detailed information about sample and respondents characteristics, see Appendix C.

4.2. Large-Scale Instrument Assessment Methodology

The first step after collecting the large-scale data is to perform a confirmatory factor analysis for the measurement models, and then, focus on the structural equation model displaying the hypothesized relationships. In order to avoid possible interactions between the measurement and the structural model, as proposed by Gerbing and Anderson, 1988, the researcher first test the measurement model and then the researcher test the structural model. The purification of the measurement models was done only to those new constructs in the study: procurement practices, eprocurement performance and procurement performance. The researcher examined the modification indexes along with the factor loadings and error terms as first criteria for testing the model fit. Then, the researcher studied the logic and theoretical support for deleting items. The researcher deleted one item at a time if there was a reason to do so, based on the criteria for model fit. Otherwise, the item remained in the model. The researcher continued the modifications in each of the measurement models until an acceptable model fit was obtained.

The following section details the criteria employed for assessing a model fit. Then, the next three sections will show details of the measurement models for each of the new constructs.

4.2.1. Criteria for fit indicators

The researcher used a combination of several fit measures for model testing, as proposed in the literature (Bagozzi and Yi, 1991). Bagozzi and Phillips, 1992 propose to use a confirmatory factor analysis to assess the hypothesized model

for each construct. Once the hypothesized model has passed the preliminary first criteria for model fit (absence of negative error variances, correlations greater than one and very large standard errors), the overall model fit indexes were checked. According to Hair, Anderson et al., 1998, the model fit measures can be grouped into three classes:

1. Absolute fit of the model to the data: measure the degree to which the overall model predicts the observed covariance or correlation matrix.
2. Incremental fit indexes: compare the proposed model to some baseline model, most often referred to as the null model.
3. Parsimonious fit indexes: relate the goodness-of-fit of the model to the number of estimated coefficients required to achieve this model fit. The basic purpose is to diagnose whether model fit has been achieved by "over fitting" the data with too many coefficients.

Table 12 summarizes the model fit criteria used in the measurement models and in the structural equation model.

Model fit Measures	Class	Acceptable value	References
χ^2/df	1	1<χ^2/df<3 (at most)	Carmines and McIver, 1981
p-value	1	>0.05	Joreskog, 1969
RMR	1	smaller better	Arbuckle and Wothke, 1999
GFI	1	closest to 1 better	Tanaka and Huba, 1985
AGFI	2	≥0.9	Hair, Anderson et al., 1998
NFI	2	≥0.9	Bentler and Bonett, 1980
TLI	2	≥0.9	Bentler and Bonett, 1980
CFI	2	≥0.9	Hair, Anderson et al., 1998
RMSEA	1	<0.05 (the most <0.08)	Browne and Cudeck, 1993
ECVI	3	should decrease	Hair, Anderson et al., 1998

Table 12. Model Fit Criteria

Discriminant validity measures the ability of measurement items to differentiate among constructs being measured (Syamil, 2000). The researcher assessed discriminant validity by running a chi-square test of discriminant validity for each pair of constructs (Bagozzi and Phillips, 1992). This was done by obtaining the difference in chi-square between a fixed correlation of 1 between the constructs and a freed correlation between the same constructs. Reliability estimation is left for last because in the absence of a valid construct, reliability may not be relevant (Koufteros, 1999). Chronbach's alpha was used to measure the reliability of the hypothesized individual subconstructs and then, the composite reliability was computed to assess the reliability of the final construct. The composite reliability was used to measure the reliability of the hypothesized measurement models. The formula used was:

$$Composite\_\mathrm{Re}liability = \frac{\left(\sum s\tan dardized\_loading\right)^2}{\left(\sum s\tan dardized\_loading\right)^2 + \sum \varepsilon_j}$$

Figure 4. Composite Reliability

A commonly used value for acceptable reliability is 0.7 (Hair, Anderson et al., 1998). More reliable measures give greater confidence that the individual indicators are all consistent in their measurements, and therefore, the model is repeatable.

4.3. Large-Scale Measurement Results

For each of the constructs, the researcher followed the same procedure for assessing construct validity, discriminant validity and reliability. As explained before, a refinement of the measurement models was done a randomly selected sample of 192 cases by examining one item at a time for path coefficients, error terms, modification indexes and correlations. If there is enough evidence (both theoretically and empirically) to delete an item, then, the researcher deleted the item, rerun the model and tested it again. Only one item was allowed to be deleted in each round. Before deleting an item based only on empirical results, the theory was first reviewed and if there was any logic to delete it, the researcher proceeded to delete it, otherwise, the item stayed in the model. The following is a description of the results for each of the constructs.

4.3.1. Procurement practices (PPR)

Procurement practices is defined as the practices of an organization in gathering information, contacting suppliers for pre-contract requests, negotiating and fulfilling of orders. The procurement practices (PPR) construct was represented by five dimensions and 26 items in the large-scale questionnaire, which are distributed as: information gathering (IG) with 4 items, supplier contact (SC) with

4 items, contracting (CNF) with 6 items, requisitioning (RNF) with 4 items and intelligence and analysis (IANF) with 8 items. The original 26 items and their corresponding code names are listed in Table 13.

Code Names	Questionnaire Items
Procurement Practices: Information Gathering (PPR/IG)	
When gathering information, your procurement department:	
ig1	Searches for suppliers to contract purchases
ig2	Searches for an appropriate product/service to order
ig3	Consult references for product/service quality
ig4	Investigates requirements for follow-up services, installation, maintenance and warranty
Procurement Practices: Supplier Contact (PPR/SC)	
When contacting suppliers, our procurement department requests for	
sc1	Quotes (RFQ)
sc2	Proposals (RFP)
sc3	Information (RFI)
sc4	Bids (RFB)
Procurement Practices: Contracting (PPR/CN)	
When developing a contract with suppliers, our procurement department negotiates	
cnf1	price
cnf2	quality standards
cnf3	customization possibilities
cnf4	delivery schedules
cnf5	delivery quantities
cnf6	final contract
Procurement Practices: Requisitioning (PPR/RNF)	
When requisitioning orders, our procurement department	
rnf1	approves orders
rnf2	places orders
rnf3	processes supplier invoices
rnf4	processes payments
Procurement Practices: Intelligence/Analysis (PPR/IA)	
When analyzing the negotiation and fulfillment of orders, our procurement department tracks	
ianf1	orders of materials
ianf2	shipments of materials
ianf3	product specifications and data
ianf4	complaints of defective/late materials and/or deliveries
ianf5	suppliers performance
ianf6	historical spending on materials
ianf7	demand of materials
ianf8	procurement performance

Table 13. Procurement Practices (PPR) - Large-Scale Study Items

The first model was run with all 26 items in each of the dimensions. The path diagram is showed in Figure 5. The extremely low path coefficient of the dimension requisitioning (RNF) forced the researcher to drop this construct for further analyses. It was important to show this trial since it is an exception to the rule of not allowing more than 1 item deletion at a time. The model fit indicators support this decision since χ^2/df is above accepted (3.10), GFI, AGFI, NFI, TLI, and CFI are below 0.73 and RMSEA is 0.11, showing a very poor model fit.

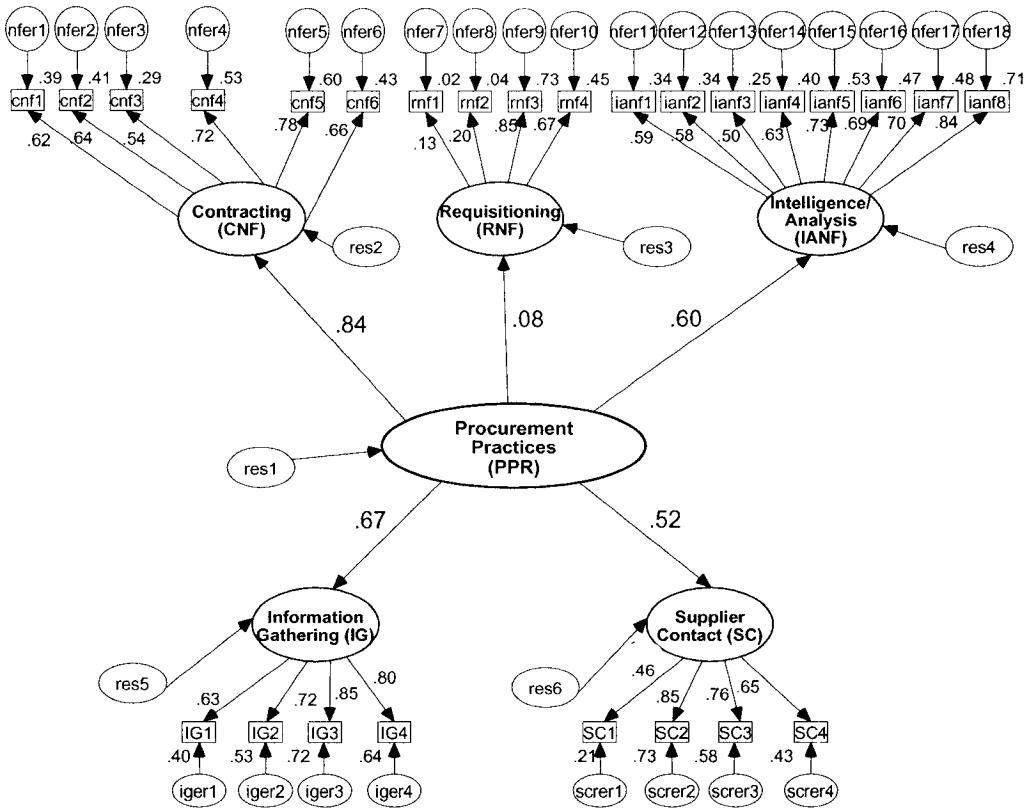


Figure 5. Procurement Practices Measurement Model-Trial 1.

The following is a description of each of the justifications for each of the deletions performed in the 11 trials for procurement practices (PPR), until an accepted

model was achieved. Appendix D contains all the path diagrams for the different trials for achieving a good model fit for procurement practices. Table 14 shows a summary of each of the trials performed in AMOS 5.0.

1. The model fit in overall is very poor with all the items. First, the dimension Requisitioning (RNF) has a terrible path coefficient (0.08). Therefore, it is the first step to eliminate this dimension. It is routine activities for procurement practices and not all of them are totally done in procurement.
2. The model requires further refinement. The lowest path coefficient of items with dimensions is sc1 (0.46). The researcher proceeds to delete sc1.
3. ianf1 and ianf2 present a high correlation (0.79). The researcher deletes ianf2 since respondents might not see the difference between keeping track of orders of materials and shipments of materials.
4. cnf4 and cnf5 present high correlation (0.80). Cnf4 present higher modification indexes. The wording might confuse the respondent, when contracting, usually they negotiate on transit days and quantities, but not on particular schedules, therefore, the researcher deleted cnf4.
5. ianf5 and ianf8 are highly correlated (0.70). Ianf8 presents a higher path coefficient. Also ianf5 has higher modification indexes. The researcher deletes ianf5.
6. Model fit indexes have improved, however, not enough. Ianf1 presents high modifications indexes. Orders of materials tracking could be involved in historical spending on materials, therefore, the researcher deletes ianf1.

7. ianf3 shows a low path coefficient and it is not a critical item in intelligence/analysis to keep track of product characteristics and specifications. The researcher deletes ianf3.
8. cnf3 presents high modification indexes, therefore the researcher examines that customization possibilities might not be a general contracting term, and therefore, deletes the item.
9. AGFI and NFI are still below accepted criteria, therefore, the model should be improved. Cnf5 presents the lowest path coefficient, except for sc1 which was determined to remain in the model due to conceptual reasons. Delivery quantities might not come in the contract themselves; therefore, the researcher deletes cnf5.
10. IG1 presents modification indexes higher than accepted. The researcher deletes ig1 since it might be interpreted to be included in other subcontracts.

As seen in Table 14, the last trial (MM_PPR11) is an accepted model fit. The ratio chi-squared/degrees of freedom is 1.28; a p-value for the hypothesis stating that the model fits perfectly in the population of 0.07; RMR of 0.07 representing the average squared amount by which the sample variances and covariances differ from their estimates obtained under the assumption that the model is correct (Arbuckle and Wothke, 1999); all GFI, AGFI, NFI, TLI and CFI are above 0.9; RMSEA is below 0.05 (0.04) and ECVI changed from 5.37 in the first trial to 0.72 in the last trial, providing evidence that the model has been significantly improved.

		Trials	1	2	3	4	5	6	7	8	9	10	11
		AMOS File Name (.amw)	MM_PPR1	MM_PPR2	MM_PPR3	MM_PPR4	MM_PPR5	MM_PPR6	MM_PPR7	MM_PPR8	MM_PPR9	MM_PPR10	MM_PPR11
Path Coefficients	Information Gatherng (IG)	ig1: Searches for suppliers to contract purchases	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0 63	
		ig2: Searches for an appropriate product/service to order	0.72	0.72	0.72	0.72	0 72	0.72	0.72	0.72	0.72	0.72	0.67
		ig3: Consult references for product/service quality	0.85	0.85	0.85	0.85	0.84	0.84	0.84	0.85	0.84	0.84	0.86
		ig4: Investigates requirements for follow-up services, installation, maintenance and warranty	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.82
	Supplier Contact (SC)	sc1: Quotes (RFQ)	0.46	0.46									
		sc2: Proposals (RFP)	0.85	0.85	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.87	0.87
		sc3: Information (RFI)	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.75	0.75
		sc4: Bids (RFB)	0.65	0.65	0.65	0.65	0.66	0.66	0.66	0.65	0.65	0.65	0.65
	Contracting (CNF)	cnf1: price	0.62	0.63	0.62	0.63	0.70	0.70	0.70	0.70	0.75	0.78	0.78
		cnf2: quality standards	0.64	0.64	0.64	0.64	0.70	0.70	0.70	0.70	0.63	0.60	0.60
		cnf3: customization possibilities	0.54	0.54	0.54	0.55	0.60	0.60	0.60	0.69			
		cnf4: delivery schedules	0.72	0.72	0.73	0.72							
		cnf5: delivery quantities	0.78	0.78	0.78	0.77	0.61	0.61	0.61	0.61	0.59		
		cnf6: final contract	0.66	0.66	0.66	0.66	0.72	0.71	0.71	0.72	0.76	0.77	0.77
	Requisitioning (RNF)	mf1: approves orders	0.13										
		mf2: places orders	0.20										
		mf3: processes supplier invoices	0.85										
		mf4: processes payments	0.67										
	Intelligence/Analysis (IANF)	ianf1: orders of materials	0.59	0.59	0.59	0.52	0.51	0.52					
		ianf2: shipments of materials	0.58	0.58	0.58								
		ianf3: product specifications and data	0.50	0.50	0.50	0.48	0.47	0.50	0.48				
		ianf4: complaints of defective/late materials and/or deliveries	0.63	0.63	0 63	0.61	0.60	0.58	0.56	0.53	0.53	0.53	0.53
		ianf5: suppliers performance	0.73	0.73	0.73	0.74	0.74						
		ianf6: historical spending on materials	0.69	0.69	0.69	0.71	0.71	0.74	0.75	0.76	0.76	0.76	0.76
		ianf7: demand of materials	0.70	0.70	0.70	0.70	0.70	0.75	0.76	0.75	0.74	0.74	0.74
		ianf8: procurement performance	0.84	0.84	0.84	0.86	0.86	0.81	0.80	0.81	0.82	0.82	0.82
		Chi-Squared	911.96	683.99	642.05	489.17	313.67	249.55	209.20	175.67	133.80	106.60	78 09
		df	294	205	185	166	148	131.00	115.00	100.00	86.00	73.00	61 00
		Chi-Squared/df	3.10	3.34	3.47	2.95	2.12	1.90	1.82	1.76	1.56	1.46	1.28
		p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07
		RMR	0.15	0.12	0.12	0.10	0.09	0.09	0.08	0.07	0.07	0.07	0.07
		GFI	0.73	0.75	0.76	0.80	0.86	0.87	0.89	0.90	0.92	0.93	0.94
		AGFI	0.68	0.70	0.69	0.74	0.82	0.83	0.85	0.86	0.88	0.89	0.91
		NFI	0.64	0.69	0.70	0.74	0.81	0.83	0.85	0.87	0.89	0.90	0.92
		TLI	0.69	0.73	0.73	0.79	0.87	0.90	0.91	0.92	0.95	0.96	0.98
		CFI	0.72	0.76	0.76	0.81	0.89	0.91	0.92	0.94	0.96	0.97	0 98
		RMSEA	0.11	0.11	0.11	0.10	0.08	0.07	0.07	0.06	0.05	0.05	0.04
		ECVI	5.37	4.08	3.84	3.02	2.08	1.73	1.49	1.30	1.06	0.89	0.72
		Reliability	0.70	0.76	0.75	0.76	0.77	0.77	0.78	0.77	0.77	0.77	0.77

Table 14. Model Refinement Process for Procurement Practices (PPR)

The path coefficients are above 0.55 for the four dimensions of the construct procurement practices (PPR). The overall model fit indicators show the measurement model shown in Figure 6 an accepted model for measuring procurement practices (PPR).

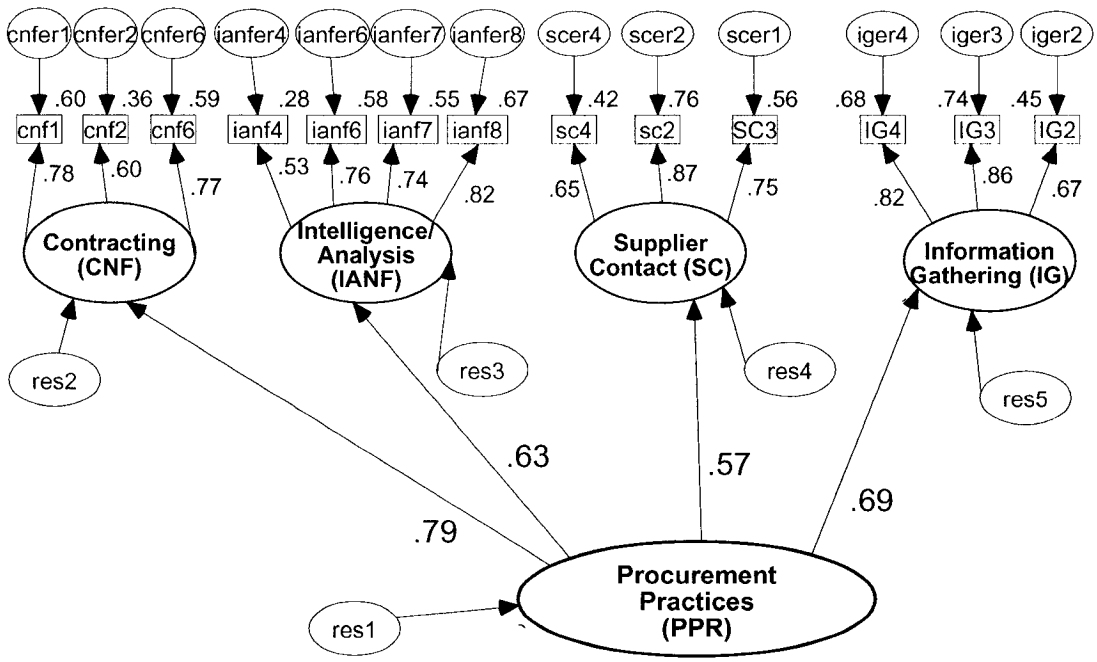


Figure 6. Procurement Practices (PPR) Measurement Model

Content validity was assessed in the pre-test with literature review and interviews with practitioners and academicians. Discriminant validity of the construct procurement practices (PPR), along with the correlations are shown in Table 15. Discriminant validity is verified by a significant difference in chi-squared test between correlated and uncorrelated models, where all pairs of dimensions demonstrated discriminant validity at $p < 0.001$. Bivariate correlation analysis was

used to confirm the correlation among the dimensions, all correlations showed to be significant in a two tail test.

	Correlation (χ^2 [constrained model] - χ^2 [unconstrained model)]		
	IG	SC	CNF
SC	0.373 (χ^2 = 58.2)*		
CNF	0.417 (χ^2 = 92.5)*	0.356 (χ^2 = 102.1)*	
IANF	0.328 (χ^2 = 192.0)*	0.193 (χ^2 = 81.5)*	0.450 (χ^2 = 81.3)*

*p-value<0.001

Table 15. Discriminant Validity and Correlation for Procurement Practices (PPR)

Table 16 shows the composite reliability and mean and standard deviations for the dimensions of procurement practices. Reliability was assessed for each dimension using the composite reliability (Figure 4). All reliability estimates exceed customary acceptable levels of 0.7.

	IG	SC	CNF	IANF
Reliability	0.83	0.76	0.72	0.72
Mean	3.38	3.27	4.36	3.93
(Std.Dev)	(0.939)	(1.047)	(0.713)	(0.884)

Table 16. Reliability and Descriptive Statistics for Procurement Practices (PPR)

Mean responses for the four procurement practices ranged from 3.27 to 4.36. The most commonly used procurement practice is contracting (CNF) followed by intelligence and analysis (IANF). These levels of procurement practices indicate that the procurement activities could be further improved. There is a window of opportunity for continuous improvement.

The previous data analyzes support the measurement model for procurement practices (PPR) as a second-order with four first-order factors (information gathering, supplier contact, contracting and intelligence and analysis). A measurement model for the first construct has been accepted, therefore, the researcher should duplicate the procedure for both eprocurement technology usage (EPT) and procurement performance (PP).

4.3.2. eProcurement technology usage (EPT)

eProcurement is defined as any electronically mediated technology which facilitates the acquisition of goods and/or services by one business organization from another business organization. eProcurement technology usage measures the extent of usage of eprocurement technologies for facilitating procurement tasks. The eprocurement technology usage (EPT) construct was represented by 9 items in the large-scale questionnaire. The original 9 items and their corresponding code names are listed in Table 17.

Code Names	Questionnaire Items
eProcurement Technology Usage (TU)	
Extent of usage of the following technology in your firm which facilitates procurement tasks	
ept1	Internet Search Engines
ept2	Extranet
ept3	Electronic Data Interchange (EDI)
ept4	Email
ept5	Electronic Catalogs
ept6	Electronic File Transferring (FTP)
ept7	Video Conferencing
ept8	Electronic Markets
ept9	Internet Auctions/Reverse Auctions

Table 17. eProcurement Technology Usage (EPT) - Large-Scale Study Items

The same purification procedure explained for procurement practices (PPR) was followed for this construct. The following is a description of each of the justifications for each of the deletions performed in the 5 trials for eprocurement technology usage (EPT), until an accepted model was achieved. Appendix E contains all the path diagrams for the different trials for achieving a good model fit for eprocurement technology usage. Table 18 shows a summary of each of the trials performed in AMOS 5.0.

1. ept4 showed a low path coefficient < 0.5. Also, email was argued to be a strong item for the construct, since it is not directly related to procurement practices. The researcher deleted ept4 for further analyses.
2. ept1 shows a very low path coefficient (.42). It has high modification indexes. It can be justified to delete it since search engines are just a search tool, and not a procurement tool itself.
3. ept2 and ept5 show path coefficients below 0.5. ept5 present high modification indexes with other items. Therefore, the researcher deleted ept5.
4. ept2 still shows a path coefficient less than 0.5, therefore the researcher proceeds to delete this item for further analyses.

As seen in Table 18, the last trial (MM_EPT4) is an accepted model fit. The ratio chi-squared/degrees of freedom is 1.57; a p-value for the hypothesis stating that the model fits perfectly in the population of 0.16; RMR of 0.05 representing the average squared amount by which the sample variances and covariances differ from their estimates obtained under the assumption that the model is correct

(Arbuckle and Wothke, 1999); all GFI, AGFI, NFI, TLI and CFI are above 0.95; RMSEA is 0.05 and ECVI changed from 0.58 in the first trial to 0.15 in the last trial, providing evidence that the model has been significantly improved.

Trials		1	2	3	4	5
AMOS File Name (.amw)		MM_EPT1	MM_EPT2	MM_EPT3	MM_EPT4	MM_EPT5
Path Coefficients	ept1: Internet Search Engines	0.42	0.42			
	ept2: Extranet	0.49	0.50	0.47	0.45	
	ept3: EDI	0.63	0.63	0.65	0.67	0.67
	ept4: e-mail	0.40				
	ept5: e-Catalogs	0.49	0.49	0.45		
	ept6: FTP	0.69	0.66	0.67	0.67	0.67
	ept7: Video Conferencing	0.60	0.60	0.62	0.62	0.64
	ept8: eMarkets	0.64	0.66	0.66	0.64	0.65
	ept9: Internet/Reverse Auctions	0.62	0.63	0.62	0.63	0.61
Chi-Squared		74.50	59.24	25.12	12.33	7.86
df		27	20	14	9	5
Chi-Squared/df		2.76	2.96	1.79	1.37	1.57
p-value		0.00	0.00	0.03	0.20	0.16
RMR		0.08	0.09	0.06	0.05	0.05
GFI		0.92	0.93	0.97	0.98	0.98
AGFI		0.86	0.87	0.93	0.95	0.95
NFI		0.82	0.85	0.92	0.96	0.97
TLI		0.84	0.85	0.94	0.98	0.98
CFI		0.88	0.89	0.96	0.99	0.99
RMSEA		0.10	0.10	0.06	0.04	0.05
ECVI		0.58	0.48	0.28	0.19	0.15
Reliability		0.80	0.80	0.79	0.78	0.78

Table 18. Model Refinement Process for eProcurement Technology Usage (EPT)

The path coefficients are above 0.60 from five of the six indicators to the construct eprocurement technology usage (EPT). The overall model fit indicators support the measurement model shown in Figure 7 as accepted model for measuring eprocurement technology usage (EPT).

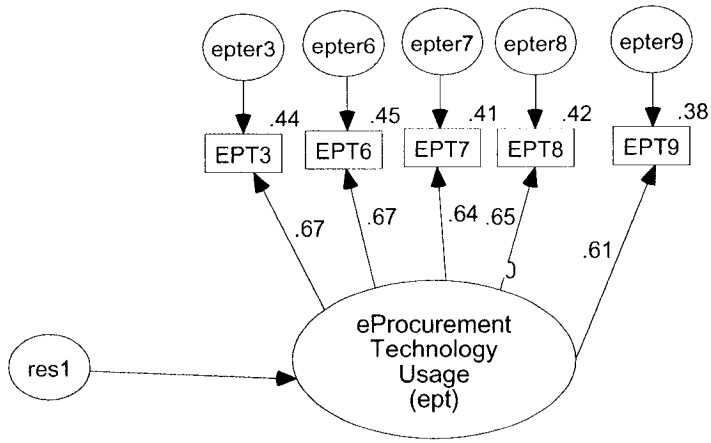


Figure 7. eProcurement Technology Usage (EPT) Measurement Model

Content validity was assessed in the pre-test with literature review and interviews with practitioners and academicians. Discriminant validity of the construct eprocurement technology usage (EPT) will be tested in the structural equation modeling. Since there are no sub dimensions, the researcher cannot test internal discriminant validity of the dimensions. eProcurement technology usage is a first-order factor with 6 items. Reliability was assessed using the composite reliability formula in Figure 4 (see Table 19). The previous data analyzes support the measurement model for eprocurement technology usage (EPT) as a first-order with five indicators.

	EPT
Reliability	0.78
Mean	2.37
(Std.Dev)	(0.895)

Table 19. Reliability and Descriptive Statistics for eProcurement Technology Usage

A measurement model for the first construct has been accepted, therefore, the researcher should replicate the procedure for procurement performance (PP).

4.3.3. Procurement Performance (PP)

Procurement performance is defined as the level of improvements in the benefits due to the procurement practices in the firm. The procurement performance (PP) construct was represented by three dimensions and 21 items in the large-scale questionnaire, which are distributed as: internal performance (IP) with 8 items, supplier-related (SR) with 5 items and internal customer (IC) with 8 items. The original 21 items and their corresponding code names are listed in Table 20.

Code Names	Questionnaire Items
Internal Performance (IP)	
Our procurement practices have helped our firm to:	
pp1	Reduce transaction time
pp2	Reduce transaction costs
pp3	Reduce search costs
pp4	Reduce paperwork
pp5	Reduce order processing errors
pp6	Increase materials/service quality
Supplier-Related Performance (SP)	
Our procurement practices have helped our firm to:	
pp7	Reduce "maverick buying"
pp8	Reduce number of suppliers
pp9	Reduce inventories
pp10	Reduce cost of materials/cost of providing services
pp11	Improve communication with suppliers
pp12	Improve partnership with suppliers
pp13	Improve data sharing with suppliers
Internal Customer-Related Performance (IC)	
Our procurement practices have helped our firm to:	
pp14	Improve overall service quality to internal customers
pp15	Increase reliability of information to internal customers (reports,updates)
pp16	Meet internal customer expectations
pp17	Increase communication with internal customers
pp18	Deliver on-time products/services to internal customers
pp19	Deliver on-time information to internal customers (reports, updates)
pp20	Increase quality products/services to internal customers
pp21	Increase flexibility to internal customer's changing needs

Table 20. Procurement Performance (PP) - Large-Scale Study Items

The following is a description of each of the justifications for each of the deletions performed in the 9 trials for procurement performance (PP), until an accepted model was achieved. Appendix F contains all the path diagrams for the different trials for achieving a good model fit for procurement performance. Table 21 shows a summary of each of the trials performed in AMOS 5.0.

1. There is a high correlation between pp1 and pp2 (0.837). Responders might have been confused since organizations reduce transaction costs by reducing transaction time. The researcher deleted pp2.
2. There is a high correlation between pp11 and pp12 (0.751). Communications with suppliers is improved by default if firms improve supplier partnership. Delete pp11, since pp12 is a broader concept.
3. pp12 and pp13 show high correlation (0.65). Modification indexes show evidence to delete pp12, however, pp13 is included in pp12 and conceptually, it is better to keep pp12.
4. pp8 shows high modification indexes. The wording could be confused since by reducing suppliers itself, it does not improve the procurement performance.
5. pp16 is reflected already in pp14, and this might be causing some problems. Overall service quality is improved only if customer expectations are met. The researcher deleted pp16.
6. pp20 is highly correlated to pp19, pp18, pp14. Quality might have been perceived by the responder as the TQM approach, not just as the physical quality of the products. The researcher deleted pp20.

7. pp19 has highly correlated error terms with pp14 and pp15. pp14 (overall service quality) could be interpreted as including pp19 (delivering on-time information), and therefore, the researcher delete pp19.
8. The model can still be improved, even though a lot of the model fit criteria has been met. However, AGFI is still below 0.9 and RMSEA is higher than 0.05. pp6 and pp7 both show high modification indexes. Pp7 shows lower path coefficient, however, conceptually, the researcher found important to keep the maverick effect into the construct and delete pp6.

As seen in Table 21, the last trial (MM_PP9) is an accepted model fit. The ratio chi-squared/degrees of freedom is 1.44; a p-value for the hypothesis stating that the model fits perfectly in the population of 0.01; RMR of 0.04 representing the average squared amount by which the sample variances and covariances differ from their estimates obtained under the assumption that the model is correct, (Arbuckle and Wothke, 1999); all GFI, AGFI, NFI, TLI and CFI are above 0.9; RMSEA is 0.05 and ECVI changed from 3.08 in the first trial to 0.77 in the last trial, providing evidence that the model has been significantly improved.

The overall model fit indicators show the measurement model shown in Figure 8 an accepted model for measuring procurement performance (PP).

Trials			1	2	3	4	5	6	7	8	9
AMOS File Name (.amw)			MM_PP1	MM_PP2	MM_PP3	MM_PP4	MM_PP5	MM_PP6	MM_PP7	MM_PP8	MM_PP9
Path Coefficients	Internal Performance (IP)	pp1: Reduce transaction time	0.89	0.79	0.78	0.78	0.78	0.78	0.79	0.78	0.79
		pp2: Reduce transaction costs	0.90								
		pp3: Reduce search costs	0.70	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
		pp4: Reduce paperwork	0.72	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.81
		pp5: Reduce order processing errors	0.65	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.71
	Supplier-Related (SR)	pp6: Increase materials/service quality	0.53	0.54	0.60	0.63	0.61	0.62	0.61	0.61	
		pp7: Reduce "maverick buying"	0.51	0.52	0.59	0.66	0.59	0.59	0.59	0.58	0.53
		pp8: Reduce number of suppliers	0.52	0.52	0.60	0.66					
		pp9: Reduce inventories	0.49	0.49	0.53	0.55	0.56	0.55	0.55	0.56	0.55
		pp10: Reduce cost of materials/cost of providing services	0.58	0.48	0.63	0.63	0.65	0.65	0.65	0.64	0.65
		pp11: Improve communication with suppliers	0.84	0.83							
		pp12: Improve partnership with suppliers	0.80	0.80	0.70	0.62	0.67	0.67	0.67	0.67	0.70
		pp13: Improve data sharing with suppliers	0.75	0.76	0.69						
	Internal Customer (IC)	pp14: Improve overall service quality to internal customers	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.84	0.83
		pp15: Increase reliability of information to internal customers (reports,updates)	0.72	0.72	0.71	0.71	0.72	0.70	0.72	0.68	0.68
		pp16: Meet internal customer expectations	0.76	0.76	0.76	0.76	0.76				
		pp17: Increase communication with internal customers	0.74	0.74	0.74	0.74	0.74	0.71	0.72	0.69	0.70
		pp18: Deliver on-time products/services to internal customers	0.77	0.77	0.77	0.78	0.78	0.78	0.76	0.76	0.75
		pp19: Deliver on-time information to internal customers (reports, updates)	0.78	0.78	0.78	0.78	0.78	0.79	0.78		
		pp20: Increase quality products/services to internal customers	0.81	0.81	0.82	0.82	0.81	0.82			
		pp21: Increase flexibility to internal customer's changing needs	0.74	0.74	0.74	0.74	0.74	0.75	0.74	0.73	0.73
Chi-Squared			497.84	452.45	385.05	322.24	248.01	183.86	165.03	122.85	89.10
df			186	167	149	132	116	101.00	87.00	87.00	62.00
Chi-Squared/df			2.68	2.71	2.58	2.44	2.14	1.82	1.90	1.41	1.44
p-value			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RMR			0.06	0.05	0.05	0.05	0.04	0.04	0.05	0.04	0.04
GFI			0.80	0.81	0.83	0.85	0.88	0.90	0.90	0.92	0.94
AGFI			0.75	0.76	0.78	0.81	0.84	0.86	0.86	0.88	0.91
NFI			0.81	0.81	0.82	0.83	0.86	0.88	0.88	0.90	0.92
TLI			0.85	0.85	0.86	0.88	0.91	0.93	0.93	0.95	0.97
CFI			0.87	0.87	0.88	0.89	0.92	0.94	0.94	0.96	0.97
RMSEA			0.09	0.10	0.09	0.09	0.08	0.07	0.07	0.06	0.05
ECVI			3.08	2.82	2.45	2.10	1.69	1.33	1.21	0.97	0.77
Reliability			0.86	0.89	0.86	0.84	0.86	0.86	0.86	0.87	0.87

Table 21. Model Refinement Process for Procurement Performance (PP)

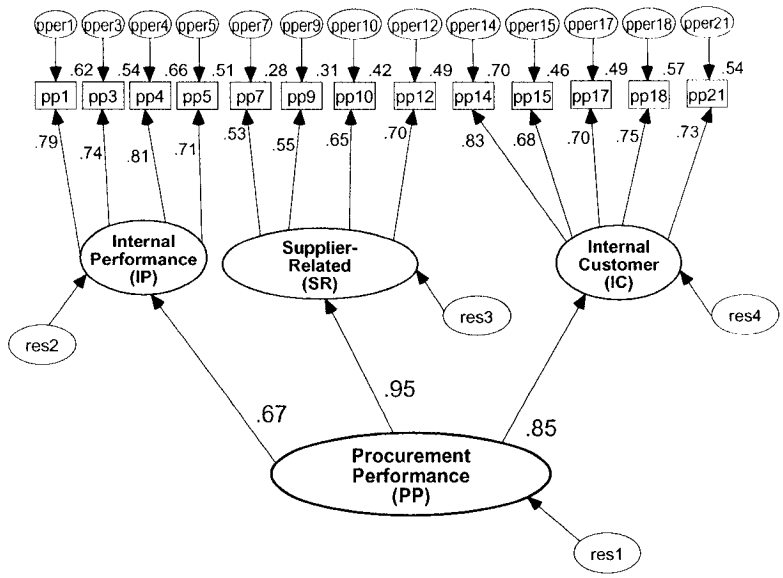


Figure 8. Procurement Performance (PP) Measurement Model

Content validity was assessed in the pre-test with literature review and interviews with practitioners and academicians. Discriminant validity of the construct procurement performance (PP), along with the correlations are shown in Table 22. Discriminant validity is verified by the difference in chi-squared test between correlated and uncorrelated models where all pairs of dimensions demonstrated discriminant validity at $p < 0.001$. All correlations were significant using a two-tail test, proving the correlation among dimensions.

	Correlation (χ^2 [constrained model] - χ^2 [unconstrained model])	
	IP	**SR**
SR	0.480 (χ^2 = 59.4)*	
IC	0.495 (χ^2 = 170.9)*	0.606 (χ^2 = 19.7)*

*p-value<0.001

Table 22. Discriminant Validity and Correlation for Procurement Performance (PP)

Reliability was assessed for each dimension using the composite reliability (Figure 4). Table 23 shows the composite reliability and mean and standard deviations for the dimensions of procurement performance. All reliability estimates exceed customary acceptable levels (higher than 0.75 for all of them). Respondents evaluated their firm's procurement performance most highly on internal customer (3.90), followed by supplier-related (3.82) and internal performance (3.44). All three levels of procurement performance indicate that performance could be further improved.

	IP	SR	IC
Reliability	0.85	0.75	0.86
Mean	3.44	3.82	3.90
(Std.Dev)	(0.858)	(0.716)	(0.618)

Table 23. Reliability and Descriptive Statistics for Procurement Performance (PP)

The previous data analyzes support our measurement model for procurement performance (PP) as a second-order with three first-order factors (internal performance, supplier-related and internal customer).A measurement model for the first construct has been accepted; therefore, the researcher has the complete set of accepted measurement models and can proceed with the structural equation model.

5. Causal Model and Hypothesis Testing

The presence of a moderating variable in the theoretical model proposed in Figure 1 forces the researcher to first perform a moderating regression analysis (MRA) for testing H2 before testing the other hypotheses in a structural equation model.

5.1. Moderating Regression Analysis (MRA)

The original model shows H2, which is the hypothesis that states eprocurement technology practices (EPT) as a moderating variable in the relationship between procurement practices (PPR) and procurement performance (PP). According to Sharma, Durand et al., 1981, one should examine three regression equations for equality of regression coefficients (Figure 9), when applying MRA in terms of one predictor variable:

$$(a)\ y = a + b_1 x \Rightarrow PP = a + b_1 PPR$$
$$(b)\ y = a + b_1 x + b_2 z \Rightarrow PP = a + b_1 PPR + b_2 EPT$$
$$(c)\ y = a + b_1 x + b_2 z + b_3 xz \Rightarrow PP = a + b_1 PPR + b_2 EPT + b_3 PPR * EPT$$

Figure 9. Equations required for Moderating Regression Analysis (MRA)

The researcher run a regression analysis for each of the cases, and obtained the following results:

Equation	b_1	b_2	b_3
(a)	0.531*	-	-
(b)	0.464*	0.182*	-
(c)	0.286*	-0.232	0.512
*Significantly different than 0 at α = 0.05			

Table 24. Moderating Regression Analysis (MRA) results (Standardized Coefficients)

Notice that equation (c) represents the moderating effect of eprocurement technology usage (EPT) on the relationship between procurement practices (PPR) and procurement performance (PP). However, the coefficient for the interaction is not significantly different from zero, and therefore, there is no impact of this interaction on the prediction of procurement performance (PP). This allows the researcher to conclude that eprocurement performance is not a moderating variable and H2 is not supported. However, the researcher decides to include a variation of H2 in the structural equation model, since equations (a) and (b) showed a possible direct and indirect effect of eprocurement technology usage (EPT) on procurement performance (PP). The following section is the analysis and development of the structural equation model for testing the support of the substantial hypotheses shown in Figure 1.

Shin and Collier, 2000 stated that "structural equation models decompose the empirical correlation or covariance among the variables to estimate the path coefficients". In order to provide the literature with a good causal model, the researcher first provides accepted measurement models. Secondly, the final structural equation model with the substantial hypothesis about the relationships among the constructs is presented. The measurement models were accepted in the previous chapter; therefore, the researcher will continue presenting the results for the structural equation model.

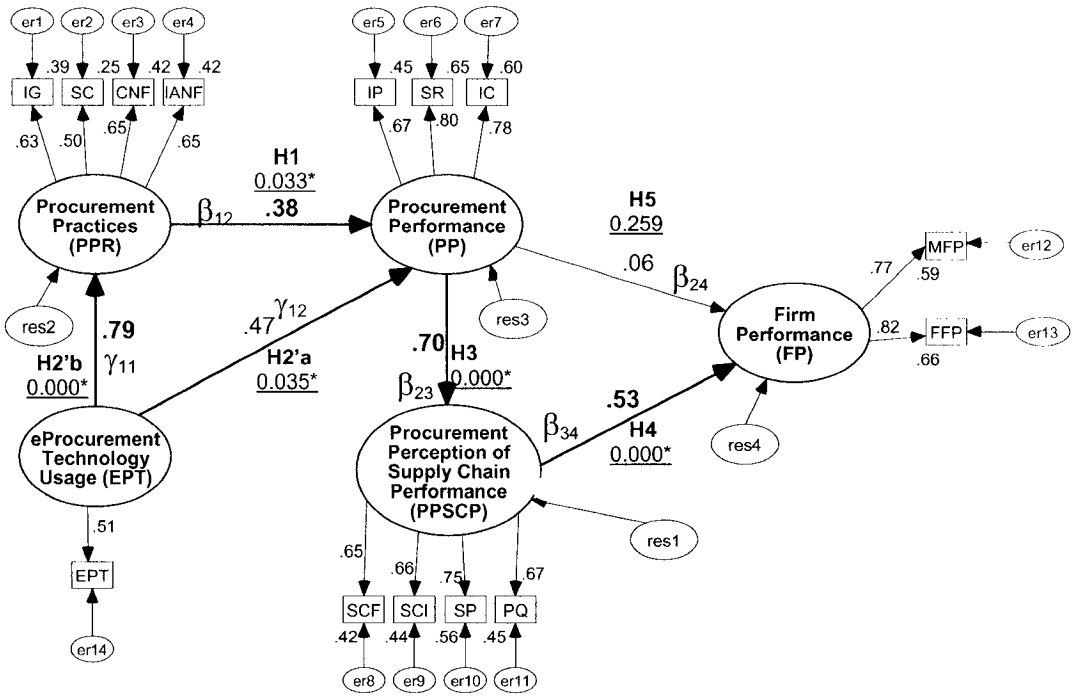
5.2. Structural Equation Model (SEM)

The method for structural equation model is that the researcher states a model based on theoretical foundations. Then, the research tests its plausibility based on sample data that comprise all observed variables in the model. If the discrepancy between the theoretical model and the data-oriented model is small, the theoretical model is statistically well fitting, and thus, substantially meaningful (Zhang, 2001).

The researcher used a sample of 368 cases. Two percent of the data was taken out of the analysis since the respondents specified that they have not used eprocurement at all. First, the averaged score of the items loaded for each dimension of each construct was computed. Second, these scores were used as indicators for the corresponding construct. In the case there are no dimensions (i.e. eprocurement technology usage –EPT), all the items are put together in one dimension (it does not mean that EPT is measured only by one item). Schumacker and Lomax, 1996 indicate that the use of items from an instrument to measure the latent variables in a structural model increases the degrees of freedom in the structural equation model and may cause problems in model fit.

The structural equation model is shown as a path diagram in Figure 10. In this model, eprocurement technology usage (EPT) is treated as the exogenous variable (ξ_1). The endogenous variables include procurement practices (η_1), procurement performance (η_2), procurement perception of supply chain performance (η_3) and firm performance (η_4). Exogenous latent variables (i.e. independent variables, X-variables) cause fluctuations in the values of other

latent variables in the model. Changes in the values of exogenous variables are not explained by the model. Endogenous latent variables (i.e. dependent variables, Y-variables) are affected by the exogenous variables in the model, either directly or indirectly.



*Significant at 0.05 level.

Figure 10. Structural Equation Model

The general structural equation model relating the above latent exogenous and endogenous variables is:

$$\eta = \beta\eta + \tau\xi + \zeta$$

Figure 11. Structural Equation Model in Equation Format

where η is a (4x1) vector of latent endogenous variables; ξ is a (1x1) vector of the latent exogenous variable; τ is a (1x1) vector of coefficients relating the exogenous variable to 1 endogenous variable; β is a (4x4) vector of coefficients relating the 4 endogenous variables to one another; and ζ is a (4x1) vector of errors in the structural equations.

The structural equation model showed a good fit between the theoretical model and the data. Measures of absolute fit of the model to the data show a high degree to which the overall model predicts the observed covariance matrix (χ^2/df = 2.52, RMR = 0.04, GFI = 0.93, RMSEA = 0.06). Measures of incremental fit show a good fit (AGFI = 0.90, NFI = 0.90, TLI = 0.92 and CFI = 0.93). Overall, the model is accepted as a good model fit.

As shown in Table 25, four out of six hypothesized paths were significant at a level of significance of 0.05.

Hypothesis	Relationship	Path	Standardized Estimate	p-value	Significantly Supported (α=0.05)
H1	PPR→PP	β_{12}	0.38	0.033	Yes
H2'A	EPT→PP	γ_{12}	0.47	0.035	Yes
H2'B	EPT→PPR	γ_{11}	0.79	0.000	Yes
H3	PP→PPSCP	β_{23}	0.70	0.000	Yes
H4	PPSCP→FP	β_{34}	0.53	0.000	Yes
H5	PP→FP	β_{24}	0.06	0.259	No

Table 25. Summary of Structural Equation Model Results for Hypothesis Testing

The results support the following set of equations:

$$\eta_1 = \gamma_{11}\xi_1 + \zeta_1 \quad \text{(a)}$$
$$\eta_2 = \beta_{12}\eta_1 + \zeta_2 \quad \text{(b)}$$
$$\eta_3 = \beta_{23}\eta_2 + \zeta_3 \quad \text{(c)}$$
$$\eta_4 = \beta_{34}\eta_3 + \zeta_4 \quad \text{(d)}$$

Figure 12. Accepted Structural Equations

The results indicate that eprocurement technology usage (EPT) affects both procurement practices (PPR) and procurement performance (PP). Presutti, 2003 supports theoretically that eprocurement technology usage significantly improves the effectiveness and efficiency of the procurement process.

The researcher also found that procurement performance (PP) affects firm performance (FP) by indirectly affecting procurement perception of supply chain performance (PPSCP). However, no direct relationship exists between PP and FP. This result could be explained by the fact that supply chain management practices are forcing firms to focus on supply chain performance first and then, on their own performance. As stated in supply chain management principles, supply chain performance directly affects firm performance (Li, 2002). Therefore, firms that work for improving supply chain performance will at the end, improve firm performance.

The researcher deleted the non-significant paths in the model, and rerun the AMOS structural equation model. The results are presented in the following section.

5.3. Alternate Recommended Structural Equation Model (SEM)

The structural equation model was developed without the two non-significant paths from Figure 10. The results are presented in the following figure.

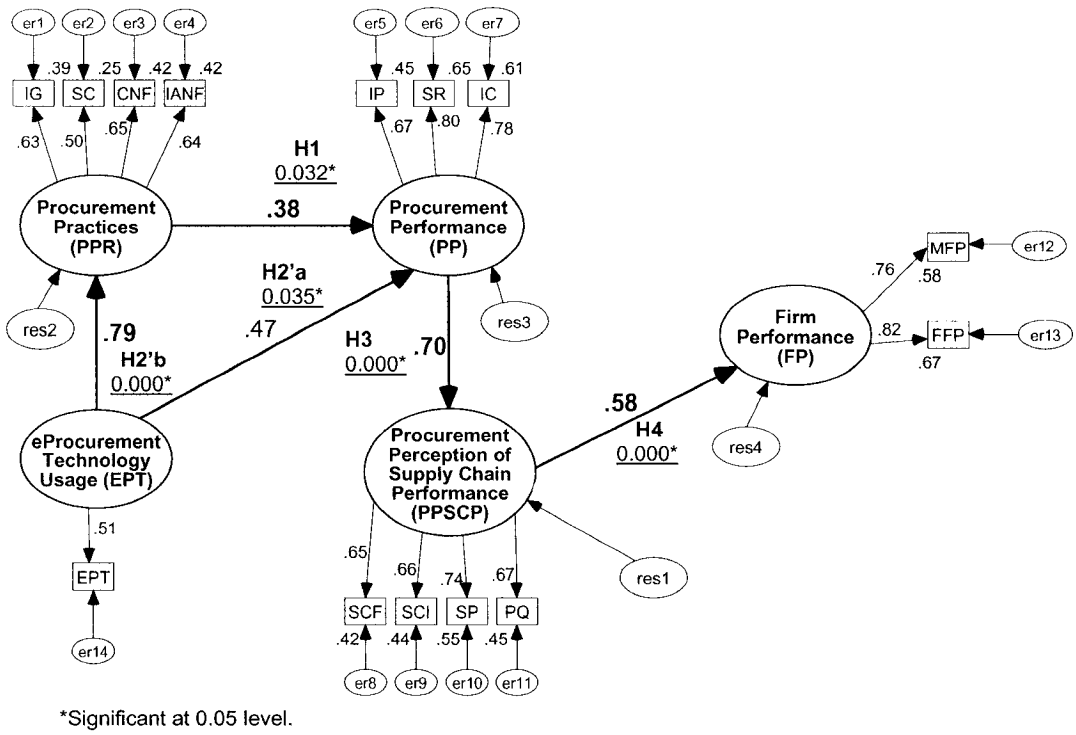


Figure 13. Alternate Recommended Structural Equation Model

The alternate structural equation model showed a good fit between the theoretical model and the data. Measures of absolute fit of the model to the data show a high degree to which the overall model predicts the observed covariance matrix (χ^2/df = 2.495, RMR = 0.04, GFI = 0.93, RMSEA = 0.06). Measures of incremental fit show a good fit (AGFI = 0.90, NFI = 0.90, TLI = 0.92 and CFI = 0.93). Overall, the model is accepted as a good model fit.

Content validity was assessed with literature review and interviews with practitioners and academicians. Reliability was assessed for each dimension

using the composite reliability (Figure 4). All reliability estimates exceed customary acceptable levels (higher than 0.75 for all of them). Reliabilities along with the mean and standard deviations are shown in Table 26.

	EPT	PPR	PP	SCP	FP
Realibility	0.77	0.77	0.80	0.82	0.77
Mean	2.53	3.84	3.73	3.61	3.46
(Std.Dev)	(0.807)	(0.621)	(0.642)	(0.534)	(0.706)

Table 26. Reliability and Descriptive Statistics for Structural Equation Model.

Discriminant validity was assessed by comparing the chi-squared and degrees of freedom differences between the constrained model and the unconstrained model relating two dimensions. This process was done for all pair of constructs, and no significant differences were found at 0.001 level of significance (see Table 27). The correlations among constructs are also shown in Table 27. All correlations were significant using a two-tail test.

	Correlation (χ^2 [constrained model] - χ^2 [unconstrained model])			
	EPT	**PPR**	**PP**	**PPSCP**
PPR	0.376 (χ^2 = 143.2)*			
PP	0.363 (χ^2 = 233.9)*	0.548 (χ^2 = 60.1)*		
PPSCP	0.333 (χ^2 = 245.3)*	0.429 (χ^2 = 118.4)*	0.536 (χ^2 = 118.5)*	
FP	0.220 (χ^2 = 162.2)*	0.273 (χ^2 = 148.0)*	0.321 (χ^2 = 146.2)*	0.444 (χ^2 = 110.7)*

*p-value<0.001

Table 27. Discriminant Validity and Correlation for Structural Equation Model.

The model has been tested for reliability and validity, and therefore, the researcher can focus on the hypotheses testing. Each path with a single headed arrow is estimated by a structural equation. The path coefficients between each

pairs of factors show p-values less than 0.05. This means that the paths in the model shown in Figure 13 are positive and significant. These results are the test for accepting the hypotheses H1, H2'a, H2'b, H3 and H4. The following section is a detail explanation of the hypotheses tested.

5.4. A Summary of the Hypotheses Testing using SEM

The structural equation model had the main interest of testing the substantive hypotheses stated in Chapter 2. The researcher will explain the implications of accepting/rejecting the respective hypotheses.

H1: Procurement practices have a direct positive relationship with procurement performance.

The structural equation model supports this hypothesis. The strength of the relationship between procurement practices and procurement performance is 0.47, which presents a p-value of 0.005. Theoretically, this hypothesis shows that when the dimensions for procurement practices are high, the dimensions for procurement performance are also high. Information gathering, supplier contact, contracting and intelligence and analysis are important procurement practices that affect positively the procurement performance (i.e. internal performance, supplier-related performance and internal customer performance). This result suggests that firms with procurement managers investing resources to seriously pursue better procurement practices achieve higher levels of procurement performance than firms with lower levels of commitment into their procurement practices.

H2: eProcurement technology usage has a moderating effect on the relationship between procurement practices and procurement performance.

The moderating regression did not support the hypothesis that eprocurement technology usage acts as moderator in the relationship between procurement practices and procurement performance. A plausible explanation for this result could be found in the low percentage of transactions using eprocurement. Only 17.4% of the respondents answered more than 31% of their procurement transactions are done via eprocurement technologies. Therefore, the moderating effect of eprocurement technology usage on the relationship between procurement practices and procurement performance could be weak at this point. The researcher hypothesizes that this result will change when firms are in higher levels of implementation and use of eprocurement technologies. From the moderating regression results, the researcher decided to include two modifications to H2, which are analyzing the direct effects of eprocurement technology usage separately on procurement practices and procurement performance.

H2'a: eProcurement technology usage has a direct positive relationship with procurement performance.

The path coefficient between eprocurement technology usage and procurement performance was 0.37 with a p-value of 0.05. Using a significance level of 0.05, this value is in the limit, and the researcher supports the hypothesis. This result implies that when procurement departments have higher levels of usage of eprocurement technologies, the impact on procurement performance will be

positive. Therefore, firms using more eprocurement technologies for their transactions and communications will receive higher levels of procurement performance results.

H2'b: eProcurement technology usage has a direct positive relationship with procurement practices.

eProcurement technology usage affects directly procurement practices, as supported by the structural equation model. This means that higher usage of these technologies will improve the levels of procurement practices. Therefore, managers should seriously consider the usage of eprocurement technologies as a means for continuously improving their information gathering, supplier contact, contracting and intelligence and analysis practices.

H3: Procurement performance has a direct positive relationship with procurement perception of supply chain performance.

As expected, procurement performance has a direct and positive effect on procurement perception of supply chain performance. If individual firms improve their procurement practices in order to achieve improvements on procurement performance, then, the whole supply chain will receive the benefits of these improvements. This result represents the importance of the procurement function in the whole supply chain. By improving individual procurement performance measures, firms are working not only towards their own departmental benefits but towards their supply chain benefits, which in turn provides them with higher competitiveness in the marketplace, as stated in the supply chain management literature (Beamon, 1999, Choon Tan, Lyman et al., 2002, Presutti, 2003).

H4: Procurement perception of supply chain performance has a positive relationship with firm performance.

The benefits of the supply chain will affect individual firm performance. If the organizations work together to improve their supply chain performance, at the long run they will have improvements in their own firm performance (Li, 2002). Therefore, the higher the level of supply chain performance, the higher the level of firm performance. This hypothesis was statistically supported.

H5: Procurement performance has a direct positive relationship with firm performance.

The last hypothesis in the model was not supported by the data. This means that higher procurement performance does not mean a direct improvement in firm performance. The effect of procurement performance on firm performance is indirect by affecting supply chain performance. This result was surprising and not expected by the researcher. A plausible explanation for this result could be found in the fact that supply chain management is attracting firms into the mindset of working towards the supply chain performance and less on individual firm performance. The first affected by this mindset is the procurement function since it is a crucial component in the supply chain. An additional explanation could be based in the fact that all areas of a company affect firm performance, and the efforts of a single area could not be sufficient if the other areas of the company do not support it. A different situation is in affecting supply chain performance in which again it is affected not only by the procurement performance but indeed

this function is critical and its impact sufficient to show results on supply chain performance.

The following chapter helps in understanding in detail the implications of the structural equation results. It goes to a dimension-level analysis to explore which eprocurement technologies affect which procurement practices and procurement performance dimensions.

6. Dimension-Level Analysis

Structural equation modeling allows the researcher to prove causal relationships among variables. In the last chapter, the researcher showed a positive relationship between eprocurement technology usage and both procurement practices and procurement performance. However, the researcher could not provide further conclusions on which eprocurement technologies are producing better results. Therefore, the researcher will perform a dimension-level analysis to further explore these relationships (eprocurement technology usage-procurement practices and eprocurement technology usage-procurement performance).

Dimension-level analysis was performed using ANOVA. First, the researcher did an ANOVA for testing differences between low, medium and high levels of procurement practices and procurement performance for each of the eprocurement technologies. Then, if significant differences were found, individual ANOVAs were performed for each dimension of procurement practices (information gathering – IG, supplier contact – SC, contracting – CN, intelligence and analysis – IANF) and procurement performance (internal performance – IP, supplier-related performance – SP and internal customer-related performance – IC). Finally, if significant differences were found, multiple comparisons tests were done in order to see the impact of each eprocurement technology usage on each

of the procurement practices and procurement performance dimensions. It is important to explain that the classification between low, medium and high users of the different eprocurement technologies was done by using the 25 and 75 percentiles. The following sections describe in detail the results obtained for each of the eprocurement technologies.

6.1. ept3: Electronic Data Interchange (EDI)

Electronic data interchange (EDI) is a set of standards and protocols for conducting highly structured interorganizational exchanges, such as for making purchases. In other words, EDI is the paperless exchange of information between business partners. The researcher first did the dimension-level analyses between EDI and procurement practices, and then, between EDI and procurement performance. The results are shown in the following sections.

Procurement Practices (PPR)

The ANOVA results shown in Table 28, indicate that there are differences between low, medium and high users of EDI for information gathering (IG) and supplier contact (SC).

ept3 Level	Procurement Practices (PPR) Dimensions							
	IG*		SC*		CNF		IANF	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.22	0.880	3.04	1.106	4.30	0.731	3.81	1.006
Medium	3.52	0.859	3.45	0.985	4.42	0.635	3.96	0.733
High	3.46	1.042	3.39	1.091	4.46	0.830	4.16	0.888

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept3 among procurement practices dimensions

Table 28. ANOVA results for differences in procurement practices levels among EDI levels of usage

The results are predictable. EDI is highly influencing the organization's procurement practices that relate to contacting suppliers and exchanging information with them. Contracting is the actual negotiation point where organizations must agree on price, quality standards and final contract terms, and therefore, it is not expected to be a highly standardized practice to be performed by means of EDI. Intelligence and analysis is an internal task of the organization and EDI should not greatly impact the way firms are developing their analyses on the data. Under intelligence and analysis, the researcher includes keeping track of historical spending on materials, demand of materials, procurement performance and complaints of defective/late materials and/or deliveries. Therefore it is not highly related to electronic data interchange.

The researcher explored more the differences found in ANOVA and performed multiple comparisons for information gathering (IG) and supplier contact (SC). The results are displayed on Table 29.

I - J	Mean Difference (I-J)	
	ept3 (EDI)	
	IG	SC
Medium-Low	0.30*	0.42*
High-Low	0.24	0.35
High-Medium	-0.06	-0.07
*Significant at 0.05.		

Table 29. Differences among levels of electronic data interchange (EDI) by procurement practices dimensions

As shown in the table, the two dimensions of procurement practices present significant differences between medium and low users of EDI. Some of the essential elements of EDI directly relate to supplier contact and information gathering, which are the use of structured, formatted messages based on agreed

standards; relatively fast delivery of electronic documents from sender to receiver and direct communication between applications. The results show no differences between high and low users and high and medium users. A plausible explanation could be that the perception of procurement people when they are high users of EDI is that they do not perform those activities as much as they used to, since they are automatically performed in the EDI system. Also, when high users of EDI have their systems completely implemented, they already have a few suppliers with high commitment relationships and contracts, and therefore, they do not need to search for other information, quotes, proposals and bids. It is important to emphasize that all practices show more than moderate levels in each of the procurement practices. This means that EDI users have moderate to high levels of procurement practices at all levels.

Procurement Performance (PP)

The ANOVA results show significant differences among all the procurement performance dimensions for EDI (see Table 30). All means are above 3.2 indicating that all users of EDI have from moderate to considerable procurement performance measures.

ept3 Level	Procurement Performance (PP) Dimensions					
	IP*		SR*		IC*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.23	0.883	3.57	0.799	3.77	0.708
Medium	3.55	0.726	3.88	0.697	3.90	0.625
High	3.94	0.891	4.03	0.796	4.14	0.722

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept3 among procurement performance dimensions

Table 30. ANOVA results for differences in procurement performance levels among EDI levels of usage

Since all procurement performance dimensions showed significant differences, the researcher explored further those dimensions to find what levels of EDI differ. The results are shown in Table 31.

I - J	Mean Difference (I-J)		
	ept3 (EDI)		
	IP	SR	IC
Medium-Low	0.32*	0.31*	0.13
High-Low	0.72*	0.46*	0.37*
High-Medium	0.40*	0.15	0.24
*Significant at 0.05.			

Table 31. Differences among levels of electronic data interchange (EDI) by procurement performance dimensions

EDI is proven to differentiate between high and low users when analyzing its impact to procurement performance. As shown on Table 31, all procurement performance dimensions show significant differences between high and low users of EDI. This result is very positive for those companies that have already implemented or are thinking about implementing EDI, since it reinforces the fact the EDI positively affects procurement performance. Analyzing in more detail, internal performance is highly impacted by EDI level of usage, since all levels are differentiated significantly. In the case of supplier-related performance, there is also a significant difference between medium and low users of EDI, which also suggests a positive result for current or potential users of this technology. EDI affects in a lower degree the internal customer performance, which is expected, since EDI is highly related to overall internal performance and supplier-related performance, but not so much to how procurement is doing in terms of servicing its internal customers.

6.2. ept6: Electronic File Transferring (FTP)

The ability to share information throughout and across organizations is essential in today's business environment. With the explosion of content creation and information in electronic format, there is simply more electronic data transferring today that it used to be in the past. Electronic file transferring by using the file transfer protocol (FTP) is an easy, convenient and fast way to communicate between and beyond the limits of the organization. Suppliers are using FTP as a means to easily and quickly upload CAD files or other large procurement files into their customers' servers in order to reduce online transfer time, avoid file transfer problems associated with the email process, and eliminate unnecessary downtime in the production cycle. The researcher did dimension-level analyses between different levels of FTP and procurement practices and also between different levels of FTP and procurement performance. The results are explained in subsequent sections.

Procurement Practices (PPR)

Different levels of usage of FTP impact all dimensions of procurement practices, as shown in the ANOVA results on Table 32.

ept6 Level	Procurement Practices (PPR) Dimensions							
	IG*		SC*		CNF*		IANF*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.26	0.895	2.92	1.026	4.27	0.733	3.72	0.887
Medium	3.45	0.832	3.43	1.029	4.42	0.703	3.99	0.816
High	3.67	1.097	3.78	0.944	4.56	0.568	4.32	0.813

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept6 among procurement practices dimensions

Table 32. ANOVA results for differences in procurement practices levels among FTP levels of usage

The researcher has proven differences among procurement practices by levels of usage of FTP. However, in order to make any conclusions on what type of level is better for achieving higher procurement practices, the researcher must perform further analyses in each of the procurement practices dimensions. The results are presented in Table 33. There are significant differences between high and low users of FTP in all dimensions of procurement practices. This means that higher users are really achieving higher benefits from FTP associated to procurement practices. When analyzing differences between high and medium users, only intelligence and analysis (IANF) show significant differences, in fact, this dimension is significantly different for each of the levels of usage of FTP. The latter implies that FTP is helping organizations in improving their intelligence and analysis, which is expected, since they have more reliable, faster and easy to access information. The other dimension that shows significant differences between medium and low users is supplier contact, and as stated earlier, FTP helps in sharing information across organizations, which in turn facilitates the transferring of proposals, information and bids. Medium users are also achieving the benefits of FTP, which means that not only high users can benefit from this technology.

I - J	Mean Difference (I-J)			
	ept6 (FTP)			
	IG	SC	CNF	IANF
Medium-Low	0.19	0.51*	0.14	0.27*
High-Low	0.41*	0.86*	0.29*	0.60*
High-Medium	0.22	0.35	0.15	0.33*
*Significant at 0.05.				

Table 33. Differences among levels of electronic file transferring (FTP) by procurement practices dimensions

Procurement Performance (PP)

Internal performance, supplier-related performance and internal customer-related performance of procurement are significantly impacted by different levels of electronic file transferring (FTP). The results are displayed in Table 34.

ept6 Level	Procurement Performance (PP) Dimensions					
	IP*		SR*		IC*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.23	0.884	3.64	0.811	3.78	0.736
Medium	3.56	0.726	3.84	0.694	3.91	0.612
High	3.95	0.885	4.03	0.829	4.13	0.699

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept6 among procurement performance dimensions

Table 34. ANOVA results for differences in procurement performance levels among FTP levels of usage

The multiple comparisons performed after ANOVA (see Table 35) show that the procurement performance dimension that has a strongest influence from higher levels of usage of FPT is internal performance. FTP reduces transaction times, paperwork, order processing errors and it could also impact reducing search costs, since the files containing costs, bids and information could be transmitted faster and at reduced costs. On the other hand, both supplier-related and internal customer-related performance dimensions are only influenced when high levels of use of FTP exist against low levels of use; otherwise, there are no significant differences.

I - J	Mean Difference (I-J)		
	ept6 (FTP)		
	IP	SR	IC
Medium-Low	0.33*	0.20	0.14
High-Low	0.72*	0.39*	0.35*
High-Medium	0.39*	0.19	0.21
*Significant at 0.05.			

Table 35. Differences among levels of electronic file transferring (FTP) by procurement performance dimensions

6.3. ept7: Video Conferencing

Video conferencing technology allows people at two or more locations to see and hear each other at the same time. The need to meet face-to-face in business can now be extended via the availability of mature video conferencing equipment. Video conferencing can enhance communication, improve operation efficiency and create significant saving in travel cost and time when dealing with procurement negotiations and contracting. It provides an additional tool to improve communications with multiple sites within an organization or with other business partners.

Procurement Practices (PPR)

Intelligence and analysis is not really influenced by video conferencing, as it was proved with the ANOVA results on Table 36. Video conferencing helps in improving supplier contact, contracting and information gathering.

ept7 Level	Procurement Practices (PPR) Dimensions							
	IG*		SC*		CNF*		IANF	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.20	0.934	2.87	1.115	4.26	0.814	3.81	0.898
Medium	3.44	0.856	3.40	0.939	4.41	0.641	4.00	0.864
High	3.75	0.888	3.86	0.968	4.57	0.596	4.03	0.760

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept7 among procurement practices dimensions

Table 36. ANOVA results for differences in procurement practices levels among Video Conferencing levels of usage

Under information gathering, video conferencing helped in consulting references for product/service quality and investigating requirements for follow-up services, installation, maintenance and warranty. Under supplier contact, video

conferencing provides support in requesting for proposals, information and bids. Finally, it also helps in negotiating particularly price and quality standards. The following analyses provide more detailed information in differences between high, medium and low users of video conferencing among information gathering, supplier contact and contracting practices.

I - J	Mean Difference (I-J)		
	ept7 (Video Conferencing)		
	IG	SC	CNF
Medium-Low	0.23	0.53*	0.15
High-Low	0.55*	0.98*	0.32*
High-Medium	0.31*	0.45*	0.17
*Significant at 0.05.			

Table 37. Differences among levels of video conferencing by procurement practices dimensions

As expected, there are significant differences between low and high users of video conferencing for information gathering, supplier contact and contracting practices (see Table 37). However, the dimension that is mostly affected by this technology is supplier contact, which in fact it is the one that relate directly to requests and communication between organizations. It is followed by information gathering in which there is also significant differences between high and medium users of video conferencing. In information gathering, organizations are using video conferencing for obtaining product/service quality references and investigating requirements for follow-up services, installation, maintenance and warranties.

Procurement Performance (PP)

Video conferencing is a very effective way of cutting travel expenses for contacting suppliers and meeting with them without having to physically get together the two parties. It is a technology that is mostly available to all types of companies since it could be free or at very low cost. Organizations are starting to use this technology since it is more personalized than email but still, it is not as costly as face-to-face interactions. Table 38 shows the impact of video conferencing on procurement performance dimensions, where there are differences among low, medium and high users of this technology. Further analysis are performed at the dimension-level.

ept7 Level	Procurement Performance (PP) Dimensions					
	IP*		SR*		IC*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.34	0.916	3.62	0.874	3.78	0.762
Medium	3.48	0.771	3.82	0.672	3.88	0.599
High	3.90	0.772	4.10	0.721	4.18	0.663

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept7 among procurement performance dimensions

Table 38. ANOVA results for differences in procurement performance levels among Video Conferencing levels of usage

Dimension-level analysis showed that video conferencing has a similar positive impact on all procurement performance dimensions. There are significant differences between high and low users and medium and low users of video conferencing (Table 39).

I - J	Mean Difference (I-J)		
	ept7 (Video Conferencing)		
	IP	SR	IC
Medium-Low	0.14	0.20	0.10
High-Low	0.56*	0.48*	0.40*
High-Medium	0.42*	0.28*	0.30*
*Significant at 0.05.			

Table 39. Differences among levels of video conferencing by procurement performance dimensions

According to these results, organizations perceive higher procurement performance scores by using video conferencing at high levels. However, those who use medium and low levels of video conferencing are not achieving as positive impact as the high users.

6.4. ept8: Electronic Markets (eMarkets)

Electronic markets are B2B exchanges between common groups of organizations. As stated by Bradley and Peters, 1997, an electronic market is a public listing of products and their attributes from all suppliers in an industry and available to all potential buyers. Electronic markets can focus on either indirect or direct products/services. It may be built for industry specific markets or across industries. Electronic markets integrate the e-sales with e-procurement systems of all parties in a particular industry, creating a single digital standard for doing business transactions. Advantages of electronic markets include reaching more customers and selling more products/services, accessing new opportunities in new markets, building contacts in new markets for lower costs and improving operating efficiency. However, it has also disadvantages such as its complexity

when dealing with different product/service pricing structures in different geographical markets or also with dealing with very complex products/services. The following analyses will help in showing the real impact of electronic markets on procurement practices and performance.

Procurement Practices (PPR)

The results from ANOVA (Table 40) show the strong impact of electronic markets on procurement practices. Different levels of usage of electronic markets affect all dimensions of procurement practices, from information gathering to intelligence and analysis. Detailed multiple comparisons will help in identifying between which groups of usage those differences exist.

ept8 Level	Procurement Practices (PPR) Dimensions							
	IG*		SC*		CNF*		IANF*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.13	0.922	2.97	1.142	4.23	0.811	3.71	0.977
Medium	3.46	0.847	3.39	0.976	4.43	0.652	4.01	0.796
High	3.87	0.951	3.72	1.076	4.56	0.603	4.16	0.798

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept8 among procurement practices dimensions

Table 40. ANOVA results for differences in procurement practices levels among Electronic Markets levels of usage

A positive result is that there are significant differences between high and low users of electronic markets for all dimensions of procurement performance. This means that those highly implementing this technology are achieving benefits in their procurement practices. There is also a common difference between medium and low users of electronic markets, which could lead to indicate that higher and medium users are obtaining similar results in their procurement practices. The only dimension in which there are significant differences between high and

medium users is information gathering. This result was expected due to the fact that electronic markets show complete listings of products/services, their attributes and other pertinent information necessary to the organizations. Therefore, it is not surprising the fact that it is the dimension with the highest impact from the usage of electronic markets in organizations.

I - J	Mean Difference (I-J)			
	ept8 (Electronic Markets)			
	IG	SC	CNF	IANF
Medium-Low	0.34*	0.41*	0.20*	0.30*
High-Low	0.75*	0.75*	0.34*	0.45*
High-Medium	0.41*	0.33	0.14	0.15
*Significant at 0.05.				

Table 41. Differences among levels of electronic markets by procurement practices dimensions

Procurement Performance (PP)

Electronic markets can lower coordination and transactions costs, lower physical distribution costs and eliminate retailers and wholesalers entirely, as purchasers directly access manufacturers (Bradley and Peters, 1997). The organizations surveyed in this research showed significant differences among different levels of usage of electronic markets for all procurement performance dimensions. The details on which dimensions are more affected by the usage of this technology are explained below.

ept8 Level	Procurement Performance (PP) Dimensions					
	IP*		SR*		IC*	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.17	0.848	3.52	0.789	3.76	0.655
Medium	3.56	0.782	3.88	0.748	3.92	0.660
High	3.99	0.836	4.06	0.602	4.09	0.777

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept8 among procurement performance dimensions

Table 42. ANOVA results for differences in procurement performance levels among Electronic Markets levels of usage

Higher users of electronic markets are receiving higher procurement performance than lower users. This means that organizations implementing electronic markets are receiving benefits in their internal performance, supplier-related performance and internal customer-related performance. As shown in Table 43, internal performance benefits the most from electronic markets (there are significant differences among all levels), by reducing transaction time, search costs, paperwork, order processing errors and maverick buying. Supplier-related performance is impacted also between medium and low users, which means that both high and medium users are achieving higher results in reducing inventories, reducing cost of materials/cost of providing services and improving partnership with suppliers. The less influenced dimension is internal customer-related performance, which is differentiated only between high and low users, implying that high users are achieving good results but medium users are not impacting for significant differences.

I - J	Mean Difference (I-J)		
	ept8 (Electronic Markets)		
	IP	SR	IC
Medium-Low	0.39*	0.36*	0.17
High-Low	0.82*	0.54*	0.33*
High-Medium	0.43*	0.18	0.17
*Significant at 0.05.			

Table 43. Differences among levels of electronic markets by procurement performance dimensions

6.5. ept9: Internet/Reverse Auctions

In internet auctions a seller offers an item or items for sale, but does not establish a price. Potential buyers start offering their bids until one of them wins. On the other hand, in reverse auctions the bidding starts at a high price set by the buyers and sellers bid the price down. Auctions are one of the fastest growing segments of online business today (Schneider, 2003). Also, many manufacturing companies periodically need to dispose of unusable or excess inventory, and auctions then are not used only for direct and/or indirect materials.

Procurement Practices (PPR)

Internet/reverse auctions showed impact on three out of the four dimensions of procurement practices (see Table 44). Intelligence and analysis is not affected by different levels of usage of internet/reverse auctions. This result is very expected since intelligence and analysis deals with tracking complaints, historical spending, demand and procurement performance, and not much about operational issues related to auctions. On the other hand, information gathering is highly benefited since most of the information is compressed in one site, usually from items with the same interest and/or industry. Supplier contact also is benefited since auctions are well known in improving requests for proposals, information and bids. Finally, contracting can be highly benefited by applying dynamic pricing techniques highly used in reverse auctions.

ept9 Level	Procurement Practices (PPR) Dimensions							
	IG*		SC*		CNF*		IANF	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.22	0.904	3.03	1.106	4.28	0.785	3.84	0.907
Medium	3.46	0.820	3.44	0.956	4.40	0.644	3.98	0.841
High	3.90	0.995	3.75	1.009	4.68	0.493	4.15	0.740

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept9 among procurement practices dimensions

Table 44. ANOVA results for differences in procurement practices levels among Internet/Reverse Auctions levels of usage

Firms trying to improve their information gathering practices should seek ways of considering implementation and usage of internet/reverse auctions. As shown in Table 45, it is the dimension of procurement practices that is affected the most by different levels of usage of internet/reverse auctions. Also, it is shown that there is significant differences between high users of this technology versus medium and low users when referring to contracting. High users are the ones obtaining all benefits from internet/reverse auctions, and not even medium users are achieving different results from low users. Therefore, in order to achieve higher contracting practices, the level of use of internet/reverse auctions must be high. Finally, supplier contact is differentiated between high and low users and also between medium and low users, which leads to suggesting that the benefits are incremental to the level of usage of the technology.

I - J	Mean Difference (I-J)		
	ept9 (Internet/Reverse Auctions)		
	IG	SC	CNF
Medium-Low	0.24*	0.41*	0.12
High-Low	0.68*	0.72*	0.40*
High-Medium	0.44*	0.31	0.28*
*Significant at 0.05.			

Table 45. Differences among levels of internet/reverse auctions by procurement practices dimensions

Procurement Performance (PP)

As stated by Berger and Gattorna, 2001, there are benefits for buyers and sellers when using internet/reverse auctions. Buyers may expect such benefits to cost reduction in addition to opportunities for supplier consolidation, access to improved sources of supply and increased efficiency of RFI/RFP/RFQ and bid processes. Suppliers may expect to benefit from introductions to new business opportunities, fair competition in the bidding process, increased market knowledge and ease of responding to RFQs. The latter is reinforced by the results obtained in the ANOVA (Table 46), in which only internal customer-related performance is not affected by different levels of usage of internet/reverse auctions. This result is expected since internal customer-related performance deals more with improving service quality and reliability to internal customers, increase communication between procurement and internal customers, and increase flexibility and on-time deliveries to internal customers. Therefore, not much is expected to affect the level of usage of internet/reverse auctions. On the other hand, internal performance and supplier-related performance are highly influenced by different levels of usage of this technology.

ept9 Level	Procurement Performance (PP) Dimensions					
	IP*		SR*		IC	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
Low	3.32	0.831	3.66	0.802	3.87	0.672
Medium	3.60	0.753	3.85	0.723	3.88	0.675
High	3.76	1.030	4.09	0.693	4.05	0.700

*ANOVA significant differences at $\alpha = 0.05$ between levels of ept9 among procurement performance dimensions

Table 46. ANOVA results for differences in procurement performance levels among Internet/Reverse Auctions levels of usage

The dimension-level analysis showed that the level of internet/reverse auctions affects mostly internal performance (reduce transaction time, search costs, paperwork, order processing errors and maverick buying). High and medium users of online auctions are achieving significantly higher results than those with low usage. On the other hand, only high users of internet/reverse auctions are obtaining significantly higher supplier-related procurement performance (reduce inventories and costs of materials/cost of providing services, improve partnership with suppliers). Therefore, in order to achieve higher supplier-related procurement performance measures, organizations must be high users of internet/reverse auctions. Medium users are not achieving such benefits differentiating themselves from low users.

I - J	Mean Difference (I-J)	
	ept9 (Internet/Reverse Auctions)	
	IP	SR
Medium-Low	0.28*	0.19
High-Low	0.44*	0.43*
High-Medium	0.16	0.24
*Significant at 0.05.		

Table 47. Differences among levels of internet/reverse auctions by procurement performance dimensions

7. Summary and Recommendations for Future Research

Information technology in the current decade is showing dramatic changes on the way firms are doing business. Small, medium and large firms can not ignore the impact of information networks into their strategies, operations and performance results. After supply chain management principles have enforced the change of procurement from a separate strategy to integrating procurement into corporate strategy, procurement managers have struggled in developing better ways to not only improve their procurement performance, but to improve their firm's performance by means of improving the supply chain performance (Ellram and Carr, 1994). The research framework depicts the relationship among procurement practices, eprocurement technology usage, procurement performance, procurement perception of supply chain performance and firm performance. Measurement models for three new constructs not empirically validated or tested for reliability in previous literature were developed and tested (procurement practices, eprocurement technology usage and procurement performance).

As stated in the introduction and literature review, there is no clear definition of constructs on procurement practices and performance. Most empirical research

mainly focuses on the strategic definition of procurement goals and objectives and not on any operational measurement of procurement practices and performance. The researcher summarizes in the following sections the theoretical implications and contributions of this study, the practical implications and contributions and finally, addresses guidelines for future research.

7.1. Theoretical Implications and Contributions

Based on the data collected from 368 procurement/materials managers, the model was tested using structural equation modeling methodology. The objectives of this study can be summarized as to gain an in-depth understanding of procurement practices, eprocurement technology usage and their impact on procurement performance, procurement perception of supply chain performance and ultimately, firm performance. The study contributes to the literature of procurement and supply chain management in a number of ways explained as follows.

1. The methodology for testing the measurement models was using structural equation modeling (SEM), using the software AMOS 5.0. As explained by Anderson and Gerbing, 1988, researchers are not following correct methodologies for testing models using SEM. This research provides a step-by-step approach on the methodology used from measurement models to the substantive hypotheses testing using the structural equation model. The researcher provides a guide for futures studies that attempt to measure unobserved variables for testing further relationships hypotheses.

2. The measurement models for procurement practices, eprocurement technology usage and procurement performance were validated and tested for reliability as new ways of evaluating procurement measures in the business environment. The instruments developed for the measurement models can be replicated by other researchers in the development of new models in procurement. The researcher has provided validated and reliable instruments for measuring the constructs procurement practices, eprocurement technology usage and procurement performance. Procurement practices is a construct with a multi-dimensional nature, and it was defined as a second-order factor with four first-order factors (information gathering, supplier contact, contracting and intelligence and analysis). As shown in Appendix C (Figure 16 and Figure 17), 21.4% do not process any procurement transaction in eprocurement and 37.2% use it in less than 10% of their procurement transactions. Also, 76% of the firms indicated that their experience with eprocurement technologies is less than 3 years. Therefore, the support for focusing on the operational side of procurement practices was both theoretical and empirical. eProcurement technology usage on the other hand, showed to be a first-order factor. Finally, procurement performance also showed a multi-dimensional nature and it was defined as a second-order factor with three first-order factors (internal performance, supplier-related and internal customer).

3. This research provided a theoretical framework that identified positive and significant relationships between eprocurement technology usage and both procurement practices and procurement performance; procurement practices and procurement performance, procurement performance and procurement perception of supply chain performance, and finally, procurement perception of supply chain performance and firm performance. However, the researcher failed to provide enough statistical evidence to support the hypothesis that eprocurement technology usage was a moderating variable in the relationship between procurement practices and procurement performance. Instead, it showed to be an exogenous variable that directly impacts procurement practices and procurement performance. A rationale presented earlier for this result is that eprocurement is still on early stages and that few transactions are processed using eprocurement technology usage (see Appendix C). Therefore, its impact on the relationship between procurement practices and procurement performance is still weak, but it is expected to become stronger as firms increase the number of transactions done using eprocurement technologies. The main contribution to research is supported by the research framework depicted in Figure 13. This framework provides a foundation for future research in the area of procurement and supply chain management.
4. As stated in the literature review, there is a gap in the literature when analyzing eprocurement. Previous research on eprocurement has limited

the literature to study internet-based procurement only, which creates a gap for other eprocurement technologies. This study goes beyond that to include in eprocurement those technologies that facilitate procurement practices including EDI, FTP, video conferencing, electronic markets and internet/reverse auctions.

7.2. Practical Implications and Contributions

The empirical results from this study have important implications and contributions for practitioners. It is important in any kind of research to provide strong theoretical contributions. However, contributions to the literature are a start point to provide final contributions to practitioners. This study is not an exception, and the researcher summarizes the contributions and implications to practitioners as follows:

1. The importance of studies that help understand the eprocurement process is supported by recent statistics saying that B2B electronic commerce will be $7.29 trillion by the end of 2004 (study by GernterGroup's e-Business Intelligence Services, Brunelli, 2000a). The global management consulting firm A.T. Kearney (Plano, 2002) shows an empirical study in which companies reported savings 13 times greater than their investments in eprocurement technologies, and also, global 500 companies could save $330 billion annually by capturing eprocurement's full potential. Moozakis, 2001 show projected sales for software in different enterprise applications categories, and eprocurement gets priority (53%), followed by CRM (41%), SCM (31%) and ERP (8%). This study shows practitioners that

eprocurement is in early stages (76% of the firms indicated that their experience with eprocurement technologies is less than 3 years, see Appendix C). Also, it shows that eprocurement technology usage has a positive impact on procurement practices, therefore, facilitates the development of operational tasks in the procurement area.

2. Practitioners currently interested in adopting eprocurement technologies could see the positive impact it has on procurement practices, which in turn, presented a positively significant impact on procurement performance. Therefore, organizations that are implementing eprocurement are achieving short-term benefits in procurement practices. It is expected that the adoption of eprocurement will have positive impact at the strategic level of procurement practices in a long-term. However, this hypothesis is for further research when the level of experience in eprocurement is higher than today's.
3. This research also supports previous publications in practitioners' journals that procurement practices impact procurement performance. Better procurement practices will positively benefit the outcomes of the procurement area. Another interesting and expected result of this research is that procurement performance affects directly procurement perception of supply chain performance. Previous research about supply chain performance shows that the whole supply chain benefits from supply chain practices. Procurement is not an exception. Also, procurement perception of supply chain performance directly affects firm performance. This

outcome represents a motivation for organizations to work with their supply chains in order to achieve higher supply chain performance, which in turn, will be reflected in the firm performance.

4. Electronic data interchange (EDI) is a set of standards and protocols for conducting highly structured interorganizational exchanges, it is the paperless exchange of information between business partners. The impact of different levels of EDI is not as high as other eprocurement technologies, since it only affects information gathering and supplier contact. In fact, the effect is between medium and low users of EDI. The implementation costs of EDI are very high and therefore, the researcher analyzed the impact of this technology on procurement performance to see if it is worth it the high cost of implementation. EDI is proven to differentiate between high and low users when analyzing its impact to procurement performance. High and low users of EDI differentiate themselves in procurement performance, allowing for the cost of implementation to be worth it in performance impact. Internal performance is the dimension that is highly influenced by EDI, followed by supplier-related performance, and then, internal customer-related performance.
5. Electronic file transferring by using the file transfer protocol (FTP) is an easy, convenient and fast way to communicate between and beyond the limits of the organization. FTP is one of the eprocurement technologies that influence the most all dimensions of procurement practices, enabling procurement departments to improve their internal operations. FTP is

helping organizations in improving their intelligence and analysis, which is expected, since they have more reliable, faster and easy to access information. The other dimension that shows high impact is supplier contact, since FTP helps in sharing information across organizations, which in turn facilitates the transferring of proposals, information and bids. Medium users are also achieving the benefits of FTP, which means that not only high users can benefit from this technology. When referring to the impact of FTP on procurement performance, all dimensions showed positive differences between high and low users, confirming that FTP benefits procurement performance. FTP influences mostly internal performance, but both supplier-related and internal customer-related performance are higher for high users of FTP versus low users of FTP.

6. Video conferencing technology allows people at two or more locations to see and hear each other at the same time. Video conferencing can enhance communication, improve operation efficiency and create significant saving in travel cost and time when dealing with procurement negotiations and contracting. It provides an additional tool to improve communications with multiple sites within an organization or with other business partners. Intelligence and analysis is not really influenced by video conferencing since it is a procurement practice that deals with keeping track of complaints, historical spending, demand of materials and procurement performance, and therefore, video conferencing does not affect at all. On the other hand, video conferencing has a positive impact

on the three other dimensions of procurement practices. The dimension with the highest impact is supplier contact since the communication between business partners is the main focus of this technology. It is followed by information gathering and finally, contracting (negotiating price and quality standards in particular). High users of video conferencing are achieving higher procurement performance in all dimensions than medium and low users. However, medium users do not achieve higher levels than low users. The conclusion is that for video conferencing to show positive performance changes, it must be used in a high-level; otherwise, its benefits are hardly perceivable.

7. Electronic markets are public listings of products and their attributes from all suppliers in an industry and available to all potential buyers. Electronic markets is the eprocurement technology that showed higher impact on procurement practices, which means that it really helps procurement departments to be more efficient and effective in their procurement practices. Both high and medium users of electronic markets are achieving higher information gathering, supplier contact, contracting and intelligence and analysis practices. When analyzing its impact on procurement performance, electronic markets influence more internal performance, followed by supplier-related performance, and finally, internal customer-related performance. Therefore, electronic markets are a very positive way of firms to improve their procurement practices and also their procurement performance.

8. Auctions are one of the fastest growing segments of electronic commerce. Internet/reverse auctions showed impact on three out of the four dimensions of procurement practices. Intelligence and analysis is not affected by different levels of usage of internet/reverse auctions. This result is very expected since intelligence and analysis deals with tracking complaints, historical spending, demand and procurement performance, and not much about operational issues related to auctions. On the other hand, information gathering is highly benefited since most of the information is compressed in one site, usually from items with the same interest and/or industry. Supplier contact also is benefited since auctions are well known in improving requests for proposals, information and bids. Finally, contracting can be highly benefited by applying dynamic pricing techniques highly used in reverse auctions. Firms trying to improve their information gathering practices should seek ways of considering implementation and usage of internet/reverse auctions. High and medium users of internet/reverse auctions are achieving higher information gathering, supplier contact and contracting practices. The dimension that is mostly impacted is information gathering, while supplier contact and contracting are also influenced at a high level. When analyzing the impact of internet/reverse auctions on procurement performance, it is the only eprocurement technology that does not have any effect on internal-customer performance. High and medium users of online auctions are achieving significantly higher results than those with low usage. On the

other hand, only high users of internet/reverse auctions are obtaining significantly higher supplier-related procurement performance (reduce inventories and costs of materials/cost of providing services, improve partnership with suppliers). Therefore, in order to achieve higher supplier-related procurement performance measures, organizations must be high users of internet/reverse auctions. Medium users are not achieving such benefits differentiating themselves from low users. The instrument developed in this research is a good measure tool for organizations of their procurement practices, procurement performance and eprocurement technology usage. Organizations could use the questionnaire to continuously evaluate their improvements in these areas and also, to do some kind of benchmarking to evaluate their standards with their industry standards.

7.3. Limitations of the Study and Future Research Guidelines

This research study has extended past research in several ways, by building on past theoretical and empirical studies, and close collaboration with manufacturing firms. It also opens a window for further research in this area. Each of the limitations of this study is an opening area of new research in future studies. Therefore, in the following section the researcher discuss limitations and recommendations for future research.

First, the researcher measured only the operational side of procurement practices considering the early stages of eprocurement implementation on the organizations. Further research could extend on measuring the strategic level of

procurement practices and analyze the impact of eprocurement technology usage at the strategic level. It is recommended though to wait some time until firms have at least 5 years implementing eprocurement so that their results could start achieving higher levels in the organization.

Second, it would be interesting to measure individually the impact of each of the different eprocurement technologies usage on the different procurement practices. For instance, are firms using certain eprocurement technologies on payment processing and others for supplier contact? This would have made the questionnaire far lengthier and it could have affected response rates. However, designing a research to do this specifically could be more manageable.

Third, the researcher limited the industries to the following SIC classifications: 28 "chemicals and allied products", 33 "primary metal industries", 34 "fabricated metal products, 35 "industrial and commercial machinery and computer equipment", 36 "electrical equipment and components" and 37 "transportation equipment". The results should be cautiously generalized to other industries. Therefore, the researcher proposes a future research including other industries, and also, it could be interesting to perform an invariance analysis across industries.

Finally, future research can expand the current theoretical model by incorporating constructs from other fields of study and by adding items to the current constructs to decrease error terms and increase item reliabilities. For instance, it would be interesting to include in the model ecommerce measures in general, not

limiting to eprocurement. Also, it could be interesting to measure the impact of ecommerce technology usage on supply chain practices and performance.

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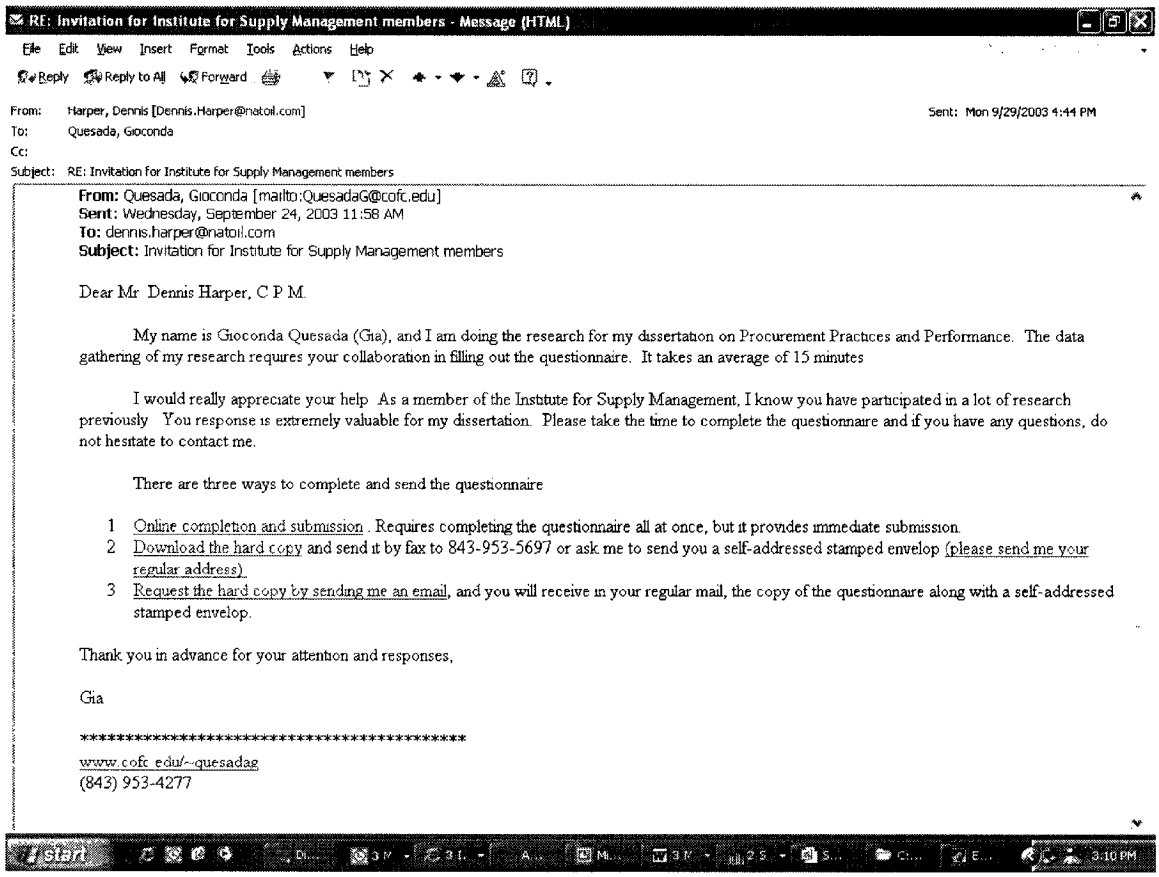
APPENDIX A: Sample emails for data collection



RE: Invitation for Institute for Supply Management members - Message (HTML)

File Edit View Insert Format Tools Actions Help

Reply Reply to All Forward

From: Harper, Dennis [Dennis.Harper@natoil.com] Sent: Mon 9/29/2003 4:44 PM
To: Quesada, Gioconda
Cc:
Subject: RE: Invitation for Institute for Supply Management members

From: Quesada, Gioconda [mailto:QuesadaG@cofc.edu]
Sent: Wednesday, September 24, 2003 11:58 AM
To: dennis.harper@natoil.com
Subject: Invitation for Institute for Supply Management members

Dear Mr Dennis Harper, C P M.

My name is Gioconda Quesada (Gia), and I am doing the research for my dissertation on Procurement Practices and Performance. The data gathering of my research requires your collaboration in filling out the questionnaire. It takes an average of 15 minutes

I would really appreciate your help As a member of the Institute for Supply Management, I know you have participated in a lot of research previously You response is extremely valuable for my dissertation. Please take the time to complete the questionnaire and if you have any questions, do not hesitate to contact me.

There are three ways to complete and send the questionnaire

1 Online completion and submission . Requires completing the questionnaire all at once, but it provides immediate submission.
2 Download the hard copy and send it by fax to 843-953-5697 or ask me to send you a self-addressed stamped envelop (please send me your regular address)
3 Request the hard copy by sending me an email, and you will receive in your regular mail, the copy of the questionnaire along with a self-addressed stamped envelop.

Thank you in advance for your attention and responses,

Gia

****

www.cofc.edu/~quesadag
(843) 953-4277

start 3:10 PM

Table 48. Sample Email 1 for Data Collection

This email was sent personalized to each of the members in the database.

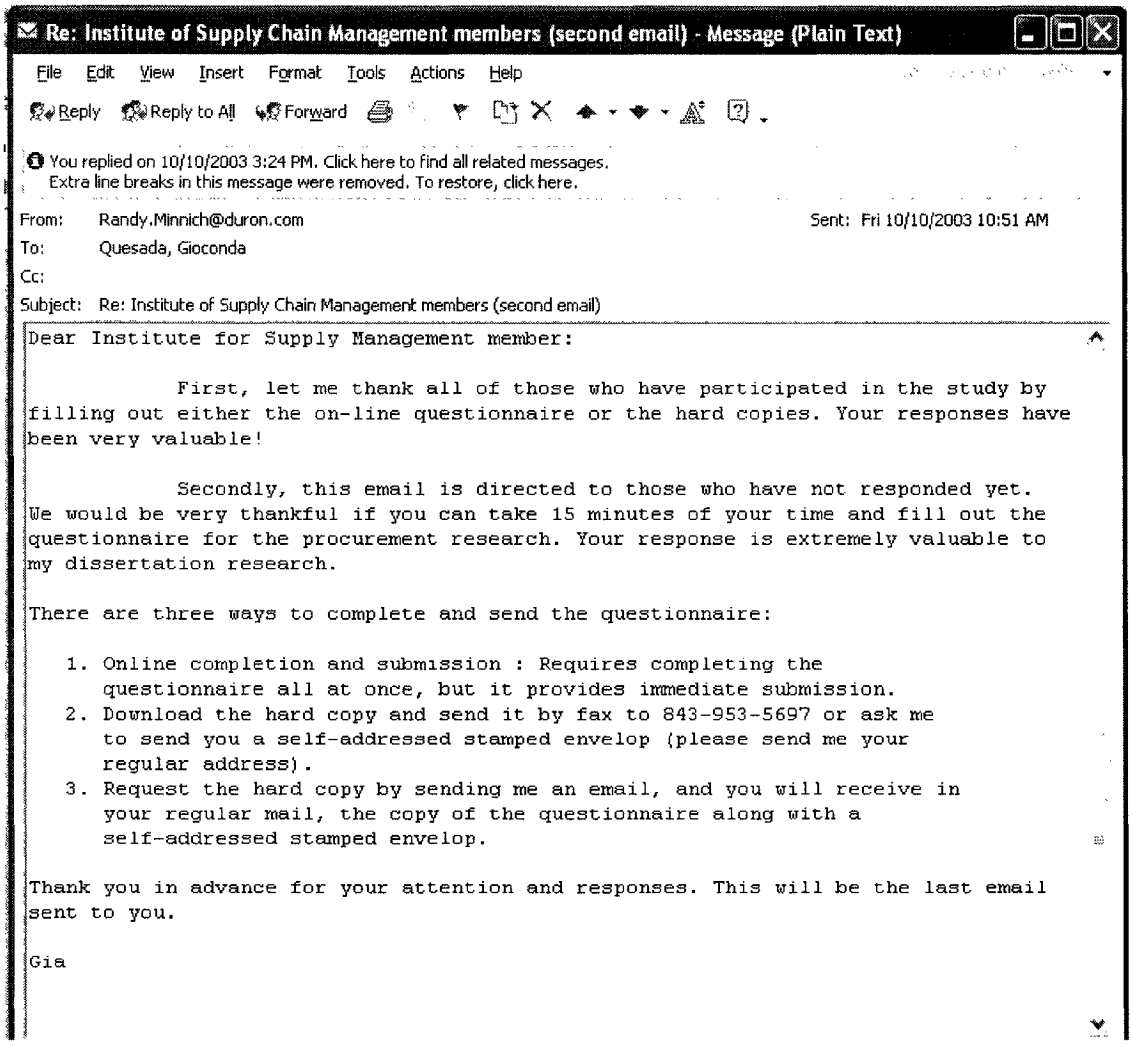


Table 49. Sample Email 2 for Data Collection

This email was sent in a general format, no name personalization.

APPENDIX B: Large-Scale Questionnaire

A Survey on the Mediating Effect of eProcurement Technology Usage on Procurement Performance by

Member Database provided by

The College of Business Administration of The University of Toledo and the School of Business and Economics at the College of Charleston in collaboration with the Institute of Supply Management (ISM)

We kindly ask you to fill out this questionnaire and thank you in advance for your responses. The data collected in this survey will be treated as confidential, it will be stored in a secure place and it will be used only for this study and in related reports. Information in reports will only be discussed at the aggregate level so that information about any particular firm cannot be ascertained or deduced by readers.

Please route this query to the individual in your firm who could most appropriately and accurately provide the pertinent information sought.

If you have any questions, you can email Gioconda Quesada (Gia) at quesadag@cofc.edu or call her at 843-953-4277.

Gioconda Quesada
66 George St.
School of Business, College of Charleston
Charleston, SC, 29424
Phone: (843) 953-42-77
Fax: (843) 953-56-97

E-mail: quesadag@cofc.edu

Unless otherwise specifically requested, please use the following scale to answer each item:

Not at all	To a small extent	To a moderate extent	To a considerable extent	To a great extent		Do not know
1	2	3	4	5		6

Section A. eProcurement Technology Usage

eProcurement is defined as any electronically mediated technology which facilitates the acquisition of goods and/or services by one business organization from another business organization.
Please indicate the **extent of usage of the following technologies** in your firm **which facilitate procurement tasks** by selecting the number that accurately reflects your firm's current level of usage.

Internet Search Engines	1	2	3	4	5	6
Extranet	1	2	3	4	5	6
Electronic Data Interchange (EDI)	1	2	3	4	5	6
Email	1	2	3	4	5	6
Electronic Catalogs	1	2	3	4	5	6
Electronic File Transferring (FTP)	1	2	3	4	5	6
Video Conferencing	1	2	3	4	5	6
Electronic Markets	1	2	3	4	5	6
Internet Auctions/Reverse Auctions	1	2	3	4	5	6

Section B. Procurement Practices

Procurement practices are the practices of an organization in gathering information, contacting suppliers for pre-contract requests, negotiating and fulfilling of orders.
Please circle the appropriate number that accurately reflects your **firm's current level of practice.**

INFORMATION GATHERING

When gathering information, our procurement department:

Searches for suppliers to contract purchases	1	2	3	4	5	6
Searches for an appropriate product/ service to order	1	2	3	4	5	6
Consult references for product/ service quality	1	2	3	4	5	6
Investigates requirements for follow-up services, installation, maintenance and warranty	1	2	3	4	5	6

SUPPLIER CONTACT (FOR PRE-CONTRACT REQUESTS)

When contacting suppliers, our procurement department requests for:

Quotes (RFQ)	1	2	3	4	5	6
Proposals (RFP)	1	2	3	4	5	6
Information (RFI)	1	2	3	4	5	6
Bids (RFB)	1	2	3	4	5	6

CONTRACTING (NEGOTIATION AND FULFILLMENT)

When developing a contract with suppliers, our procurement department negotiates:

price	1	2	3	4	5	6
quality standards	1	2	3	4	5	6
customization possibilities	1	2	3	4	5	6
delivery schedules	1	2	3	4	5	6
delivery quantities	1	2	3	4	5	6
final contract	1	2	3	4	5	6

REQUISITIONING (NEGOTIATION AND FULFILLMENT)

When requisitioning orders, our procurement department:

approves orders	1	2	3	4	5	6
places orders	1	2	3	4	5	6
processes supplier invoices	1	2	3	4	5	6
processes payments	1	2	3	4	5	6

INTELLIGENCE/ANALYSIS (NEGOTIATION AND FULFILLMENT)

When analyzing the negotiation and fulfillment of orders, our procurement department tracks:

orders of materials	1	2	3	4	5	6
shipments of materials	1	2	3	4	5	6
product specifications and data complaints of defective/late materials	1	2	3	4	5	6
and/or deliveries	1	2	3	4	5	6
suppliers performance	1	2	3	4	5	6
historical spending on materials	1	2	3	4	5	6
demand of materials	1	2	3	4	5	6
procurement Performance	1	2	3	4	5	6

Section C. Procurement Performance

Procurement performance is defined as the level of improvements in the benefits due to the procurement practices in the firm.
Our procurement practices have helped our firm to realize some or all of the following benefits. Please indicate the number that accurately reflects the **level of improvements in the benefits**

Reduce transaction time	1	2	3	4	5	6

Unless otherwise specifically requested, please use the following scale to answer each item:

Not at all 1	To a small extent 2	To a moderate extent 3	To a considerable extent 4	To a great extent 5		Do not Know 6

Reduce transaction costs	1	2	3	4	5	6
Reduce search costs	1	2	3	4	5	6
Reduce paperwork	1	2	3	4	5	6
Reduce order processing errors	1	2	3	4	5	6
Reduce inventories	1	2	3	4	5	6
Reduce cost of materials/cost of providing services	1	2	3	4	5	6
Increase materials/service quality	1	2	3	4	5	6
Reduce "maverick buying"	1	2	3	4	5	6
Reduce number of suppliers	1	2	3	4	5	6
Improve communication with suppliers	1	2	3	4	5	6
Improve partnership with suppliers	1	2	3	4	5	6
Improve data sharing with suppliers	1	2	3	4	5	6
Improve overall service quality to internal customers	1	2	3	4	5	6
Increase reliability of information to internal customers (reports,updates)	1	2	3	4	5	6
Meet internal customer expectations	1	2	3	4	5	6
Increase communication with internal customers	1	2	3	4	5	6
Deliver on-time products/services to internal customers	1	2	3	4	5	6
Deliver on-time information to Internal customers (reports, updates)	1	2	3	4	5	6
Increase quality products/services to internal customers	1	2	3	4	5	6
Increase flexibility to internal customer's changing needs	1	2	3	4	5	6

Section D. Firm Performance

Please indicate the **extent of overall performance** of your firm when **compared to your industry average**.

Market share	1	2	3	4	5	6
Growth of sales	1	2	3	4	5	6
Growth of market share	1	2	3	4	5	6
Return on investment	1	2	3	4	5	6
Growth in return on investment	1	2	3	4	5	6
Profit margin on sales	1	2	3	4	5	6
Average selling price	1	2	3	4	5	6
Overall product quality	1	2	3	4	5	6
Overall customer service levels	1	2	3	4	5	6
Overall competitive position	1	2	3	4	5	6

Section E. Supply Chain Performance

Supply Chain Performance refers to the global performance of you supply chain. You may be able to fill out this portion or ask for assistance from another person in the organization, but we ask you to please give your best estimate.

Please select the number that accurately reflects your **supply chain's current level of performance**

FLEXIBILITY

Our supply chain is able to:

handle difficult nonstandard orders	1	2	3	4	5	6
meet special customer specifications	1	2	3	4	5	6
produce products characterized by numerous features, options, sizes and colors	1	2	3	4	5	6
rapidly adjust capacity so as to accelerate or decelerate production in response to changes in customer demand	1	2	3	4	5	6
rapidly introduce large numbers of product improvements/variation	1	2	3	4	5	6
handle rapid introduction of new products	1	2	3	4	5	6

SUPPLY CHAIN INTEGRATION

There is a high level of communication and coordination between all functions in our firm	1	2	3	4	5	6
Cross-functional teams are frequently used for process design and improvement in our firm	1	2	3	4	5	6
There is a high level of integration of information systems in our firm	1	2	3	4	5	6
There is a great amount of cross-over of the activities of our firm and our trading partners	1	2	3	4	5	6

SUPPLIER PERFORMANCE

Our suppliers:

present high quality levels	1	2	3	4	5	6
present high service levels	1	2	3	4	5	6
deliver products on-time	1	2	3	4	5	6

Unless otherwise specifically requested, please use the following scale to answer each item:

Not at all	To a small extent	To a moderate extent	To a considerable extent	To a great extent		Do not Know
1	2	3	4	5		6

respond quickly to our petitions	1	2	3	4	5	6
have low price/cost of products	1	2	3	4	5	6
have enough flexibility to respond to unexpected demand changes	1	2	3	4	5	6
deliver the correct quantity of products	1	2	3	4	5	6
are willing to change products/ services to meet changing needs	1	2	3	4	5	6

PARTNERSHIP QUALITY

We believe our relationship with our trading partners is profitable	1	2	3	4	5	6
We and our trading partners share any risk that can occur in the supply chain	1	2	3	4	5	6
Our relationship with trading partners is marked by a high degree of harmony	1	2	3	4	5	6
Our overall relationship with trading partners is satisfactory	1	2	3	4	5	6

CUSTOMER RESPONSIVENESS

Our firm fills customer orders on-time	1	2	3	4	5	6
Our firm has short order-to-deliver cycle time	1	2	3	4	5	6
Our firm has fast customer response time	1	2	3	4	5	6

Section F. Perceived obstacles/barriers to eProcurement

We perceive as **barriers to implementation** of eProcurement the following:

lack of security	1	2	3	4	5	6
fear of internet fraud	1	2	3	4	5	6
legality of internet transactions	1	2	3	4	5	6
lack of management support	1	2	3	4	5	6
poor telecommunication infrastructure	1	2	3	4	5	6
unfamiliarity with the eProcurement technologies	1	2	3	4	5	6
unreadiness for technological advancement	1	2	3	4	5	6
cost of eProcurement investment	1	2	3	4	5	6
general lack of awareness as to which solution(s) best meet our company's needs	1	2	3	4	5	6
downward prices pressure on vendors resulting in diminished customer service and/or quality issues	1	2	3	4	5	6

SECTION G. Demographics Information

For the following question, please check the appropriate response.

1. Our firm distributes the use of eProcurement (if any) expenses as follows:

____ %	Services
____ %	Capital Goods
____ %	Office Products
____ %	Computer and related Equipment
____ %	MRO (maintenance, repair and operating expenses
100 %	TOTAL

2. What is your adoption strategy of eProcurement technologies? Please check ONLY ONE.

- ☐ Leave the learning cost to others and then invest
- ☐ Aware of developments of eProcurement, but do not commit major resources
- ☐ Invest selectively until the best eProcurement model four our company can be identified
- ☐ Move fast into eProcurement
- ☐ Invest heavily to gain competitive lead in the field

3. Please answer the following questions about your company

a. Annual sales (year 2002, in US Million $)

___ Under 10 ___ 10 to <50
___ 50 to <100 ___ 100 to <250
___ 250 to <500 ___ 500 to <1000 ____ 1000 or above

b. 1. Annual purchasing volume (Million $/year 2002):

___ Under 5 ___ 5 to <20 ___ 20 to <65
___ 65 to <150 ___ 150 to <500 ___ 500 or above

2. Percentage of Purchasing Transactions using eProcurement:

____ %	0%
____ %	Less than 10% but more than 0%
____ %	10 – 30 %
____ %	30 – 50 %
____ %	50 – 80 %
____ %	More than 80 %

Unless otherwise specifically requested, please use the following scale to answer each item:

Not at all	To a small extent	To a moderate extent	To a considerable extent	To a great extent		Do not Know
1	2	3	4	5		6

3. Number of years in eProcurement: _____ years

c. Number of employees in your company:

___ 1 -50 ___ 51-100 ___ 101-250
___251-500 ___ 501 -1000 ___ Over 1000

d. Number of purchasing employees in your company:

___ 1-5 ___ 6-10 ___ 11-15
___ 16-20 ___ Over 20

e. Type of industry (SIC Code) your industry is in:

	ISIC	Description
☐	28	Chemicals and allied products
☐	33	Primary metal industries
☐	34	Fabricated metal products, except machinery and transportation equipment
☐	35	Industrial and commercial machinery and computer equipment
☐	36	Electronic, electrical equipment and components, except computer equipment
☐	37	Transportation equipment
☐	Other	_____

f. Company's website:

_____

g. Your company's primary production system is: (choose the most appropriate one).

_____ Engineer to Order _____ Make to Order
_____ Assemble to Order _____ Make to Stock

g.1. Your company's primary process choice is: (choose the most appropriate one)

_____ Project _____ Job-Shop _____ Batch
_____ Line _____ Continuous Processing

h. How would you characterize the production in your plant? (choose the most appropriate one).

☐	One of a kind
☐	Multiple products - low volume
☐	Few major products - low volume
☐	Standardized products - high volume
☐	Other: _____

i. Please indicate the number of tiers across your supply chain

___ <= 3 ___ 4 – 5 ___ 6 – 7
___ 8 – 10 ___ > 10

j Please rank the position of your company in your supply chain (mark all that apply):

_____ Raw material supplier _____ Component supplier
_____ Assembler _____ Sub-assembler
_____ Manufacturer _____ Distributor
_____ Wholesaler _____ Retailer

4. Please answer the following information about yourself (the respondent)

a. Your present job title is:
____CEO/president _____ Manager
____ Director _____Other (please indicate_____)

b. Your present job function (mark all that apply)
_____ Corporate Executive
_____ Purchasing Manager
_____ Purchasing Supervisor
_____ Manufacturing/Production
_____ Distribution
_____ Sales
_____ Other (please indicate _____)

c. The years you have worked for this company
_____ under 2 years _____2-5 years
_____ 6-10 years _____over 10 years

d. Please rank the importance of the following factors (from 1-most important to 6-least important) in selecting your suppliers (use each number only once).

_____ Cost _____Quality _____Lead time
_____ Flexibility _____ Delivery reliability
_____ On time delivery

e. Please indicate your email address if you would like to receive a summary report of the findings of this research:

_____ (email)

THANK YOU!!!

APPENDIX C. Sample Characteristics

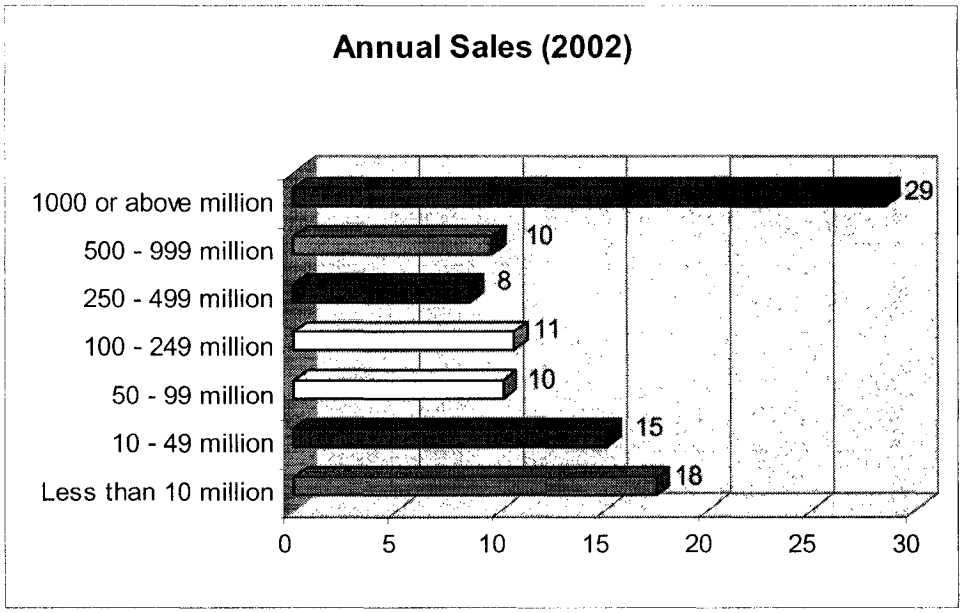


Figure 14. Company annual sales (2002)

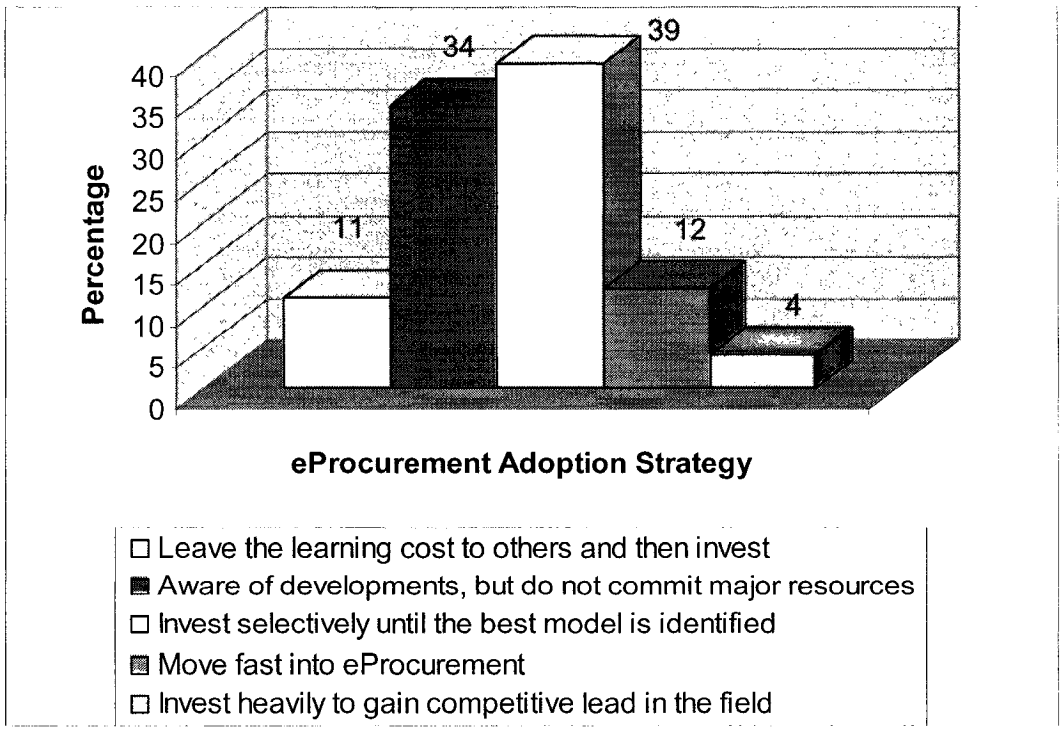


Figure 15. eProcurement Adoption Strategy

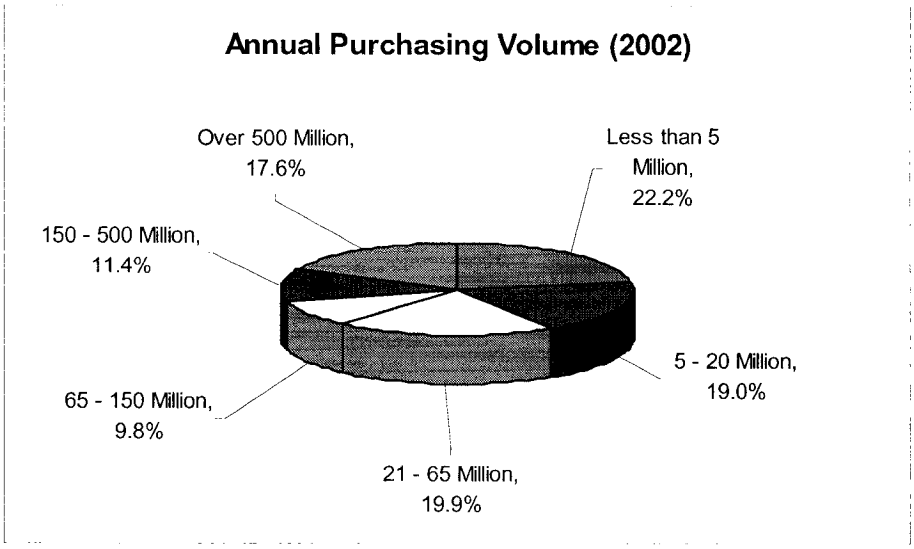


Figure 16. Annual Purchasing Volume (2002)

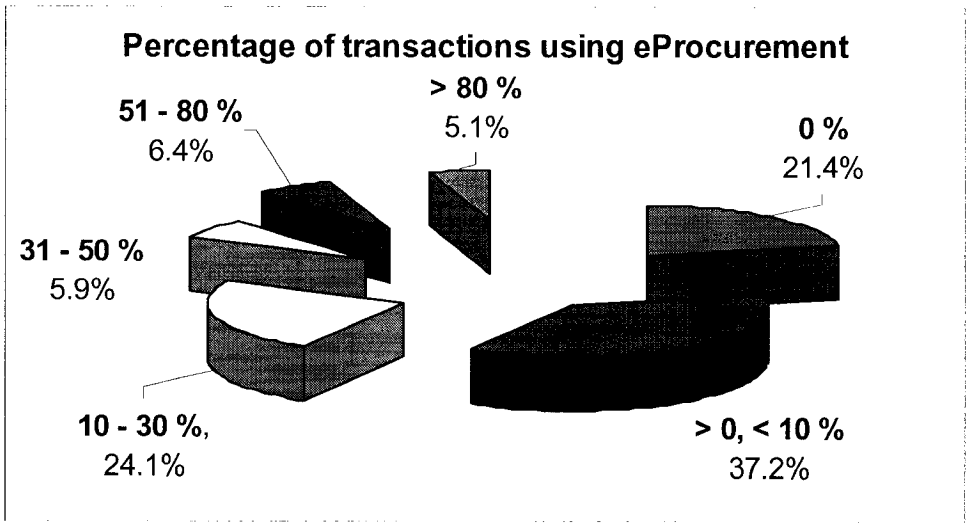


Figure 17. Percentage of transactions using eProcurement

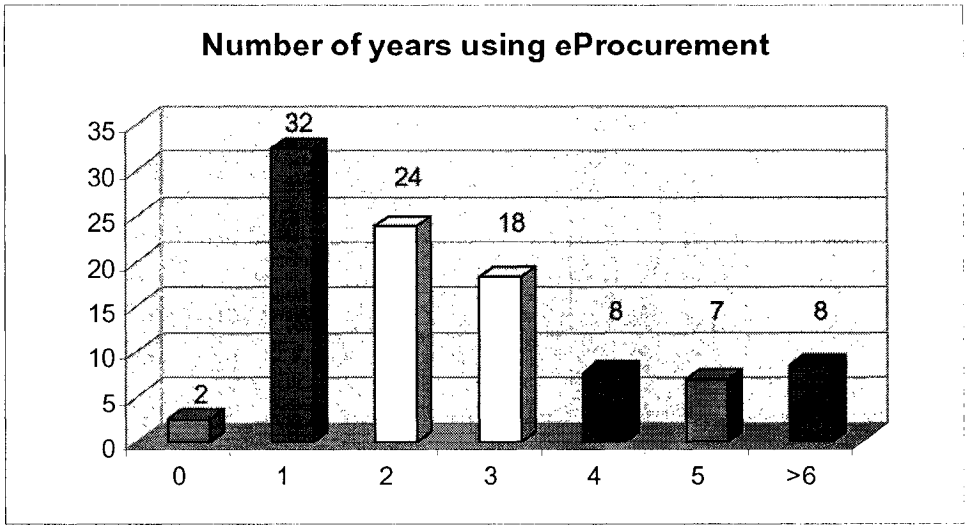


Figure 18. Number of years using eProcurement

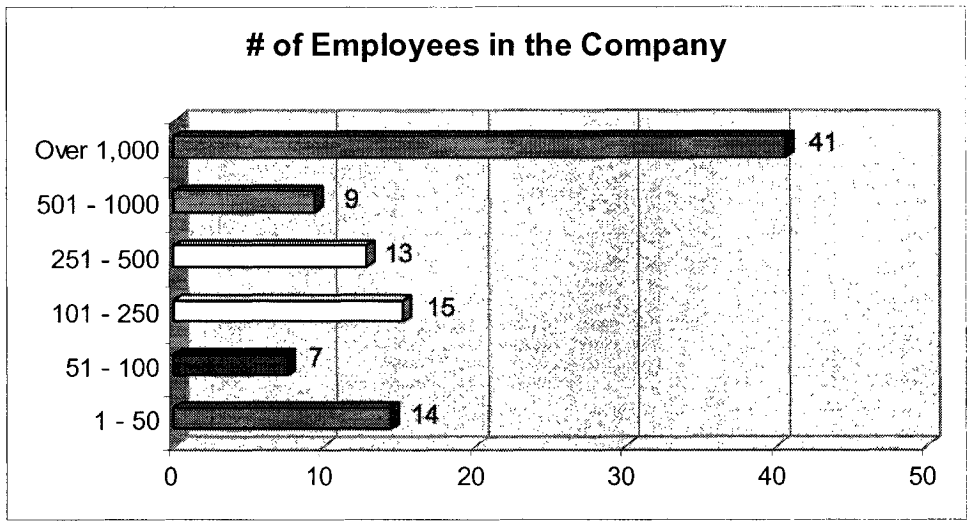


Figure 19. Number of Employees in the Company

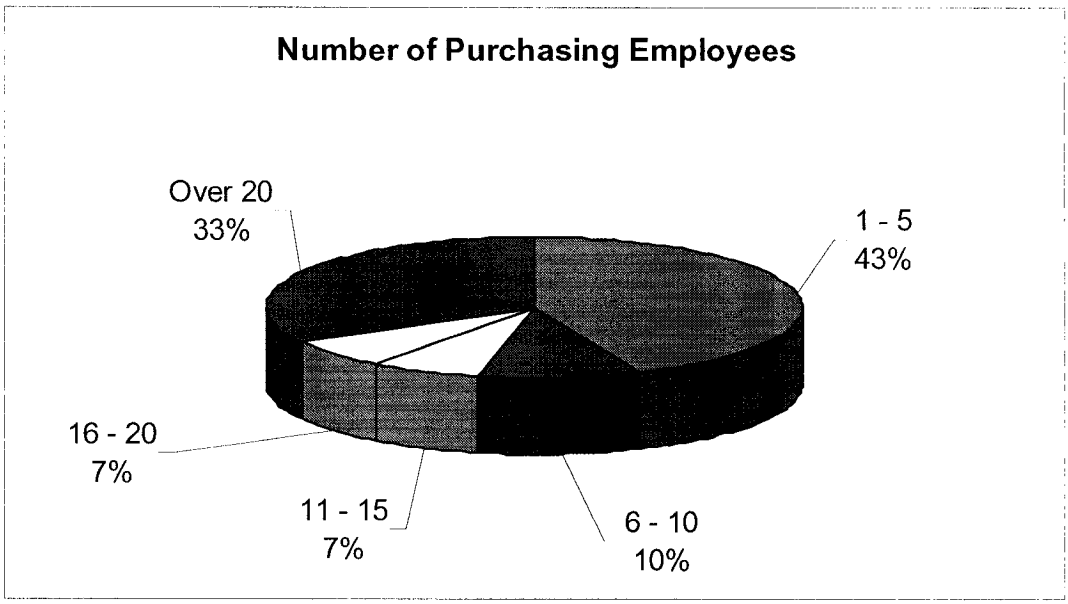


Figure 20. Number of Purchasing Employees

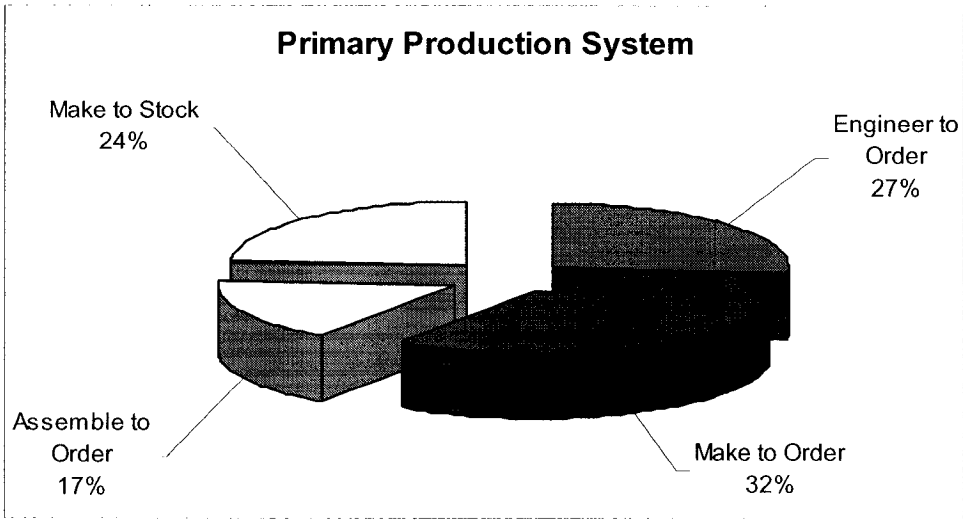


Figure 21. Primary Production System

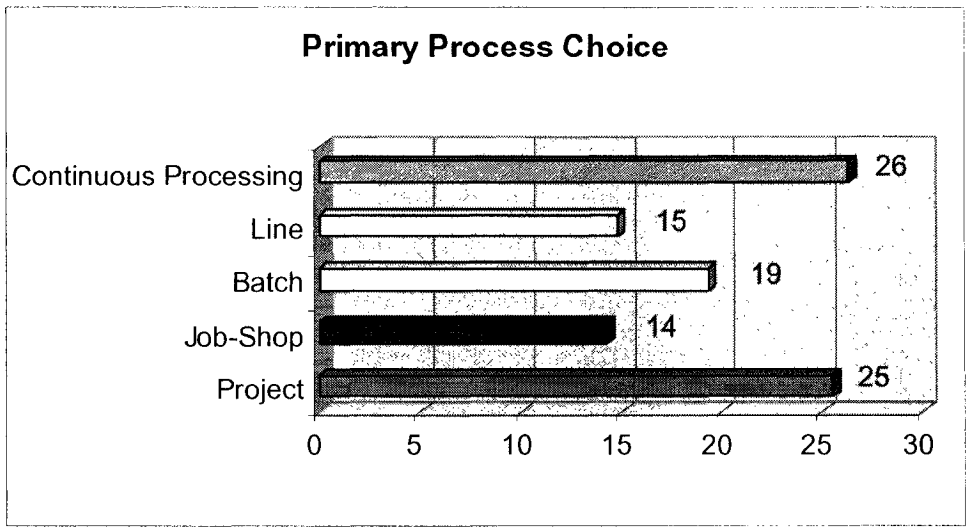


Figure 22. Primary Process Choice

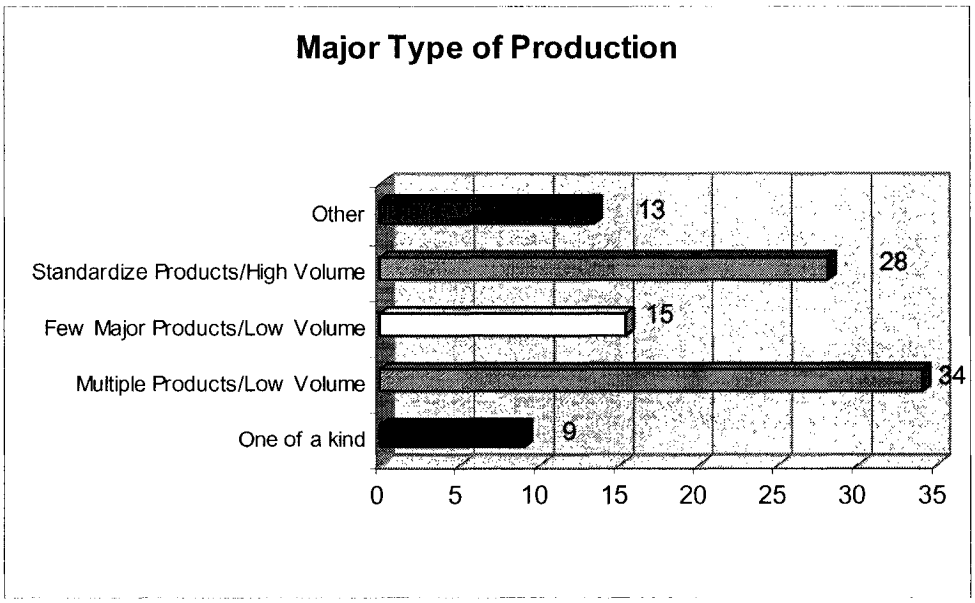


Figure 23. Major Type of Production

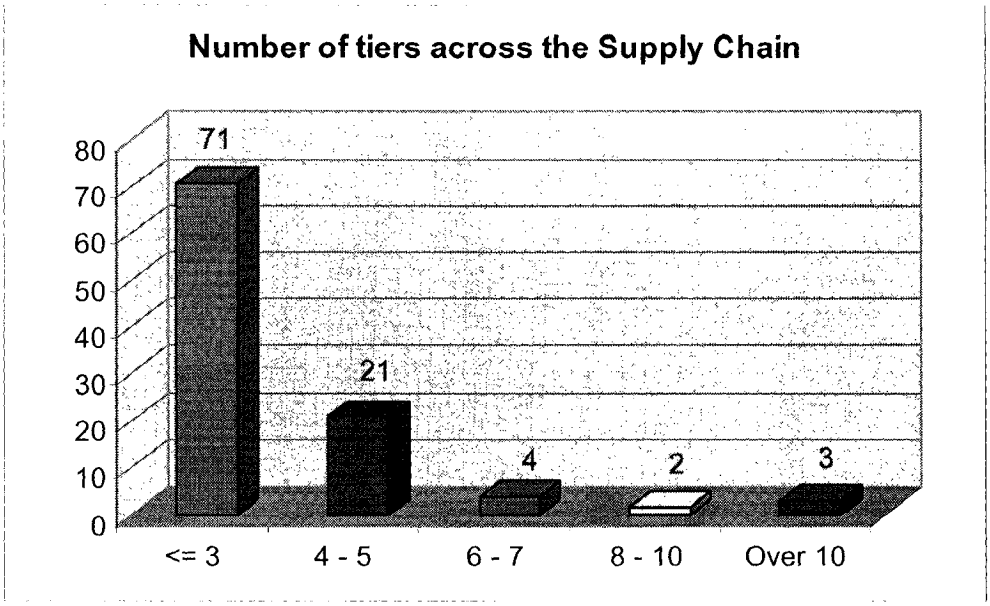


Figure 24. Number of tiers across the Supply Chain

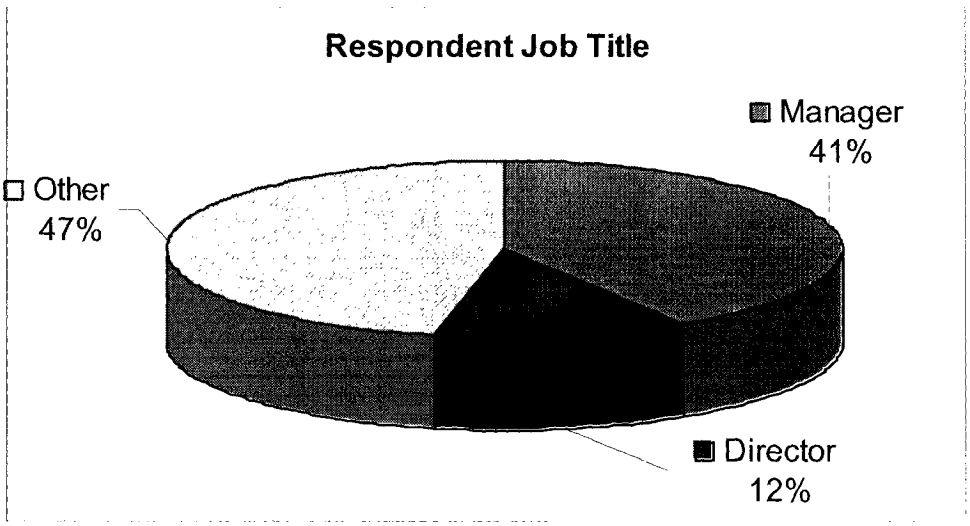


Figure 25. Respondent Job Title

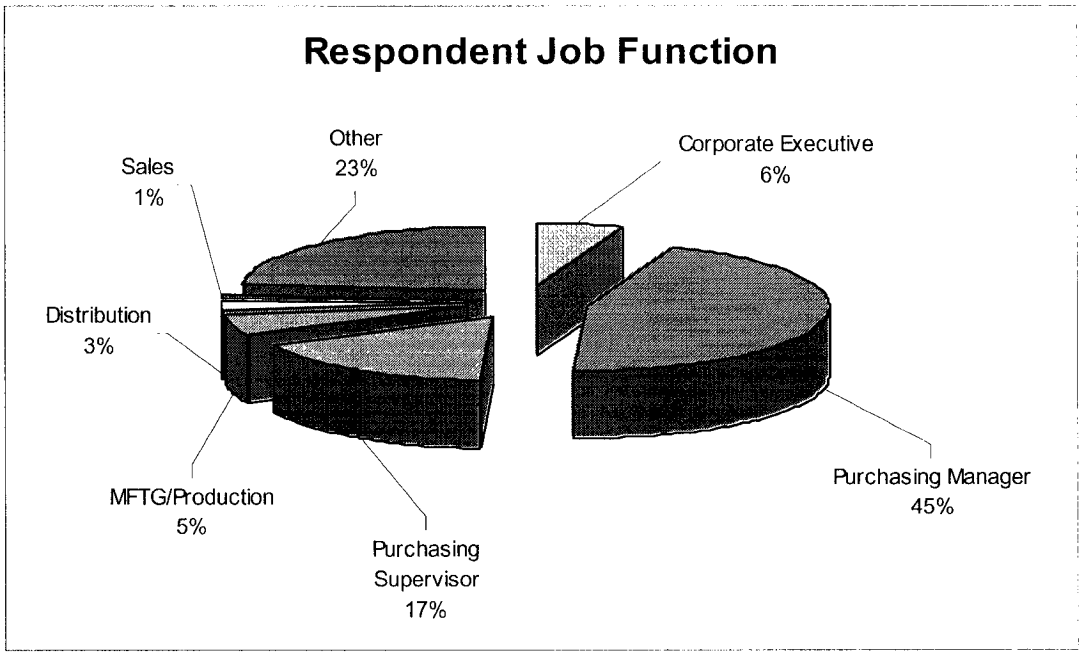


Figure 26. Respondent Job Function

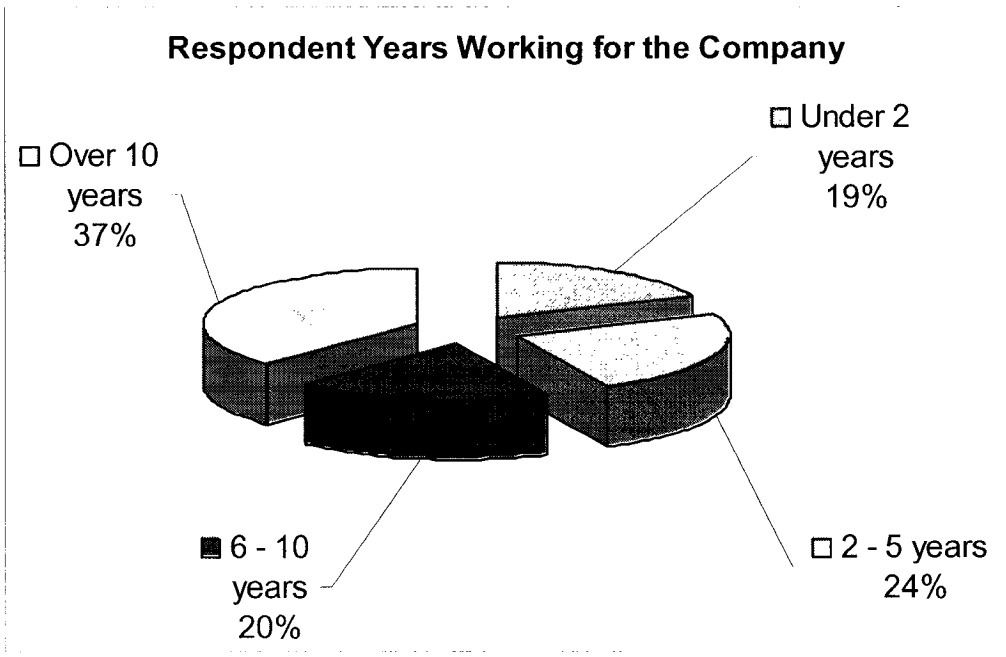


Figure 27. Respondent Years Working for the Company

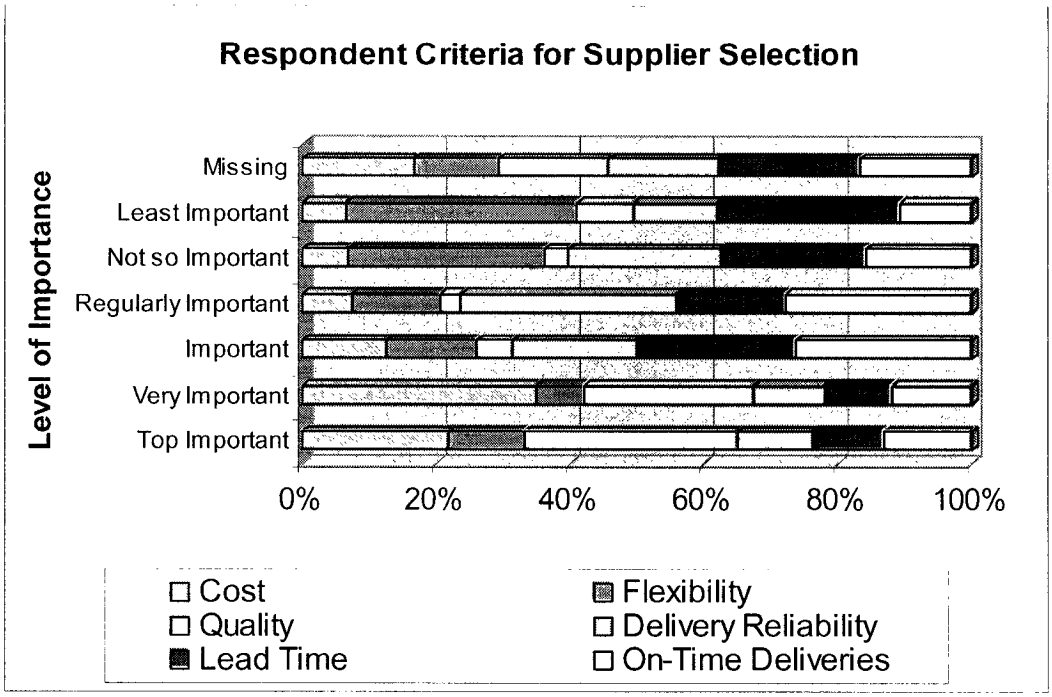


Figure 28. Respondent Level of Importance of Criteria for Selecting Suppliers

APPENDIX D: Large-Scale Item Purification for Procurement Practices (PPR) – Path Diagrams

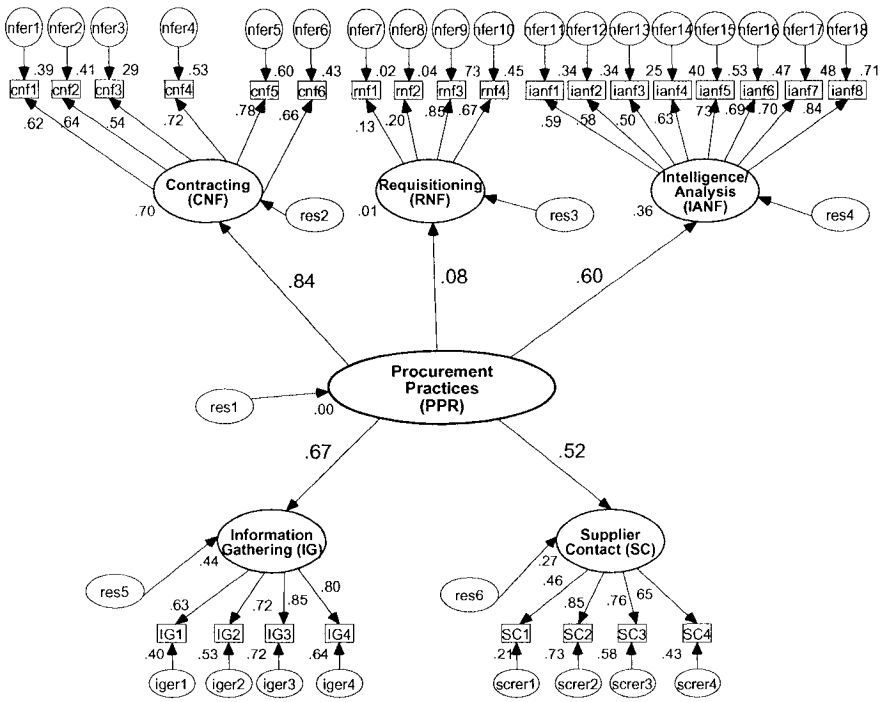


Figure 29. Procurement Practices (PPR) Measurement Model - Trial 1

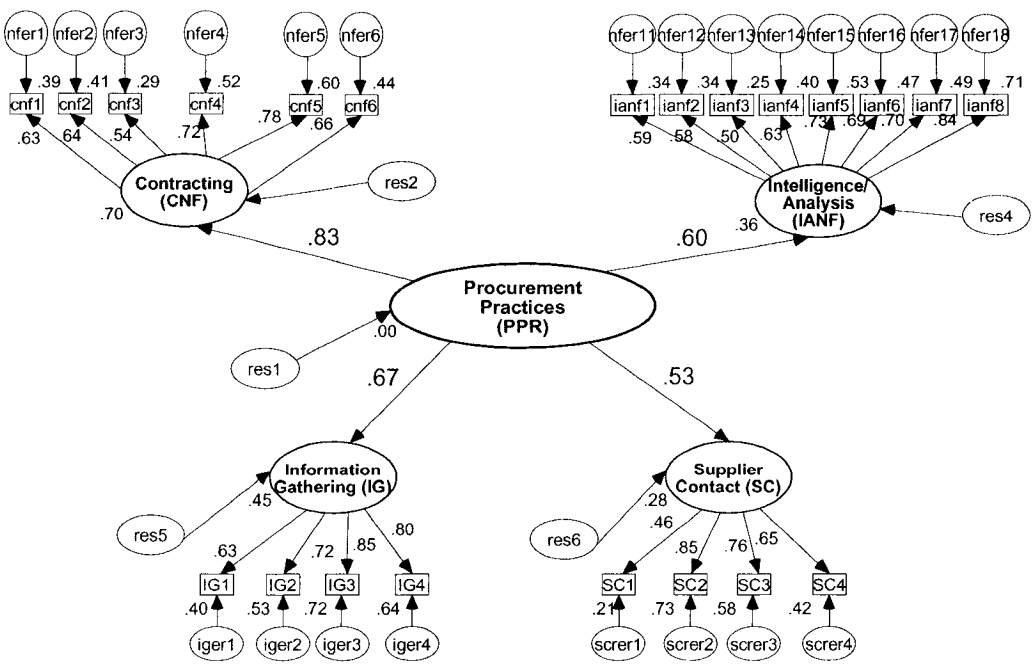


Figure 30. Procurement Practices (PPR) Measurement Model - Trial 2

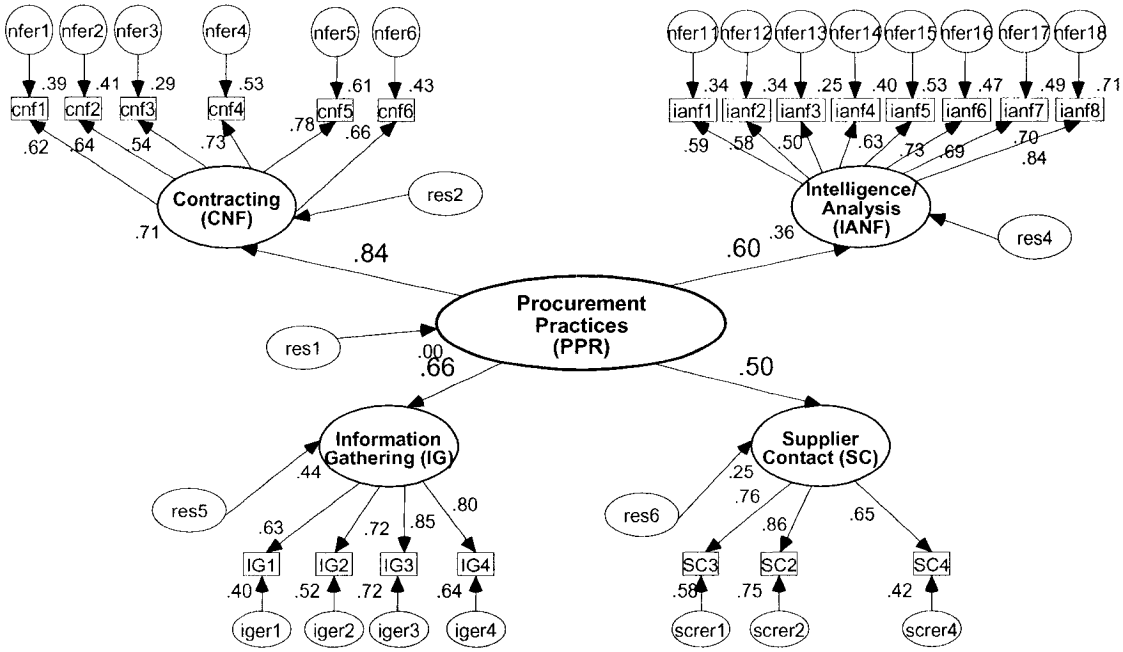


Figure 31. Procurement Practices (PPR) Measurement Model - Trial 3

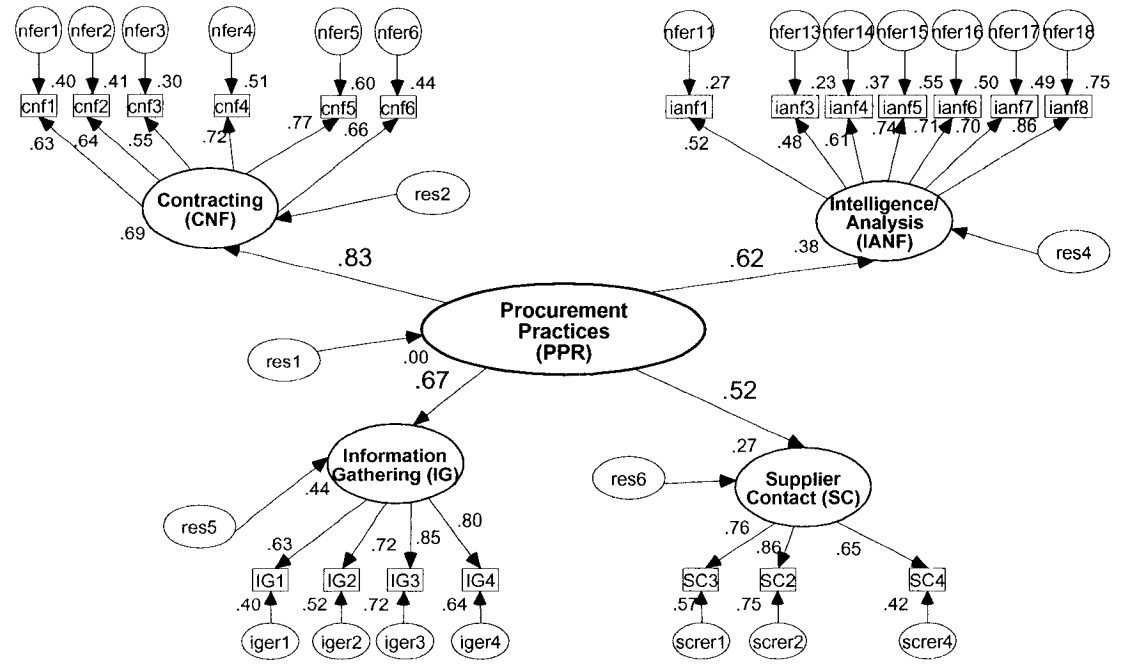


Figure 32. Procurement Practices (PPR) Measurement Model - Trial 4

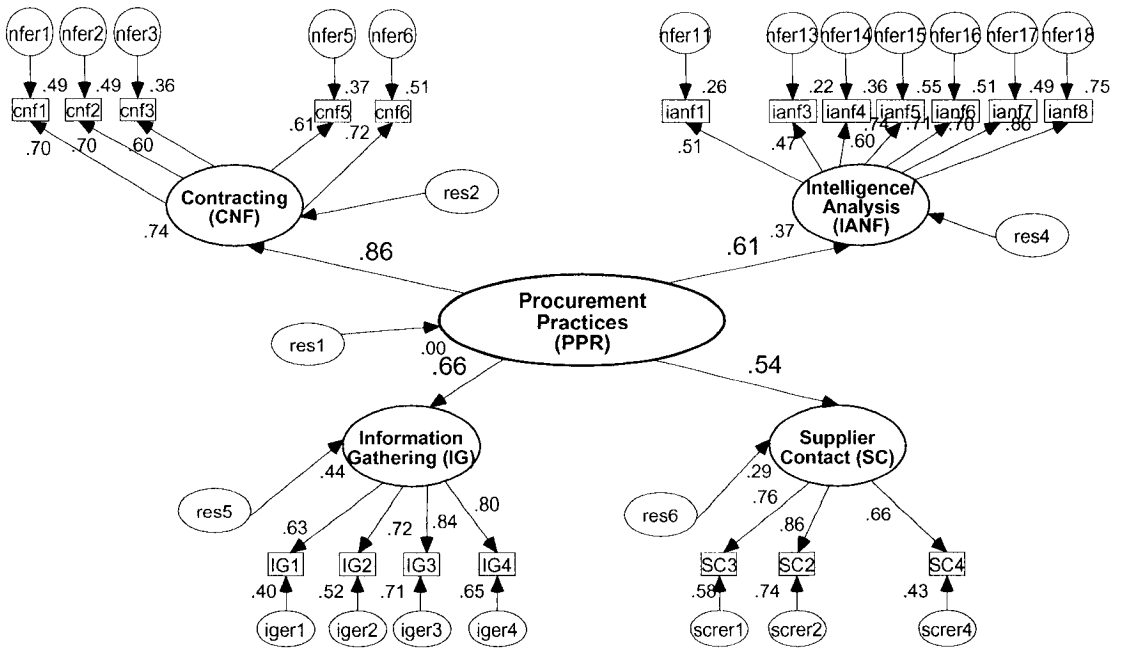


Figure 33. Procurement Practices (PPR) Measurement Model - Trial 5

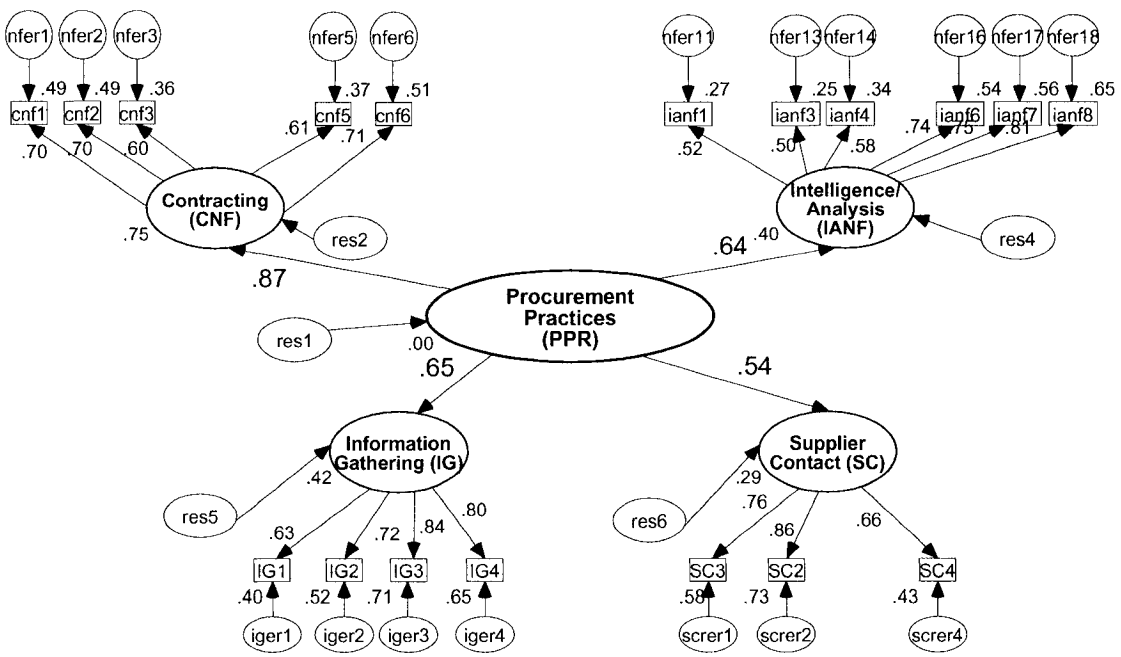


Figure 34. Procurement Practices (PPR) Measurement Model - Trial 6

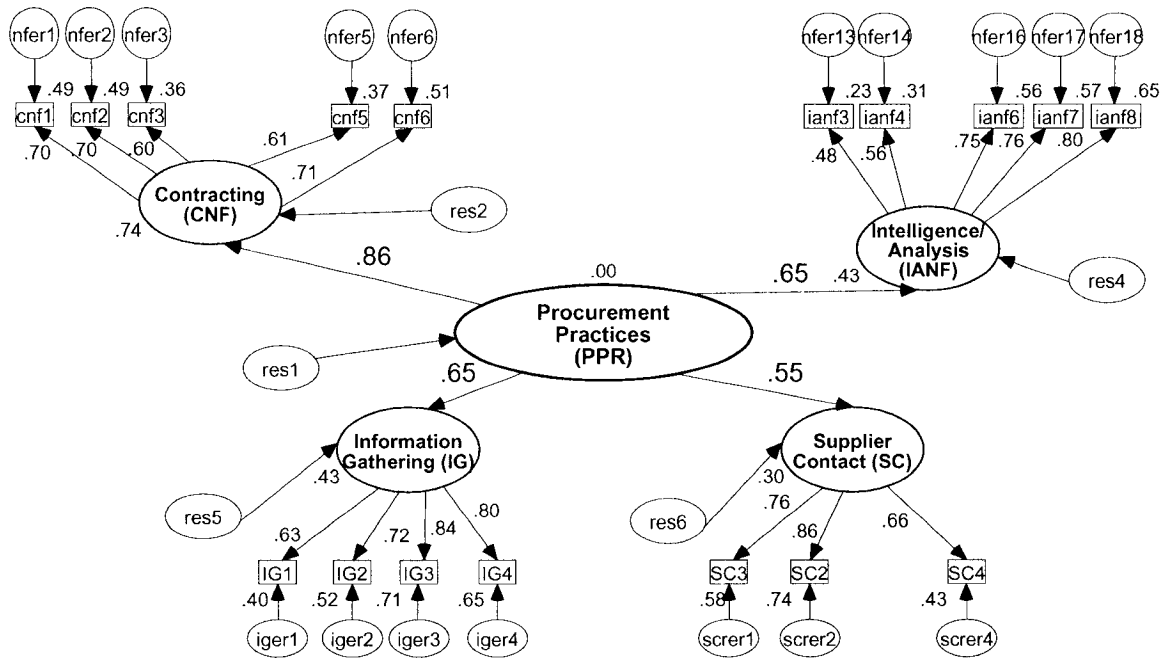


Figure 35. Procurement Practices (PPR) Measurement Model - Trial 7

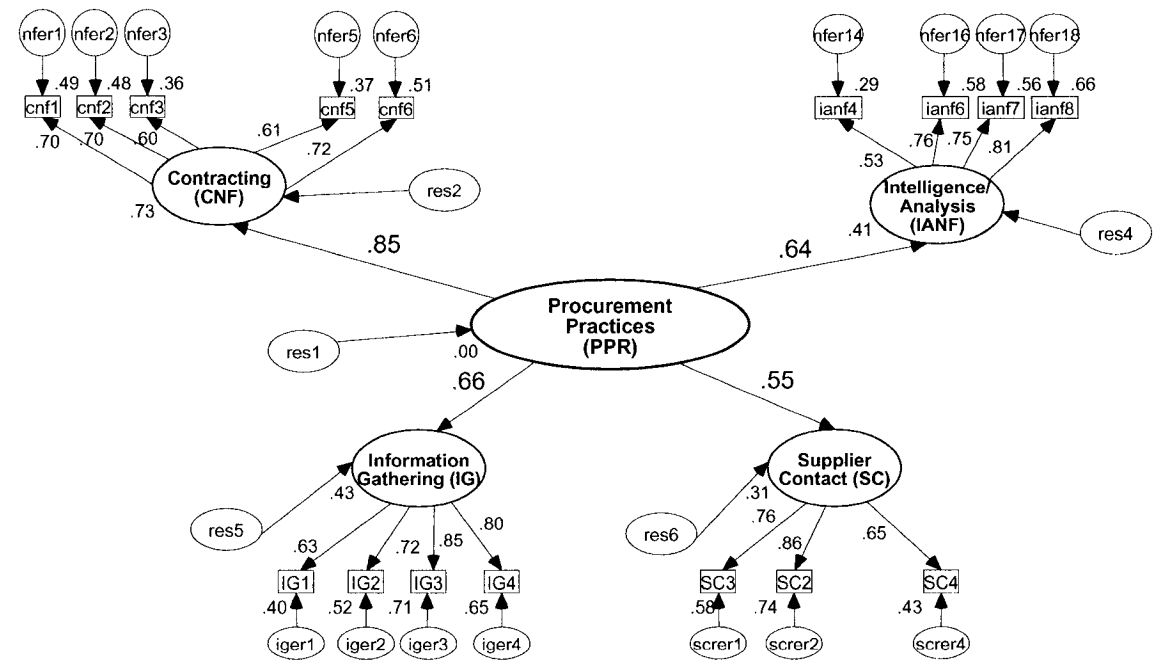


Figure 36. Procurement Practices (PPR) Measurement Model - Trial 8

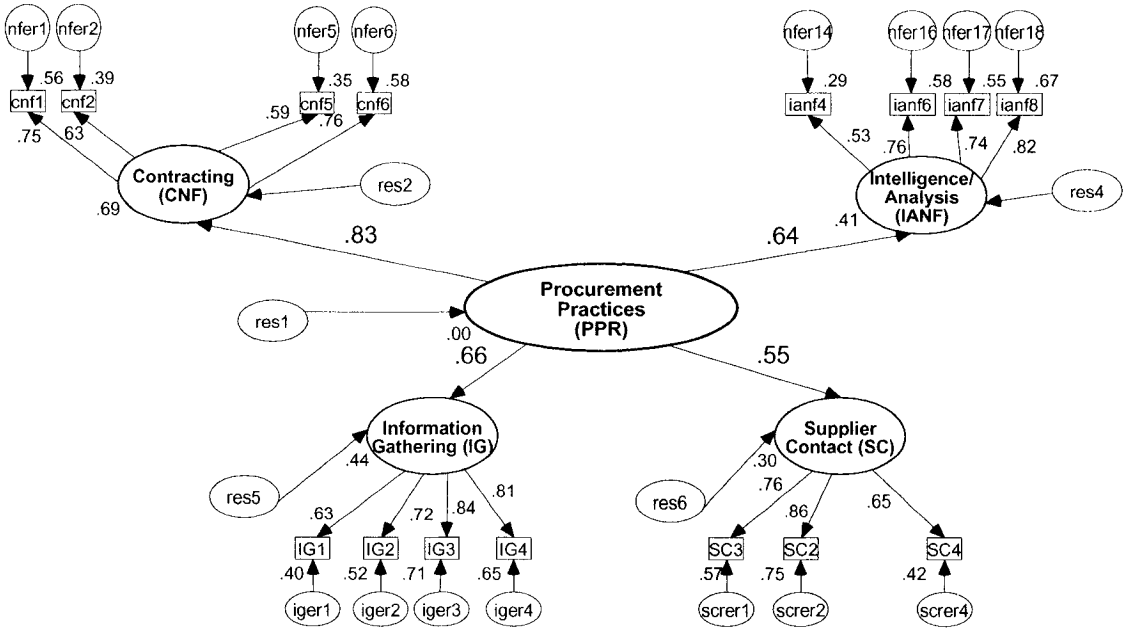


Figure 37. Procurement Practices (PPR) Measurement Model - Trial 9

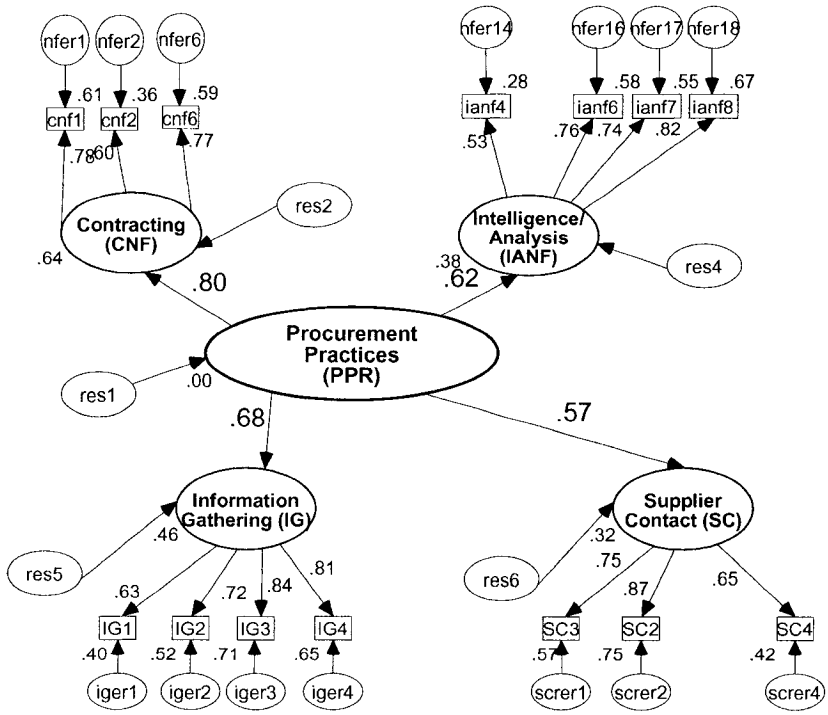


Figure 38. Procurement Practices (PPR) Measurement Model - Trial 10

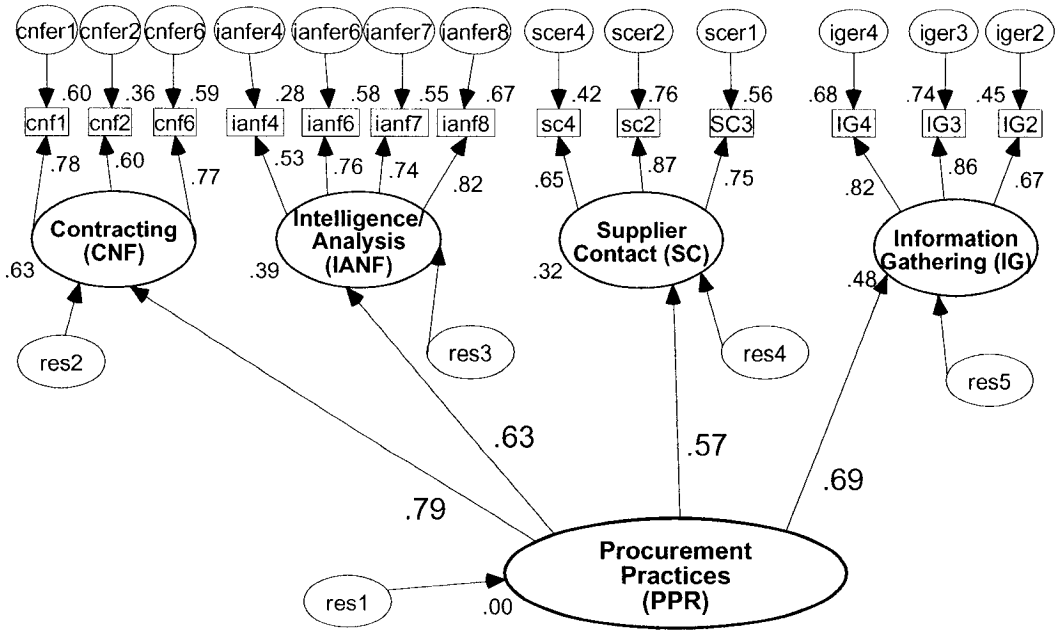


Figure 39. Procurement Practices (PPR) Measurement Model - Trial 11

APPENDIX E: Large-Scale Item Purification for eProcurement Technology Usage (EPT) – Path Diagrams

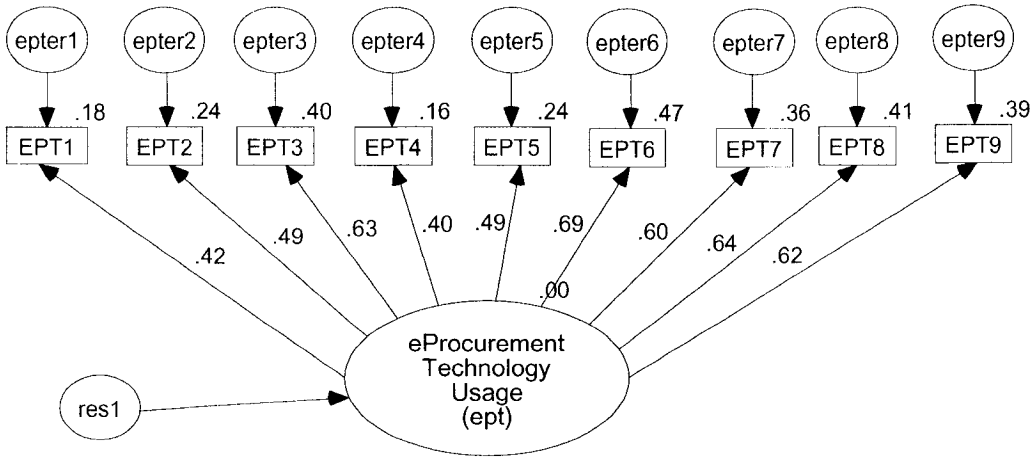


Figure 40. eProcurement Technology Usage (EPT) Measurement Model - Trial 1

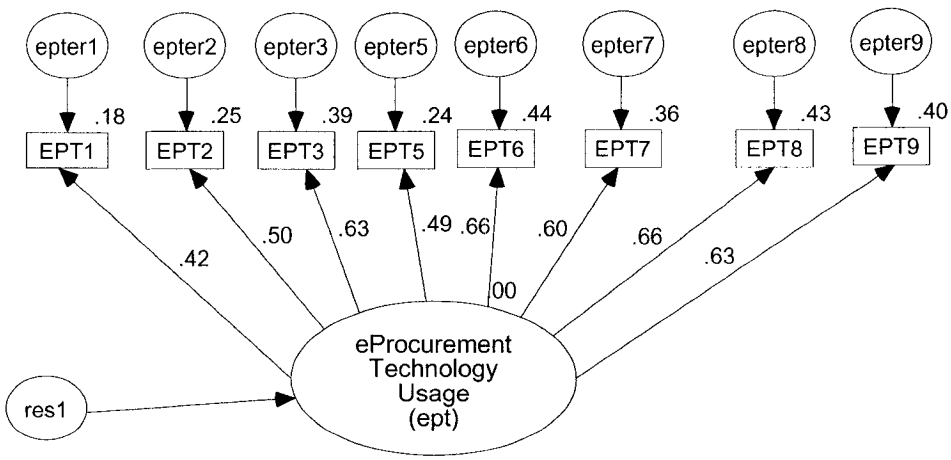


Figure 41. eProcurement Technology Usage (EPT) Measurement Model - Trial 2

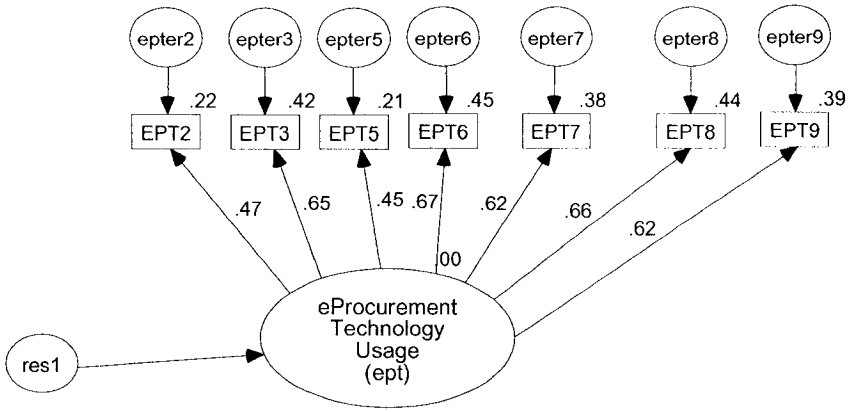


Figure 42. eProcurement Technology Usage (EPT) Measurement Model - Trial 3

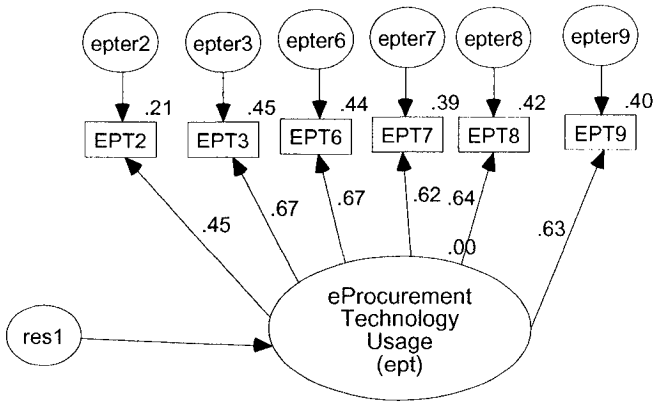


Figure 43. eProcurement Technology Usage (EPT) Measurement Model - Trial 4

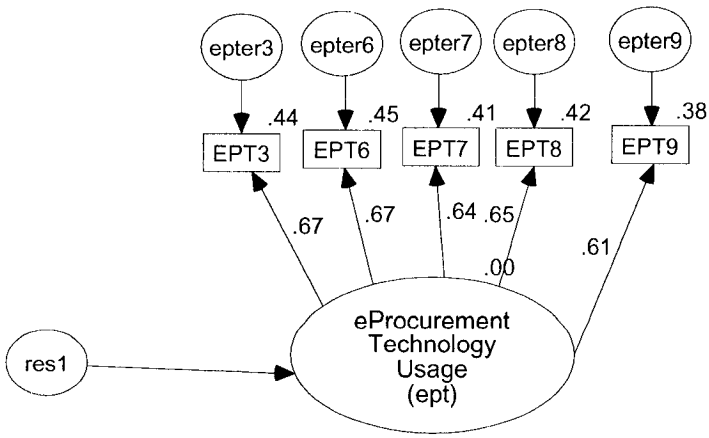


Figure 44. eProcurement Technology Usage (EPT) Measurement Model - Trial 5

APPENDIX F: Large-Scale Item Purification for Procurement Performance (PP) – Path Diagrams

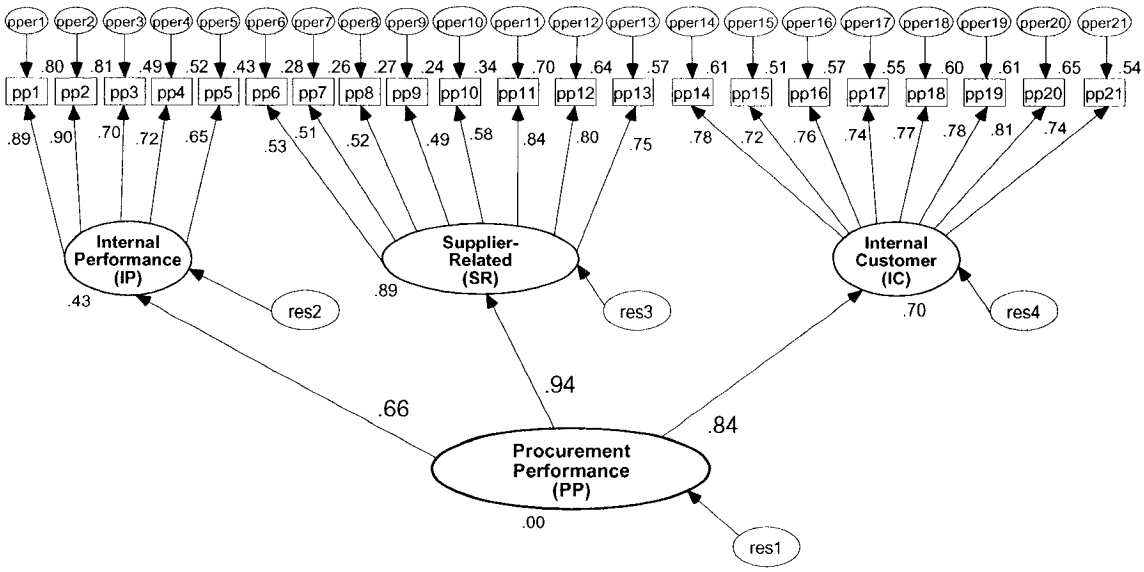


Figure 45. Procurement Performance (PP) Measurement Model - Trial 1

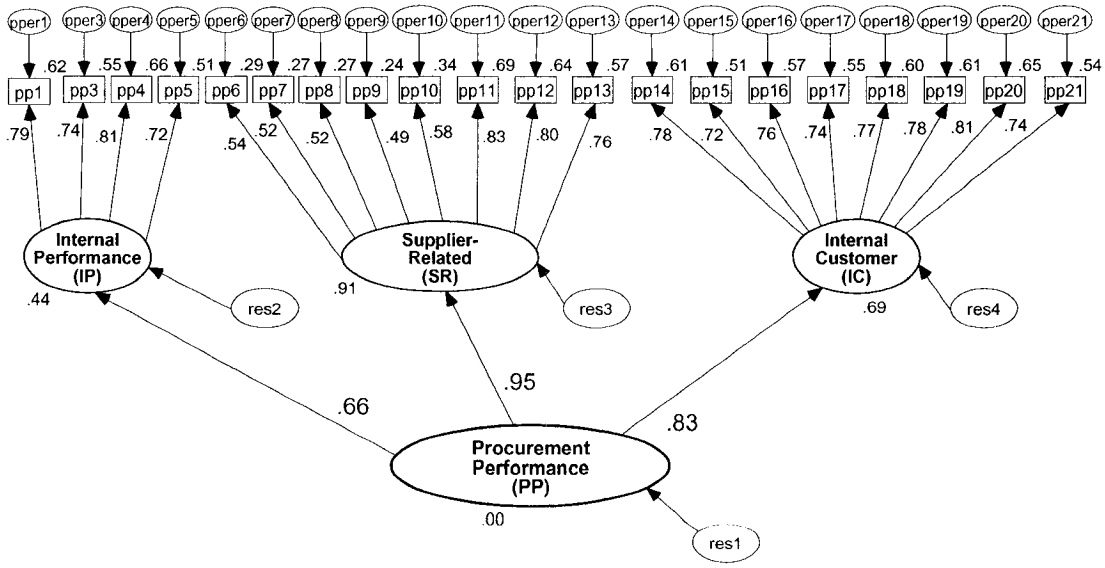


Figure 46. Procurement Performance (PP) Measurement Model - Trial 2

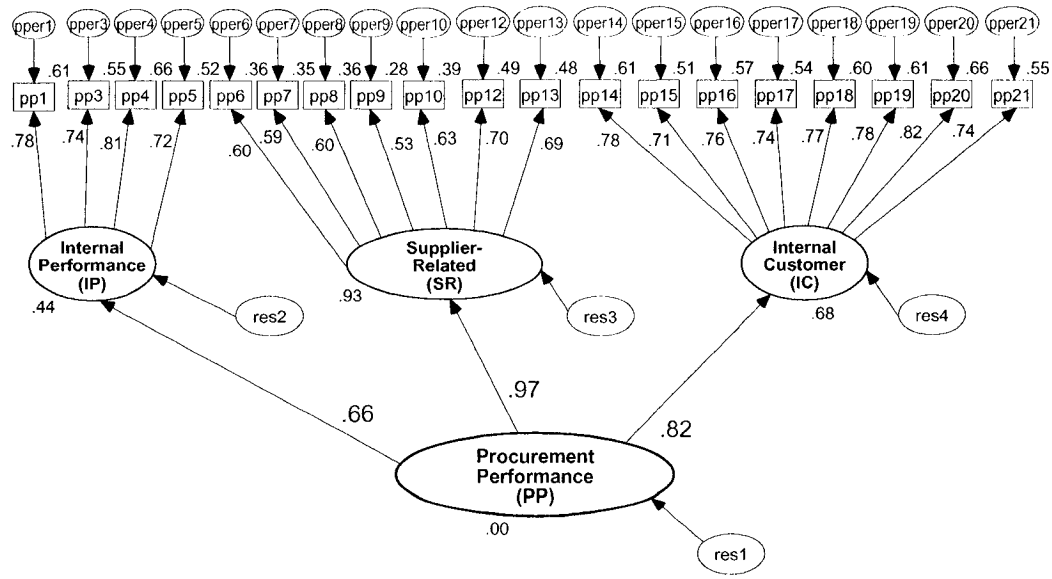


Figure 47. Procurement Performance (PP) Measurement Model - Trial 3

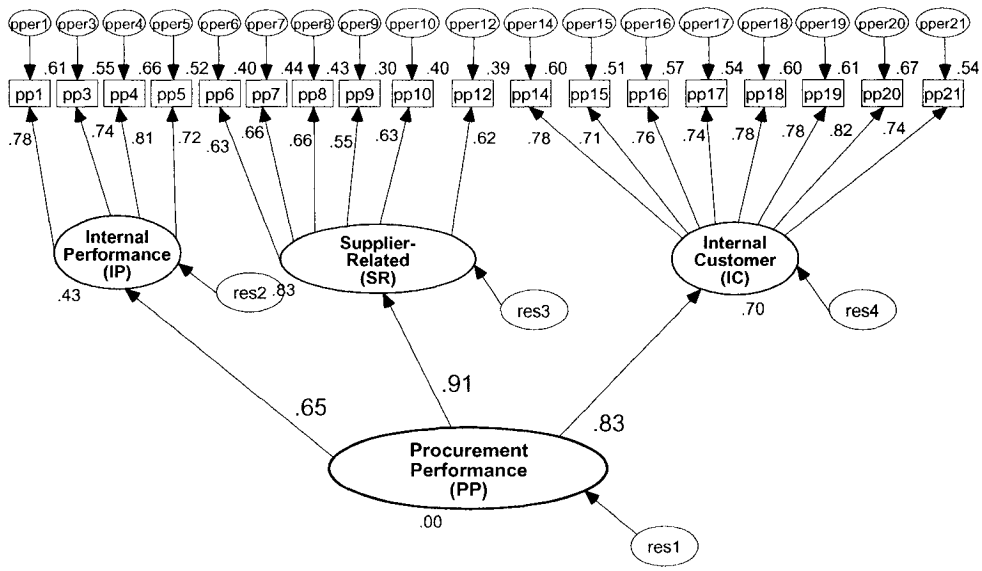


Figure 48. Procurement Performance (PP) Measurement Model - Trial 4

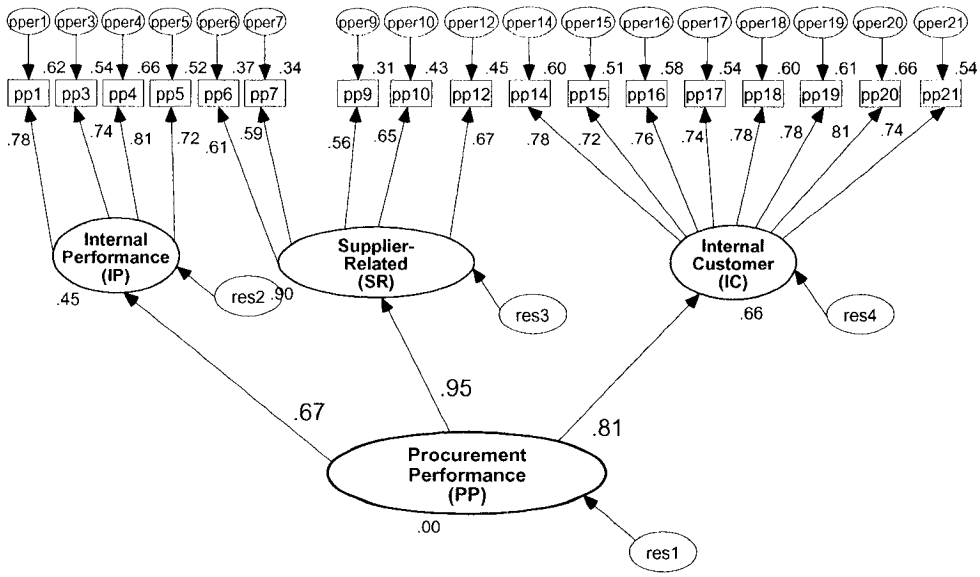


Figure 49. Procurement Performance (PP) Measurement Model - Trial 5

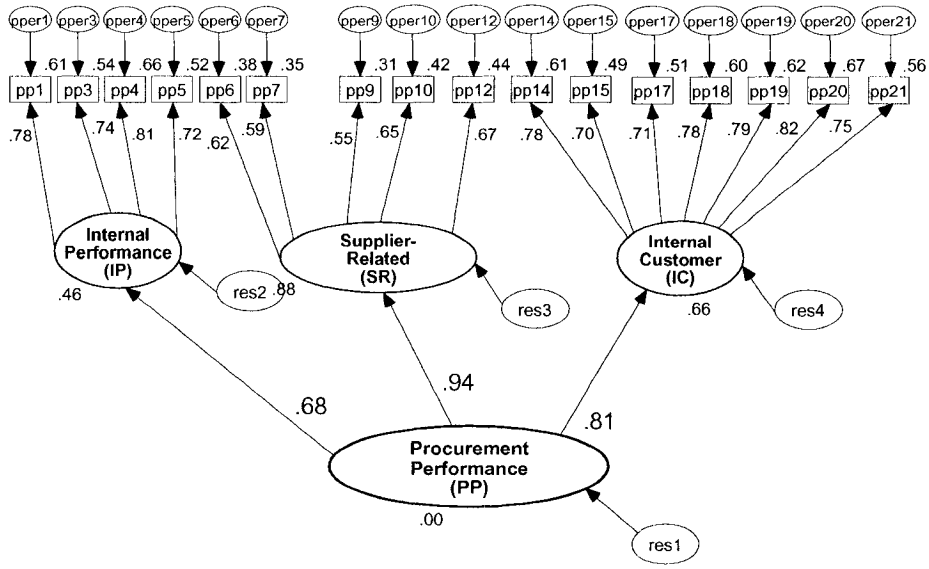


Figure 50. Procurement Performance (PP) Measurement Model - Trial 6

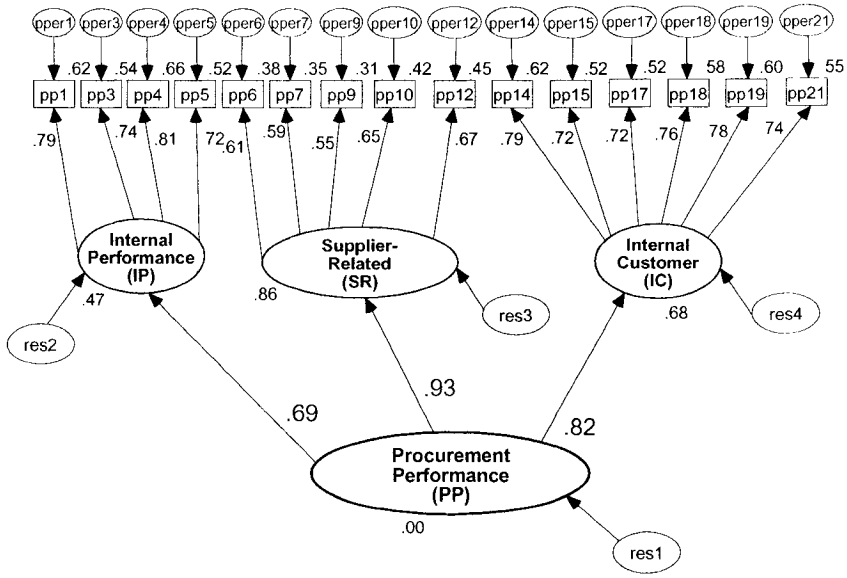


Figure 51. Procurement Performance (PP) Measurement Model - Trial 7

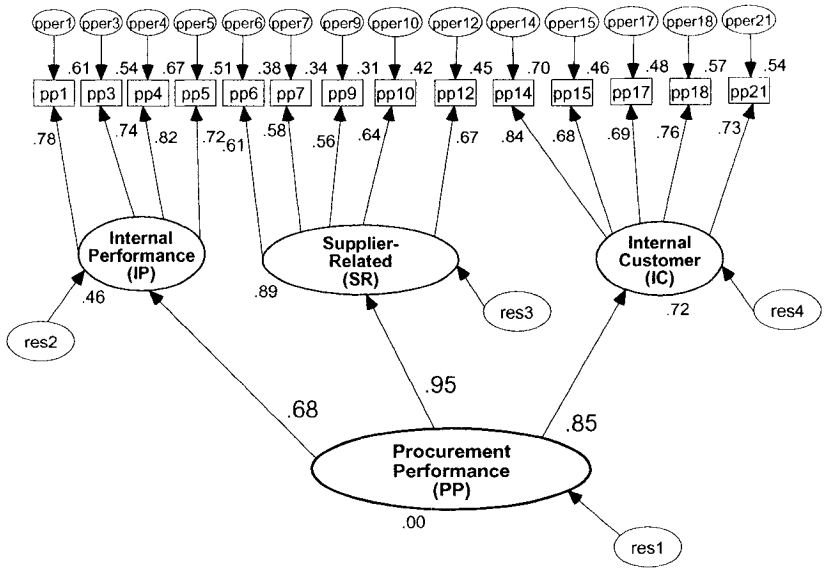


Figure 52. Procurement Performance (PP) Measurement Model - Trial 8

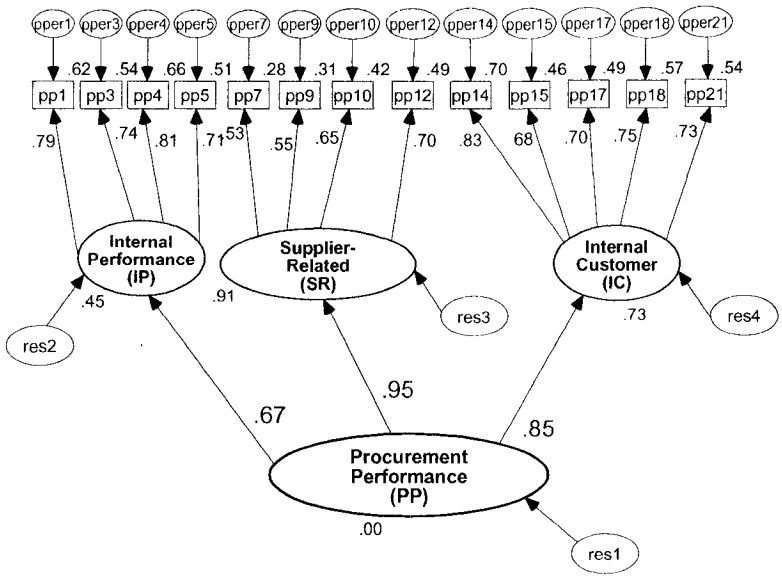


Figure 53. Procurement Performance (PP) Measurement Model - Trial 9