E-Procurement is an important business avenue for lowering purchasing price and enhancing process efficiency. Nevertheless, its implementation implies establishing a collaboration mechanism among supply chain participants based on the adopted Internet-based infrastructure. However, the value of Web-based e-procurement to supply chain participants remains an arduous task for researchers. This study proposes an e-procurement impact model based on supply chain orientation, which investigates direct and performance impacts of e-Procurement from the buyer-seller perspective. To prove the contribution of the e-Procurement model, a questionnaire survey was conducted on 69 firms in Taiwan, who participated in e-Procurement projects sponsored by the government. The results confirm that the electronic execution of purchasing activities enhances the purchasing performances including buyer and supplier. What notably, the performance impact is not derived directly from the Web-based procurement functions but through the process automation triggered by the adopted e-Procurement solution. Moreover, e-Procurement improves partnership, which in turn has positive impact on the purchasing performances of both buyer and supplier.

Keywords: e-Procurement, performance impact, supply chain collaboration

1. Introduction
The benefits of e-Procurement have been verified by many leading companies worldwide, and e-Procurement is a significant tactic in most companies’ e-Business strategies (Deloitte Consulting, 2001). The consensus is that e-Procurement benefits organizations with respect to procurement cost and process efficiency associated with procurement activities (Choudhury and Hartzel, 1998). This is due to web-based e-Procurement solutions can support four major B2B tasks in
organizations: search, processing, monitoring and control, and coordination (Subramaniam and Shaw, 2002).

When pre-Internet information technology (IT) such as Electronic Data Interchange (EDI) was applied for procurement purpose, suppliers were hesitant to adopt EDI because they worry that buyers may have the first-mover effect and reap all the benefits of the electronic linkage (Mukhopadhyay and Kekre, 2002). Implementing an e-Procurement solution is associated with establishing an inter-organizational system (IOS). An IOS usually involves two participants or groups of participants: the initiator and a number of (prospective) partners. The initiator bears the major part of the investment to set up and maintain the system. In order to make the system successful and compensate for the initial investment, a number of partner organizations have to agree to participate and use the system. The issue of trust associated with value allocation within a supply chain helps explain why EDI systems have not experienced the expected high growth rates (Chwelos et al., 2001). In fact supply chain collaboration involves many intangible values such as customer satisfaction and improved supplier relationships, which lack effective measures to translate them into real value.

How to track and allocate the value within the relationship becomes a problem. The body of research that evaluates IOS performance is large and diverse. It can be summarized into two groups. The former examined the impacts at lower operational levels in an enterprise, e.g., the impact on order processing. The latter examined strategic implications of interorganizational systems, including how IOS improves the business or manufacturing processes between firms in the supply chain. This dichotomy follows the traditional line of operational versus strategic uses of IT (Gebauer and Buxmann, 2000). The former emphasized process automation such as order-entry procedures or payroll processing within a firm. The latter addressed strategic goals like increasing customer satisfaction, providing an edge over competitors, opening new sales channels, or increasing brand awareness.

Much of the attention on IOS valuation has focused on its impact on direct impacts (i.e. business operations), in which transaction cost theory (TCT) has played an important role. IT would bring efficiency benefits from reducing the governance costs of transacting with external parties relative to internal coordination costs. However, TCT neglects the the interdependence of relationships among trading partners. How does IT positively impact the cost to coordinate activities between organizations and possibly even lead to competitive advantages? These issues remain challenges to many researchers.

TCT was applied to explain the exchange mode based on the technology superiority of web-based e-
Procurement solutions. Transactions between buyer and supplier companies can also be affected by relationship factors (Spekman and Johnston, 1986), and can be either market or relation-based. Decision making in market exchange is based on purchasing unit-price. Buyers purchase by price, trying to exploit the production capacity and the multiple number of vendors. Relational exchanges are long-term transactions based on trust and close relationships (Dwyer et al., 1987).

In sum, identifying the value impacts of supply chain collaboration has involved direct process impacts, which address operational improvement and information improvement due to the process automation. In addition, indirect process impacts capture the benefits after the technology is integrated with back-office applications so companies can use information that resides in an enterprise system to improve relationships within their supply chain (Chang and Shaw, 2004). Finally the impacts on relationships deal with the improvement of customer relations and trading partners.

Past research on the value impacts of e-Procurement has focused on the benefits for a single company through case studies (Ageshin, 2001; Subramaniam and Shaw, 2002). This phenomenon can be attributed to the complex inter-organizational environments where loyalty of business partners might be questionable and decentralized coordination and decision making mechanisms which are more susceptible to supply chain uncertainties. This study attempts to investigate direct and indirect process impacts of e-Procurement from the buyer-seller perspective. Furthermore, the impact on the collaborative relationship between buyer and seller is also investigated.

2. Literature review

2.1 Web-based e-Procurement

e-Procurement has covered procurement automation for internal organizational processes, and supplier collaboration for inter-organizational processes. The former addresses automated, paperless internal process from end user item selection, to creation and routing of purchase request and approval to purchase order creation, and receiving. The latter is about connectivity with suppliers for electronic catalogs, transaction management and on-going relationship management.

The use of web-based IOS can assist supplier collaboration and cause the boundaries between an enterprise and its suppliers disappear, making suppliers a part of the “extended enterprise” (Subramaniam and Shaw, 2004). By comparison, e-Procurement systems use real-time information flow to help buyers and sellers and acquire the collaboration benefits such as accelerating the processing of purchases, shortening purchasing time, and reducing both buyers' and sellers' coordination costs.
2.2 Impact on relationships with partners

Based on an organizational view, the buyer and suppliers are the two most important types of participant in e-Procurement systems (Barrett and Konsynski, 1982), and the partner relationship between them is a key element. If the two parties maintain a close relationship, they can readily achieve a win-win outcome, for which information sharing and technology dependence have been influential factors.

Due to the uncertain correlation between forecasts and actual needs, suppliers are inevitably forced to prepare large amounts of inventory if there is no information sharing between companies, and excessively large inventories are a waste of resources. Information sharing between B2B partners can therefore improve the efficiency of the entire supply chain (Corbett et al., 1999). Swaminathan and Tayur (2003) point out that, with the ubiquitous adoption of the Internet, companies establishing ERP systems can use the Internet to transmit information in real-time to vendors and customers, helping companies to coordinate or cooperate with their vendors and customers.

Besides the price factor, another important impact factor on buyer-supplier relationship is technology dependence. It is the integration of the technology of the supplier that is the basis of the long-term relationship (Kamath and Liker, 1994). Superlative technology is the most important bait suppliers use to hook new customers. Successful partnerships, then, depend on the right balance among a supplier's technological capabilities, a customer's willingness to share information, and both companies' strategic requirements. There is a range of postures that customers and suppliers can adopt within a long-term cooperative relationship.

Subramaniam and Shaw (2002) stress the importance that both buyers and suppliers actively participate in the web-based e-Procurement operating process and establish a partner relationship. However, close relationships between buyers and suppliers not only enhance information sharing but also eliminate the worry of participating suppliers via technical dependence about an intensely competitive market (Agi et al., 2005). This study therefore proposes the following hypotheses:

\[ H1. \text{Web-based e-Procurement tasks will be positive influence partner relationship impact.} \]

2.3 Direct process impact

Cost is the primary direct process impact encountered by companies during the implementation of e-Procurement systems. Subramaniam and Shaw (2002) propose that web-based e-Procurement should
take into consideration three types of factors, namely transaction cost and error cost.

In the procuring process, it involves procurement costs such as search cost, contract cost and monitor cost. Subramaniam and Shaw (2002) mention the e-Procurement can be classified into structured and unstructured. The former stresses organizations can reduce their transaction costs by searching, negotiating, and monitoring a long-term contract with a supplier and designing a web-based e-Procurement process for reordering if the demand is regular and product specifications do not change over time. The latter emphasizes that organizations often allow end-users to take advantage of the best deals available at the time of ordering, and very little benefit will be derived from typing such procurement to product-specific purchasing steps with a particular supplier. The greater variety of these requests and the higher intervention increase more staff time is spent in correct resolution. However, the web-based e-Procurement system can bring about the benefits such as savings in the staff resources used for search, input, and processing.

Traditional procurement process needs more labor-made processing and results in shortcomings of producing the errors such as key in data and increases the cost. On the contrary, the web-based e-Procurement system can automatically route product requests for the necessary approvals and order placements with suppliers. Hence, the system not only requires minimal data input but also decreases the error cost during the information-processing cycle.

From an operational viewpoint, the automation and acceleration of data handling, storage, and transmission activities can enhance data accuracy and reduce the number of errors (Ramamurthy et al., 1999; Sriram et al., 2000). In addition, Subramaniam and Shaw (2004) point out that, in web-based e-Procurement operations, one of the most important benefits is lower transaction cost. Based on the discussion above, this study consequently proposes the following hypothesis:

\[ H2. \text{Web-based e-Procurement positively influences direct process impact.} \]

2.4 Process integration impact
With regard to process integration impact, the key focal point is the assessment of ultimate performance. Since both buyers and sellers are autonomous participants in the supply chain, the following section examines performance assessment of both buyers and sellers while attempting not to favor either party at the expense of the other.

As for the assessment of buyer performance, Subramaniam and Shaw (2002) suggest that the
following four main assessment indicators be used to assess the performance of a web-based purchasing system: purchasing cost, purchase processing quality, user degree of satisfaction, and system responsiveness. Business processes primarily hinge on purchase processing quality, while purchasing cost performance reflects the reduction of time consumed, employee costs, manual work processing costs, coordination costs, error rate, and product lead time. As for product quality, with the buyer taking the lead in e-Procurement, the buyer can choose from many vendors and may therefore choose a vendor offering good quality. Finally, the aspect of organization explores the relationship between organization and vendor and the issue of information sharing.

Dickson (1966) and Shin et al. (2000) both demonstrate that product cost, product quality, and product delivery attainment are important indicators used to assess vendor performance. Purchasing cost is one of the main factors determining a customer's profits, and establishing a sound cooperative relationship is good method of reducing purchasing cost. For product delivery, Shin et al. (2000) point out that product lead time is a major indicator for the assessment of delivery attainment. The shorter lead time, the more inventory can be reduced and the faster inventory turnover. These are the benefits of timely deliveries. In summary, this study determines vendor performance by assessing the three factors of product cost, product delivery attainment, and product quality.

Baura et al. (1995) propose that IT use and operating process performance will have a certain amount of influence on corporate value. For instance, the use of EDI can improve process performance, which in turn can improve the level of output (Mukhopadhyay et al., 1997). Impacts of this type occur mainly at the operational level and result in cost reduction, higher productivity, and improved product quality (Mukhopadhyay, 1998). Subramaniam and Shaw (2002) also propose that the use of e-Procurement can yield a high level of performance with respect to product quality. Based on the discussion of existing work, this study consequently proposes the following hypothesis:

\[ H3. \text{Web-based e-Procurement positively influences process integration impact.} \]

In light of information sharing, Agi et al. (2005) suggest that, in EDI operating environments, the greater the information sharing between a central car manufacturer and vehicle parts manufacturers (VPMs), the better their operating performance. For instance, the central car manufacturer shares market forecast information with VPMs, leading to reduction of inventory levels for these suppliers. Hence, the sharing of information can bring the benefit of cost reduction. In addition, in light of technology dependence, Lee and Lim (2005) suggest that high technology dependence can increase the efficiency of transactions and decrease transaction process cost between partners. Furthermore, a high
level of dependence facilitated component delivery between the central car manufacturer and VPMs (Agi et al., 2005). As discussed above, this study proposes the following hypothesis:

\[ H4. \text{Partner relationship impact positively influences process integration impact.} \]

Subramaniam and Shaw (2002, 2004) propose that both buyer and seller can achieve lower transaction cost and error cost in a web-based e-Procurement environment (as proposed by H2), and also asserted that the reduction of these costs will have a positive effect on corporate performance. Therefore, this study proposes the following hypothesis:

\[ H5. \text{Direct process impact positively influences process integration impact.} \]

2.5 Research framework

This study proposes a framework for investigating the effects of web-based e-Procurement (Figure 1). This framework includes four dimensions: Web-based e-Procurement, Partner relationship impact, Direct process impact, and Process integration impact. Web-based e-Procurement functions mainly consist of process operation and collaborative operation. Partner relationship impact includes information sharing and technology dependence. Direct process impact consists of transaction cost, error cost, and inventory cost. Finally, Process integration impact includes buyer performance and supplier performance.

As illustrated in Fig. 1, this study assumes that: (1) Web-based e-Procurement positively influences partner relationship impact (H1), (2) Web-based e-Procurement positively influences direct process impact (H2), (3) Web-based e-Procurement, partner relationship impact, and direct process impact positively influence process integration impact (H3, H4, and H5).
3. Research methodology

3.1 Measurement development
A two-step procedure was employed to create items for the constructs. First, this study used a focus group to discuss the items proposed by the prior literatures. The focus group was assembled, including two professors who have researched B2B electronic commerce several years and six postgraduates who have studied B2B electronic commerce at least one year. Then, items that can be operated to determine the constructs that this study proposed were generated. Second, this study brought together a content validity panel (Lawshe, 1975) to reconsider the items generated in second step for determining the applicability and semantics of each items. A content validity panel was assembled, including two professors from management schools at universities and six managers from manufacturing firms. Based on these tests, the items were modified to create the instruments for the full-scale study.

3.2 Data collection
To promote electronic business, the government in Taiwan has subsidized many domestic leading companies’ plans for electronically integrating their supply chains, such as e-Business projects for IT industry (Project A and B) and manufacturing industries (e-Business Projects for Manufacturing Sectors). These series of projects aimed to actively promote the development of domestic industrial information technology and applications, and to improve the competitiveness of domestic industry.

The sample of this study is based on Project A and B, and e-Business Projects for Manufacturing Sectors, because both of them are all focused on e-Procurement. The questionnaire was mailed to 69 senior managers of domestic companies, including 17 companies that participate in Project A and B, and 52 companies that participate in e-Business Projects for Manufacturing Sectors. 69 questionnaires were sent out, of which 47 valid questionnaires were received; yielding a 68.1% valid response rate.

4. Analysis results
This study chose partial least squares (PLS), a structural equation modeling (SEM) technique, for analyzing relationships between variables in the research model. PLS employs a component-based approach for estimate purposes (e.g. Lohmoller, 1989) and can handle formative factors, unlike LISREL. PLS places minimal restrictions on measurement scales, sample size, and residual distributions (Chin et al., 2003). PLS was thus chosen to accommodate the presence of
formative factors and the large number of constructs.

4.1 Results of measurement model
The measurement model was assessed by using PLS to examine internal consistency reliability and convergent and discriminant validity (Barclay et al., 1995; Chin, 1998). Internal consistency reliability or composite reliability (CR) of 0.7 or higher is considered adequate (Agarwal and Karahanna, 2000; Gefen et al., 2003).

As strong evidence of convergent and discriminant validity: (1) The square root of the AVE for each construct was greater than 0.707 (ranged from 0.85 to 0.96) and greater than the correlation between that construct and other constructs (2) the factor structure matrix shows that all items exhibited high loadings (>0.707) on their respective constructs and no items loaded higher on constructs they were not intended to measure. Overall, the results suggested sufficient reliability and convergent and discriminant validity to allow an interpretation of structural parameters.

4.2 Results of structural model
The structural model was evaluated on the basis of R2 values and structural paths for each endogenous construct. As shown in figure 2, the model explained a substantial amount of variance for partner relationship impact (R2=0.594), direct process impact (R2=0.637) and process integration impact (R2=0.806), which were all greater than the recommended 0.10 (Falk and Miller, 1992).

The PLS results shown in figure 2 provide strong for hypotheses 1 to 5 except hypothesis 3 (H3). H1 is supported since relationship between web-based e-Procurement and partner relationship impact is positive and significant (path coefficient $\beta = 0.771$, $p < 0.01$). H2 is also supported since relationship between web-based e-Procurement and direct process impact is positive and significant (path coefficient $\beta = 0.798$, $p < 0.01$). H3 is not supported since there is a non-significant relationship between web-based e-Procurement and process integration impact (path coefficient $\beta = 0.122$, $p > 0.05$). H4 is supported since relationship between partner relationship impact and process integration impact is positive and significant (path coefficient $\beta = 0.224$, $p < 0.05$). H5 is also supported since relationship between direct process impact and process integration impact is positive and significant (path coefficient $\beta = 0.595$, $p < 0.01$). The proposed research model appeared to provide good power to explain 80.6 % of the variance in process integration impact.
5. Conclusion

This study verifies that the electronic execution of purchasing activities improves the purchasing performances including buyer and supplier. What is interesting is the performance impact is not directly from the web-based procurement functions but through the process automation triggered by the adopted e-Procurement solution. Furthermore, e-Procurement improves partnership, which in turn has positive impact on the purchasing performances including buyer and supplier. The findings based on the empirical survey are: the greater the procurement function with the web-based solution, the greater the automation efficiency (direct effect); thus as a result, the greater the performances for buyer and supplier altogether. The level of partnership increases, which furthers improvement of performance for buyer and supplier. The results of this study have the following implications.

By adopting a high level of web-based e-procurement solution, buyers can enhance the efficiency of purchasing operations due to automated procedures, eventually leading to performances due to the learning effect and the system integration effect. The major contribution of this study lies in incorporating supplier into performance measurement. E-Procurement is often an important part of supply chain management (SCM). According to a SCM survey conducted by Forrester Research in 2003, the main objective of SCM is to improve operation efficiency for supply chain participants.

B2B procurement is a multi-lane highway. Companies, including their customers and suppliers...
across the value chain, are evolving to operate in a new process and technology environment. It is important to understand suppliers’ perspective on their customers’ use of e-Procurement solutions, and to gauge their own readiness to enable customers to purchase goods and services through an e-Procurement solution. Supplier e-Procurement enablement is quickly becoming a customer requirement, and may well soon be a non-negotiable factor when companies make supplier selection decisions. However, corporate IT readiness may become major obstacles. Corporate technical ability may either encourage (e.g., relative advantage) or inhibit (e.g., complexity) realization of IT business values. Iacovou et al. (1995) have found firms with low IT integration level prohibit the benefits an adopter can receive given its IT capability.

Another important contribution of this study is the importance of partnership in measuring the synergy brought in by implementing an e-Procurement solution. One important objective of executing procurement on-line is to facilitate B2B transactions. Nevertheless it is also important to understand the multidimensionality of exchange. Electronic commerce (E-commerce) is sharing business information, maintaining business relationships, and conducting business transactions by means of telecommunications networks. Relational exchange participants can be expected to derive complex, personal, significant economic satisfaction and engage in social activities.

By adopting a high level of web-based e-procurement solution, buyers can enhance their partnerships with suppliers with respect to information sharing and technology dependence. Good partnership in turn yields positive impact on buyer-supplier performances. However, the levels of impact are quite different in H1 and H4 respectively (path coefficient $\beta = 0.771$ vs. 0.224). One possible explanation is that electronic execution of purchasing operations can be helpful for supply chain relationship but might not be able to resolve problems of supply chain integration. Such problems may be addressed by identifying the readiness of IT-enabled supply chain collaboration and focusing on inter-organizational process reengineering.

There is plenty of work on IT management issues and corporate business processes in a supply chain setting. According to Massetti and Zmud (1996), using IT to manage the processes with large transaction volumes is likely to produce significant benefits. Grover (1993) also points out IT is often used to manage the processes that sell customized products as those processes require intensive communication and decision making to reduce time spent and total errors made. When goods are of high value for an organization and are required recurrently, Hengst and Sol (1999) have found IT can be more successful in assisting companies utilize supply resources, improve order accuracy, and increase process flexibility. Gosastn et al. (2005) explores how enterprises in supply chains may forge supply chain linkages that enable both types of flexibility.
jointly, and allow them to deal with ubiquitous change.

References
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