

# UNDERSTANDING THE RELATIONSHIP BETWEEN PROCUREMENT PERFORMANCE AND E-PROCUREMENT SYSTEMS IMPLEMENTATION

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**Abstract:** Information Technology (IT) can help generate a positive contribution, not only to the economic growth but also to a better environment. In this context, our paper aims to analyze the role of electronic procurement systems (EPS) implementation and use on the firm's green procurement performance. We propose a conceptual model to explain the role of EPS Implementation on procurement performance where the environment component is also included. We hypothesize that: (1) procurement performance is affected by the extent of EPS implementation success; and (2) the relationship between EPS implementation success and procurement performance is moderated by both the power balance (between the focal firm and its suppliers) as well as the extent of internal and external systems integration. Additionally we propose a research methodology to empirically test the conceptual model and associated hypotheses.

## 1 INTRODUCTION

The main objective of this research is to examine the potential relationship between procurement performance (measured not only by the traditional efficiency and effectiveness criteria but also by a new environmental dimension) and the implementation of an electronic procurement system (EPS). The current understanding of this association can be enhanced by considering the specific role of power balance between the firm and its suppliers and EPS integration with both internal and external (suppliers) systems.

Procurement, public and private, of goods and services that are friends of the environment is a possible definition of green procurement. The application and effective use of this concept by the buying organizations could generate significant economical and environmental benefits. Taking into account the public sector, one knows that around 16% of European Union wide GDP is for purchasing goods and services. In what concerns to the private

sector, almost one half of the sales revenue of business firms is typically spent in acquiring inputs (goods and services) from external suppliers. Most of that extensive budget is spent in products that could easily be replaced by products with better environmental characteristics. Just as an example, if all public authorities across the EU demanded green electricity, this would save the equivalent of 60 million tonnes of CO<sub>2</sub>, which is equivalent to 18% of the EU's greenhouse gas reduction commitment under the Kyoto Protocol. Because the electronic procurement systems (EPS) are designed to store and process large amounts of data about product characteristics as well as suppliers, we see this type of information system as an enabler for organizations to significantly contribute to the improvement of the environment. So, this paper presents one main research question and two additional accessory research questions: (1) Is there a relationship between procurement performance and EPS implementation success? (1a) Does power balance moderate this relationship? (1b) Does EPS

integration with both the firm’s internal and external information systems moderate this relationship?

Getting answers to these research questions can not only give firms one more management instrument to improve their procurement performance but also enable academics to use this model to enrich the curricula and develop further research. Based on the previously introduced research questions, a theoretical framework as well as the associated research hypotheses are developed on Section 2. In Section 3 we propose a research methodology that can be used to test the hypotheses and find the answers to the former research questions. Section 4 presents some limitations and difficulties we will have to deal with along this study. Finally, Section 5 presents the conclusions and, since this is a research in progress paper, a work plan to complete the research projects is also suggested.

## 2 CONCEPTUAL MODEL AND RESEARCH HYPOTHESES

The conceptual model that we propose is presented in Figure 1. This conceptual model posits three predictors for procurement performance: (1) EPS implementation success; (2) power balance between the focal firm and their main suppliers; and (3) EPS integration with both internal information system and external (main suppliers) information systems; while controlling for firm size, EPS age and industry effects. Next, we discuss in some detail each model component while developing the study hypotheses.

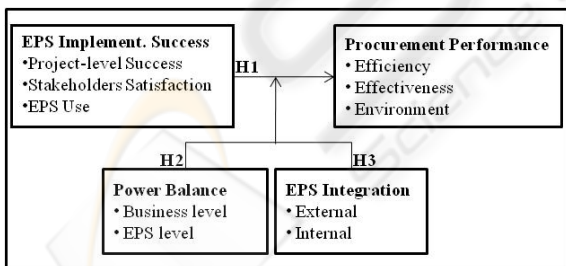


Figure 1: A Conceptual Model for Procurement Performance.

### 2.1 Procurement Performance

Procurement performance is the final dependent/endogenous variable in the model. Typically, procurement consists of five stages: search, negotiation and pricing or price discovery, ordering, order coordination, and payment (Leenders

et al. 2002; Premkumar et al. 2005). Weele (2000) developed a Procurement Performance Model where effectiveness (product price) and efficiency (process cost) were the main variables to evaluate. Using that model, Kumar et al. (2005) developed a procurement performance measurement system that could be used by organizations in the health industry. In accordance with these studies, the highest priorities for procurement managers surveyed in Williams and Hardy (2007) and Tanner et al. (2008) were reductions in both purchase price (effectiveness) and process costs of procurement (efficiency). Taking into account both practitioners and researchers we plan to use these variables to capture the impact of EPS use on procurement performance. Additionally, since EPS use can also have an impact at the environmental level we are also interested in capturing these possible benefits (waste and carbon dioxide reduction) that can emerge from a successful EPS implementation and use.

### 2.2 EPS Implementation Success and Procurement Performance

In general, IT implementation success can be evaluated not only through the effective use of the system and user satisfaction but also at the Project-Level (Finch 2003; Schwalbe 2007). Even though users could use an IS it does not mean that they are satisfied or feel comfortable using it. According to Subramaniam and Shaw (2002) satisfaction is affected by how well the IT is perceived to meet user expectations. If the EPS is easy to use, allows users to have lower cycle times on their orders or allows them to access information quickly and with minimum effort, user satisfaction could increase and so would the EPS implementation success. On the other hand, if an employee had the habit of going physically to the purchase department in order to request some items, s/he would probably have had an informal and perhaps a pleasant conversation with people around. Producing the order requisition at the employee’s own computer keyboard drastically reduces these unofficial meetings and perhaps some satisfaction. When a firm is able to implement an information system paying attention to the appropriate implementation factors and it is being used satisfactorily by employees (based on DeLone and McLean (2003) updated model) it will bring net benefits for the organization. In the context of EPS one could say that with effective consideration of the factors identified and defined by Cooper and Zmud (1990) during the stages of the implementation process one would expect that the

use of EPS will have a positive impact on the procurement performance of the organization. Based on these arguments we posit that:

**H1:** *Higher levels of EPS implementation success are positively associated with higher levels of procurement performance.*

### 2.3 EPS Implementation Success, Power Balance and Procurement Performance

While we argue above that EPS implementation success could result in improved procurement performance we also note EPS is an inter-organizational system (IOS). In the context of IOS the extent of dependence and an ability to exercise power and control determines the balance of power between the focal firm and its key suppliers, and has often been cited as a key factor both in terms of deciding on and setting the design parameters for such systems as well as in terms of nature and extent to which the systems would be managed and used. Following the old adage that a chain is only as strong as its weakest link, unless EPS is used by both the focal firm and its major suppliers its implementation can neither be deemed to be a success nor is it likely to result in improved performance. There is evidence to indicate that dependence (of customer-supplier) and power have a significant role in the decision to adopt and use these systems (Wey and Gibson, 1991; Hart and Saunders, 1997). In a typical supplier-customer interaction there is a certain amount of built-in dependency in the relationships between the two parties given that each is dependent on the other for resources that are subsequently exchanged (Pfefer and Salancik, 1978). The party that is less dependent on the other (e.g., has alternate sources for required resources) would be in a position to exert greater control and power over the inter-organizational transactional context (Stern and Kaufman, 1985; Oliver, 1990; Hart and Estrin, 1991). Research in marketing has found that exercise of such power and control has a significant influence on various aspects of inter-organizational relationships such as decisions related to, for instance, the system's design parameters (Copeland and McKenney, 1988), transaction parameters (price, delivery schedule etc.), channel conflict, and channel performance (Gaski, 1984). Based on these discussions we posit that:

**H2:** *The effect of EPS implementation success on procurement performance will be low in contexts where the balance of power is not in favor of the*

*focal firm; conversely, the effect will be high in contexts where the balance of power is in favor of the focal firm.*

### 2.4 EPS Implementation Success Systems Integration and Procurement Performance

As a large-scale system that can involve several business processes within a firm and its numerous trading partners across the supply chain, an e-procurement system requires huge investments in terms of acquisition, implementation, integration, training, and maintenance, placing tremendous strain on company resources (Talluri et al. 2006). Barua et al. (2004) defined the concept of systems integration as the extent to which a firm integrates its various IT systems to provide visibility to customer and supplier data and to allow online information sharing and transaction execution across the value chain. A distinction can be made between internal processes integration and external processes integration (Porter, 1985; Williamsson, 1985). With regard to internal processes, the integration of primary processes (e.g., those integrating primary activities and directly producing the outputs of the firm) can be distinguished from the integration of secondary processes, those that support secondary activities (Barki and Pinsonneault, 2005). According to Williamsson (1985), external processes integration can also be separated according to whether they integrate customers (direct forward integration), suppliers (backward integration), or third parties for instance, banks or government entities (lateral integration). Since the focus of the analysis is the procurement performance we are interested not only in the effect of EPS integration with the firm's main suppliers (external backward integration) but also in the effect of EPS integration with the firm's internal processes (internal process integration). We confine only to the main suppliers of the firm because, according to Talluri et al. (2006) at this stage of evolution of the EPS life cycle it is not plausible that all the suppliers could be integrated with the firm. Indeed, EPS integration is a process of continuous evolution when organizations have resources to assign to that activity and are willing to be persistent at those efforts. Thus, this study focuses its attention on measuring the extent to which EPS is integrated with different information systems within the organization such as the ERP or even CRM systems. The literature presents several studies showing that the higher the extent of integration the greater the benefits for the organization (Frohlich and

Westbrook, 2001; Frohlich, 2002; Subramaniam, 2003). Indeed, if the use of EPS can (1) automate the order scheduling and fulfillment processes; (2) support the operations or production planning, scheduling, and shipment; (3) foster the access to the supplier's databases, for instance, to enable the firm to track the status of an issued order; and (4) allow the firm to receive electronic invoices from the suppliers directly on its accounting system, then chances are that the overall procurement performance of the firm would improve. However, based on Saeed et al. (2005) the impact of external integration on process efficiency is significant for higher levels of integration and not significant for lower levels of integration. Based on the foregoing discussion we posit that:

**H3a:** *The effect of EPS implementation success on procurement performance is low in contexts of lower integration of EPS with other internal systems of the firm; conversely, the effect is high in contexts of higher integration of EPS with other internal systems of the firm.*

**H3b:** *The effect of EPS implementation success on procurement performance is low in contexts of lower systems integration between the focal firm and its main suppliers; conversely, the effect is high in contexts of higher systems integration between the focal firm and its main suppliers.*

### 3 RESEARCH METHODOLOGY

There are some parameters that should be evaluated in order to design a research project (Sekaran, 2003): the purpose of the study, the type of the research, the unit of analysis, the time schedule, and the research environment. Beyond that, this section also describes the universe of the study, the data collection methods, pretest of the survey, and, the measurement issues.

The purpose of the study depends on the stage of knowledge development on the topic under analysis. A study may be either exploratory in nature, descriptive, or it may test hypotheses. The purpose of this study is to validate a model to explain procurement performance based on EPS implementation success, the power balance between the focal firm and its suppliers and the systems integration of the EPS and internal and external systems. The validation of the model depends on the test of three hypotheses proposing the relationships between the model's variables presented in Fig. 1.

The type of research can be causal or correlational. A causal research is supposed to meet the following criteria: 1) the cause must happen before the effect; 2) variations observed in causes should lead to systematic variations on effects; and 3) variations on the effects should not be assigned to other factors except the causes (Reto e Nunes, 1999). Since the present research may not warrant these conditions, this study must be considered correlational.

The unit of analysis is a research design choice that is associated with the level of data aggregation. In this research, the unit of analysis is the firm.

With regard to time schedule, a study may be longitudinal or cross-sectional (Sekaran, 2003). A study is longitudinal when the data about the unit of analysis are collected at multiple points in time. When the data regarding the unit of analysis are collected on a single moment in time, the study is cross-sectional. Since the data for this research is planned to be collected just once and refers to just one moment in time, this study is cross-sectional.

The research environment refers to the extent of interference of the researcher in the location where the phenomena occur. Therefore, we can have a field study, a field experiment, or a laboratory experiment. Field experiments and laboratory experiments should be carried out when the purpose of the research is to establish casual relationships. In such a research environment, the interference of the researcher is moderate to high. Field studies are conducted when the researcher intends to perform correlational studies with minimal interference, which is the present case.

Regarding the universe of the study, we think that a given phenomenon should be analyzed where it occurs. In Portugal, EPS is nowadays a phenomenon of the large companies. So, we have selected the 2500 largest companies operating in Portugal as the sampling frame to empirically test the model presented in section III.

With regard to the data collection method we plan to use a primary data source. Data will be collected through a questionnaire that will be available on the Web. Beyond the Web site, we will also develop a database with information that will allow us to send emails to chief procurement officers of the targeted companies.

The questionnaire will be pretested through interviews with procurement managers and IT managers to assess its initial validity and overcome any other inherent problems.

Operationally defining a concept to render it measurable is done by looking at the behavioral



dimensions, facets, or properties denoted by the concept. These are then translated into observable and measurable elements (indicators) so as to develop an index of measurement of the concept. The measurement of constructs is developed according to information shown on Table 1 through Table 5. There, we show the concepts of the theoretical model presented on Section II, the indicators, the scales, and the sources used.

In this study, we want to test an association between one metric dependent variable, the procurement performance (PP, See Table 1) and a set of metric independent variables (See Table 2 to Table 5). As a consequence of the developed conceptual model in Figure 1 and based on the definitions in the previously introduced Tables (1 to 5), we can write that:

$$PP = \beta_0 + \beta_1 * EIS + \beta_2 * PB + \beta_3 * II + \beta_4 * EI + \beta_5 * (EIS * PB) + \beta_6 * (EIS * II) + \beta_7 * (EIS * EI) + \sum_k \beta_k * I_k$$

where, the  $I_k$ 's ( $k = 8, 9, 10$ ) stands for the industry dummies (three broad groups are considered for analysis: manufacturing, commerce and services). This model is consistent with our conceptual framework in Figure 1 and the hypotheses defined earlier. Testing the hypotheses is equivalent to testing whether the coefficients  $\beta_j$ 's ( $j = 1, 5, 6, 7$ ) are significant or not, that is: (1) a significant and positive coefficient  $\beta_1$  means support for H1; (2) a significant and positive coefficient  $\beta_5$  suggests support for H2; (3) a significant and positive coefficient  $\beta_6$  suggests support for H3a; and (4) a significant and positive coefficient  $\beta_7$  suggests support for H3b; while significant and negative coefficients imply inhibitors to procurement performance.

Table 1: Measurement of variables in the conceptual model.

Concept	Indicator	Scale	Source
Procurement Performance (PP)	PP1-4	Likert Scale	Kumar et al. (2005)
EPS Internal Integration (II)	II1-3	Likert Scale	Authors
EPS External Integration (EI)	EI1-4	Likert Scale	Authors
Power Balance (PB)	PB1-4	Likert Scale	Wey and Gibson (1991)
EPS Implementation Success (EIS)	EIS1-3	Likert Scale	Premkumar et al. (2005)

Table 2: Green procurement performance indicators.

Indicator	Description
PP1	The use of EPS has contributed to reducing the price of products/parts/supplies that we purchase
PP2	The use of EPS has contributed to reducing the total costs in our procurement process
PP3	The use of EPS has contributed to buy new products that allow us to reduce the waste generated by the firm's operations
PP4	The use of EPS has contributed to buy new products that allow us to reduce the carbon dioxide generated by the firm's operations

Scale range (1= Strongly disagree; 7 = Strongly agree)

Table 3: EPS internal and external integration indicators.

Indicator	Description
	<b>To what extent have you implemented web-based processes to integrate EPS with your company's following systems?</b>
II1	Inventory consumption tracking, planning, and control systems
II2	Supplier payment/Accounts payable systems
II3	Materials and product costing/accounting systems
II4	Customer facing systems (e.g., sales order, customer relationship, distribution, etc.)
	<b>To what extent have you implemented web-based processes to integrate your EPS with the following systems/processes at your main suppliers?</b>
EI1	Order scheduling and fulfillment
EI2	Operations (or Production) planning, scheduling, and shipment
EI3	Allowing access to their databases (to enable you to track status of your order)
EI4	Accounting processes (e.g., billing, receivable, claims, reconciliation...)

Scale range (0 = Not at all; 1= Rarely; 7 = Fully)

Table 4: Power balance indicators.

Indicator	Description
PB1	Our firm primarily set prices and supply terms/conditions for supplies to be procured
PB2	Our firm set the rules and procedures for order placement and fulfillment
PB3	Our firm made most of the key decisions regarding various design parameters for EPS
PB4	Our firm decided on enhancements/upgrades to EPS and set standards for its use

Scale range (1= Strongly disagree; 7 = Strongly agree)

Table 5: EPS implementation success indicators.

Indicator	Description
EIS1	EPS project did not violate the budgeted costs
EIS2	Users are happy with the opportunity to use EPS to perform their job
EIS3	Users of EPS are using it to perform all the activities of the procurement cycle (search, negotiation, ordering, order coordination, and payment).

Scale range (1= Strongly disagree; 7 = Strongly agree)

## 4 LIMITATIONS

We recognize that one big issue in the development of this investigation will be data collection. In Portugal, the executives do not have a good attitude in responding to research inquiries. To be successful, managers of those firms have to understand the value of the research project and that's not an easy job! Furthermore, even though our target is the 2500 larger firms in Portugal, we are aware of the low rate of EPS adoption (around 20%, based on a study by Soares-Aguiar and Palma-dos-Reis, 2008). So we do expect some difficulties but we look forward to have the wisdom and tools to overcome them.

## 5 CONCLUSIONS

We propose to empirically test a research model to explain procurement performance based on EPS implementation success, power balance between the focal firm and its main suppliers, and EPS integration with both internal and external (main suppliers) information systems. If the hypotheses are confirmed, then, the instrument can be used by both academics and practitioners. While the academics can use it for several purposes including further research, the practitioners can apply it to improve their green procurement performance measured by the reductions on process cost, product price, waste and carbon dioxide emission.

Since this is a research in progress paper, we propose to empirically test the research model and hypotheses using a large scale cross-sectional survey study in the context of the 2500 relatively large companies operating in Portugal. In order to accomplish that task we plan to develop a data base with information about the respondents (respondent name, job title, email, company name, etc.), implement a web-based survey, perform a pretest and refine the instrument as necessary. After these tasks have been completed, data collection will

follow. Care will be taken at various stages to ensure that none of these steps is compromised to assure satisfactory psychometric properties. Furthermore, efforts will be made to ensure adequate sample coverage to minimize inherent biases and sample size to address concerns relating to statistical power of the test. Given the contemporary nature and importance of the domain of inquiry, it is gratifying to note that a major association of purchasing professionals has agreed to support the study by requesting its members to respond to the survey.

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