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ELECTRONIC PROCUREMENT SYSTEMS: IDENTIFYING FACTORS THAT FOSTER THEIR ADOPTION

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Abstract

In this study, we developed a model to explain electronic-procurement systems (EPS) adoption, considering the technology-organization-environment framework as well as the institutional theory. This model was tested with data collected from the 2500 biggest companies operating in Portugal. Based on the t-test for equality of means we found evidence that EPS adoption is positively and significantly related to (1) firm size, (2) technological capabilities, (3) the perception companies have about the EPS success of their competitors, (4) the extent of adoption among competitors and (5) the trading partner readiness to perform electronic transactions. The logistic regression supplied further evidence that technological capabilities, firm size, extent of adoption among competitors and trading partner readiness provide a reasonable estimate for each firm’s likelihood to adopt EPS. We also found evidence that firms which main activity is commerce are more likely to adopt EPSs than companies from manufacturing or services industries.

Keywords: e-procurement systems, propensity of adoption, technology-organization-environment framework, institutional theory, survey method, Portugal.

1 INTRODUCTION

Teo et al. (2003) proposed a model to predict firms’ intention to adopt Financial EDI systems using institutional theory as a lens to understand the factors that explain the adoption of such systems. Meanwhile, Zhu et al. (2003) used the technology-organization-environment framework to predict e-business adoption intention by European firms. However, none of these models is appropriate to evaluate electronic procurement systems (EPS) adoption since both models do not consider some variables which are relevant for EPSs adoption. For instance, institutional theory does not consider the capacity of the firm’s managers to deal with EPS, while the technology-organization-environment framework does not consider mimetic pressures that can influence an organization to adopt an EPS. The present paper uses both theories in developing a new model and tests it empirically with data gathered in the 2500 largest Portuguese companies.

The results presented may be relevant for three types of economical agents. First, Academics may have access to a new literature based conceptual model that was empirically verified with data gathered from the 2500 largest firms operating in Portugal. Second, Governments will be able to

1 This project benefits from financial support from FCT – Fundação para a Ciência e Tecnologia.
define better policies in what concerns to developing programs to support the productivity improvement of the economy. Third, software vendors and consultants will be able to improve the quality of their marketing and sales plans to address B2B markets.

Beyond this section, the paper has seven more sections: Section 2 contains a brief explanation of the problem that lead us to raise the research questions; The third Section presents a literature review about EPS and the adoption models considered; Section 4 develops a conceptual model as well as the six hypotheses under investigation; The fifth Section describes the research methodology that was used in order to answer the research questions; Section 6 discusses the results, validity and reliability issues; and, finally; Section 7 shows the main conclusions and managerial implications of the research and Section 8 provides directions for future research.

2 THE PROBLEM AND RESULTING RESEARCH QUESTIONS

According to the existing literature, EPSs are likely to increase firms competitiveness through cost reduction (Bakos, 1997; Amaral et al. 2003) and increased efficiency on the inbound logistics (Subramaniam, 2004). However, even though some firms are adopting and using such systems, other firms are not intending to do so. In such circumstances, we intend to understand what makes a difference on what regards to EPSs adoption, what leads us to the following research questions: (i) What are the factors that foster the intention to adopt EPSs? What is their relative relevance? (ii) How likely is a specific organization to adopt an EPS? (iii) What are the features that differentiate EPS adopters from non-adopters?

In order to ascertain the answers for the questions above, we reviewed the literature to develop a research model containing a set of factors for explaining the firm’s likelihood to adopt EPSs, collected data about EPSs adopters and non-adopters and analyzed it with the purpose of finding the answers to the research questions.

3 LITERATURE REVIEW

The literature review includes the state of the art in what concerns to studies regarding EPSs – subsection 3.1 – and the existing models explaining the adoption of new technologies – subsection 3.2.

3.1 EPS definition and its functionality

According to Subramanian (2004) an EPS is a web-based client/server application used to replace the manual procurement process. Figure 1 shows the EPSs’ components and its functionality. Horizontally, EPSs may support three procurement areas: procurement transaction support, procurement management, and market making. Vertically, EPSs may support the Demand side, the Supply side and Inter-Organizational area. Besides this, EPSs should communicate with both the buyer’s information system and the seller’s information system through the Enterprise Information Systems Gateway. Out of these features, the transaction support ends up being the most visible part for the end user. The authorized users may, through a browser and a search engine, search and find all the information required to process a requisition according to the firm’s procedures. Once the requisition is approved, it turns into an order sent to the supplier that is responsible for order fulfillment and shipping. After the order arrives at the buyer establishment, financial accounts should be updated. At the heart of the procurement management unit is an electronic catalog having the specifications and prices of all the products being sourced from contracted suppliers. The catalog management component may allow the suppliers to directly access the enterprise server and update their product information. Analytical tools are used to provide procurement decision support to managers and users. At last, there is the authorization and security module that is responsible for users data access and assures the quality of the transmitted messages between agents involved on transactions. A more
advanced market-making functionality can help the organization to do some of its human-intensive
tasks through the Web, such as managing quotes, bidding and negotiation. At a higher level of
maturity, the enterprise can also use the e-procurement system to electronically conduct auctions or
run a B2B exchange where its internal users and suppliers can bid and trade goods.

![Diagram of an e-procurement system]

Figure 1. Main functionalities of an e-procurement system. Adapted from Subramaniam (2004)

3.2 Technology Adoption Models

The technology adoption can be analyzed at the individual or at the organizational level. The analysis
of the individual’s attitude and behavior towards technological innovations is presented in Venkatesh

At the organizational level, Tornatzky and Fleischer (1990) developed the technology-organization-
environment framework, which identified three aspects of a firm’s context that can influence the
process by which companies adopt technological innovations: organizational context, technological
context, and environmental context. Organizational context is typically defined in terms of several
descriptive measures: firm size; the centralization, formalization, and complexity of its managerial
structure; the quality of its human resource; and the amount of slack resources available internally.
Technological context describes both the internal and external technologies relevant to the firm. This
includes technologies existing inside the firm, as well as the pool of available technologies in the
market. Environmental context is the arena in which a firm conducts its business - its industry,
competitors, access to resources supplied by others, and dealings with government. On the other hand,
Teo et al. (2003), using institutional theory as a lens to understand Financial EDI adoption, posit that
mimetic, coercive and normative pressures existing in an institutionalized environment could influence
organizations predisposition toward an information technology based inter-organizational system.
Beyond the results described above, other studies on inter-organizational information systems
adoption provided examples of methodological approaches that were considered helpful while
building the research model and designing the research methodology. Such studies focused on EDI
Adoption (Chwelos et al., 2001), antecedents of organizational participation on marketplaces (Grewal
et al., 2001) and e-business adoption (Min and Galle, 1999; Zhu et al., 2003).
4 CONCEPTUAL MODEL AND HYPOTHESES

Based on previous studies, institutional theory, and the technology-organization-environment framework, we propose a conceptual model for electronic procurement adoption, shown in Figure 2.

![Diagram](image)

**Figure 2. Conceptual Model for EPS Adoption**

This conceptual model posits six predictors for EPS adoption intention within the three-context framework, and is controlled for industry effects.

4.1 EPS Adoption Intention

The dependent variable in the conceptual model in Figure 2 is the EPS adoption intention (EAI). It is a binary variable which is assigned a “1” if the company has a concrete plan to implement an EPS within one year or had already adopted the EPS. Otherwise the variable is assigned a “0”.

4.2 Technological Context

In the existing literature, technology resource has been consistently demonstrated as an important factor for successful IS adoption (Crook and Kumar, 1998; Kuan and Chau, 2001). Hence, this study posits technological capabilities as an adoption driver, which, as conceptualized to be a second-order construct, encapsulating three sub-constructs: (1) IT infrastructure - technologies that enable Internet-related businesses; (2) IT expertise - employees knowledge of using these technologies; and (3) B2B know how - executive’s knowledge of managing online procurement. By these definitions, technological capabilities constitutes not only physical assets but also intangible resources, since expertise and know how are complementary to physical assets (Helfat, 1997). The above viewpoints lead to the following hypothesis:

H1: Firms with higher levels of technological capabilities are more likely to adopt EPS.
4.3 Organizational Context

Firm scope is defined as the extent of geographical dispersion of a firm’s operations. The existing literature has proposed that the larger the scope, the greater the demand for IT investment (Dewan et al., 1998; Hitt, 1999), which suggested us to posit scope as a facilitator for EPS adoption. The role of scope as an adoption predictor can be explained from two perspectives. Firstly, greater scopes lead to higher internal coordination costs, higher search costs and inventory holding costs (Chopra and Meindl, 2001). Since business digitalization can reduce internal coordination costs (Hitt, 1999), and B2B EC (electronic commerce) can lower search costs for both sellers and buyers (Bakos, 1998), achieve demand aggregation and improve inventory management, firms with greater scopes are more motivated to adopt EPS. Secondly, firms with greater scopes, having a great propensity to run different systems on different places, enclose more potential to benefit from synergy between web-based and traditional business processes. Indeed, the connectivity and open-standard data exchange of the Internet may help remove incompatibility of traditional legacy information systems. Typical examples are: (1) linking various legacy databases by common Internet protocols and open standards; and (2) using web-based graphical interfaces to improve the user-friendliness of ERP systems. These perspectives lead to the following hypothesis:

H2: Firms with greater scope are more likely to adopt EPS.

Firm size has also been consistently recognized as an adoption facilitator (Damanpour, 1992). With regard to EPS adoption, larger firms have several advantages over small firms. Larger firms (1) tend to have more slack resources to facilitate adoption; (2) are more likely to achieve economies of scale, an important concern due to the substantial investment required for e-business projects; (3) are more capable of bearing the high risk associated with early stage investment in e-business; and (4) possess more power to urge trading partners to adopt technology with network externalities. Therefore, it is reasonable to hypothesize:

H3: Larger firms are more likely to adopt EPS.

4.4 Environmental Context

Sociological research on threshold models (Krass a, 1988) suggests that decisions to engage in a particular behavior depend on perceived number of similar others in the environment that have already done likewise. Hence, if enough similar organizations do things in a certain way such that it gives rise to that particular course of action being legitimated or taken for granted throughout a sector, others will follow to avoid the embarrassment of being perceived as less innovative or responsive (Goodstein, 1994). So, in the context of EPS adoption, we can hypothesize that:

H4: Greater perceived extent of EPS adoption among competitors will lead to greater intent to adopt EPS.

A firm's EPS adoption decision may also be influenced by the adoption status of its trading partners along the value chain, since for an electronic trade to take place, it is necessary that all trading partners adopt compatible electronic trading systems and provide Internet-enabled services for each other. Furthermore, the Internet is fundamentally about connectivity. EPS may necessitate tight integration with suppliers, which goes beyond the walls of an individual organization (Zhu et al., 2002). Accordingly, a lack of trading partner readiness may hinder EPS adoption. So we hypothesize that:

H5: Firms with higher levels of perception of trading partner readiness are more likely to adopt EPS.

Although there are no studies directly examining mimicry of IT practices, there is implied evidence that followers, out of competitive necessity, imitate pioneers that have successfully exploited IT, especially in the banking and airlines industries (Coopeland and Mckenney, 1988). Therefore, in the context of EPS adoption, potential adopters will be more likely to adopt it if they perceive that EPS has conferred success to other competitor adopters. Hence we can hypothesize that:
H6: Greater perceived success of competitors that have adopted EPS will lead to greater intention to adopt EPS.

4.5 Control variable

Finally Industry Effect will be used as independent variable to control data variation not explained by the explanatory or independent variables.

5 RESEARCH METHODOLOGY

Sekaran (2002) identified some parameters that should be evaluated to design a research project: the purpose of study, the type of investigation, the time horizon, the unit of analysis, the research environment, the universe of study, the data collection methods, the pre-test and the measurement. Next, we present some considerations regarding these research parameters.

According to Sekaran (2002) the type of investigation can be causal or correlational. Based on Reto and Nunes (1999) there are three conditions that should be present if we want to develop a causal investigation: (1) the cause must happen before the effect; (2) variations observed in causes should lead to systematic variations on effects; (3) variations on the effects should not be assigned to other factors except the causes. As we do not want to analyze such a relationship, we developed a correlational study.

In what concerns to the time horizon, we can have longitudinal or cross sectional studies. The study is longitudinal when we have data about the unit of analysis from multiple points on time. When we get data from one moment in time we have a cross-sectional study. In our case we get data from companies just once and it represents a picture from the situation on September 2005.

The research environment is associated with the extent of interference of the researcher in the place where the phenomenon occurs. We can have a field study, a field experience or a laboratory experience. Field experiences and laboratory experiences should be realized in order to establish casual relationships where the interference of the researcher is moderate and high, respectively. Field studies are conducted to perform correlational studies with minimal interference of the researcher, which is the case of the present research.

Measurement of constructs was done by looking at the behavioral dimensions, facets, or properties denoted by the concept. These are then translated into observable elements (indicators) so as to develop an index of measurement of the concept. The Tables 1 and 2 present the different concepts, dimensions and indicators. They also show the scales used and sources where we got those definitions.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Dimension</th>
<th>Scale</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS Adoption Intention (EAI)</td>
<td>(EAI = “1” for adopters; “0” to non adopters)</td>
<td>Nominal</td>
<td>Authors</td>
</tr>
<tr>
<td>Firm Scope (FS)</td>
<td>Number of establishments</td>
<td>Ratio</td>
<td>Zhu et al (2002)</td>
</tr>
<tr>
<td>Firm Size (FSZ)</td>
<td>Number of effective employees</td>
<td>Ratio</td>
<td>Cragg and Kim (1993)</td>
</tr>
<tr>
<td>Extent of adoption among</td>
<td>(Perception variable)</td>
<td>Interval;</td>
<td>Teo et al. (2003)</td>
</tr>
<tr>
<td>competitors (AOC)</td>
<td></td>
<td>Likert (1 a 7)</td>
<td></td>
</tr>
<tr>
<td>Perceived success of</td>
<td>(Perception variable)</td>
<td>Interval;</td>
<td>Adapted from</td>
</tr>
<tr>
<td>competitor adopters (SOC)</td>
<td></td>
<td>Likert (1 a 7)</td>
<td>Teo et al. (2003)</td>
</tr>
<tr>
<td>Trading partner readiness</td>
<td>(Perception variable)</td>
<td>Interval;</td>
<td>Adapted from</td>
</tr>
</tbody>
</table>

Table 1 Measurement of variables in the conceptual model
<table>
<thead>
<tr>
<th>Concept</th>
<th>Dimension</th>
<th>Indicators</th>
<th>Scale</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological Capabilities (TC)</td>
<td>IT Infrastructure (ITI)</td>
<td>Company uses: EDI; Internet; Intranet; E-mail; Groupware tools; Video-conference.</td>
<td>Nominal (Yes / No)</td>
<td>Zhu <em>et al</em> (2003)</td>
</tr>
<tr>
<td></td>
<td>IT Expertise (ITE)</td>
<td>% of employees who can: Send email internally; Send email externally; Browse internet sites; Browse intranet; Communicate via video-conferencing</td>
<td>Interval Likert (1 to 5)</td>
<td></td>
</tr>
<tr>
<td>B2B know how</td>
<td>(perception variable)</td>
<td></td>
<td>Interval Likert (1 to 7)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Technological capabilities measurement

6 ANALYSIS

As we can see from Table 3, about 80% of the respondents were people in relatively high positions at their companies, suggesting the high quality of the data source. We had a database with 2500 companies from which we selected randomly 1500 firms and sent emails to them. 300 companies responded but about 60 responses were rejected due to errors or missing data.

<table>
<thead>
<tr>
<th>Respondent Position</th>
<th>Number of observations</th>
<th>Percentage</th>
<th>Industry</th>
<th>Number of observations</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEO / Board Member</td>
<td>19</td>
<td>7.9%</td>
<td>Manufacturing</td>
<td>119</td>
<td>49.4%</td>
</tr>
<tr>
<td>Managing Director</td>
<td>8</td>
<td>3.3%</td>
<td>Commerce</td>
<td>57</td>
<td>23.2%</td>
</tr>
<tr>
<td>Chief Purchasing Officer</td>
<td>40</td>
<td>16.6%</td>
<td>Services</td>
<td>64</td>
<td>27.4%</td>
</tr>
<tr>
<td>Chief Information Officer</td>
<td>100</td>
<td>41.7%</td>
<td>Total</td>
<td>240</td>
<td>100%</td>
</tr>
<tr>
<td>Financial Manager</td>
<td>25</td>
<td>10.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>48</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>0.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Sample characteristics: respondent position and industry profiles

Additionally, Table 4 presents some sample descriptive statistics. We see that Firm Size has a mean value of 504 employees, confirming that the respondents were essentially large companies operating in Portugal. We also can see that, 27% of the 240 respondents considered for the analysis have adopted or have the intention to adopt EPS.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS Adoption Intention</td>
<td>240</td>
<td>0</td>
<td>1</td>
<td>0.27</td>
<td>0.445</td>
</tr>
<tr>
<td>Industry Effect (Manufacturing)</td>
<td>240</td>
<td>0</td>
<td>1</td>
<td>0.50</td>
<td>0.501</td>
</tr>
<tr>
<td>Industry Effect (Commerce)</td>
<td>240</td>
<td>0</td>
<td>1</td>
<td>0.23</td>
<td>0.424</td>
</tr>
<tr>
<td>Industry Effect (Services)</td>
<td>240</td>
<td>0</td>
<td>1</td>
<td>0.7</td>
<td>0.445</td>
</tr>
<tr>
<td>Firm Scope</td>
<td>240</td>
<td>1</td>
<td>1500</td>
<td>26.08</td>
<td>129,617</td>
</tr>
<tr>
<td>Extent of Adoption among Competitors</td>
<td>240</td>
<td>1</td>
<td>7</td>
<td>2.48</td>
<td>1.293</td>
</tr>
<tr>
<td>Trading Partner Readiness</td>
<td>240</td>
<td>1</td>
<td>7</td>
<td>3.0192</td>
<td>1.25033</td>
</tr>
<tr>
<td>Technological Capabilities</td>
<td>240</td>
<td>1.24</td>
<td>3.79</td>
<td>2.6293</td>
<td>0.49568</td>
</tr>
<tr>
<td>Firm Size (thousands of employees)</td>
<td>240</td>
<td>0.005</td>
<td>16.406</td>
<td>0.50410</td>
<td>1.374255</td>
</tr>
<tr>
<td>Perceived Success of Competitor Adopters</td>
<td>240</td>
<td>1</td>
<td>7</td>
<td>4.13</td>
<td>1.189</td>
</tr>
</tbody>
</table>

Table 4. Descriptive Statistics of the variables used in the logit model
6.1 Validity and Reliability

Since the research model involves a second-order construct, we validated it, as well as the first order constructs, using Amos confirmatory factor analysis (Figure 3). Besides the significance of each of the constructs’ elements, we also tested the reliability of the IT Expertise through the Cronbach’s Alpha Coefficient which hold the value of 0.778 which is above the recommended minimum value of 0.7 (Straub, 1989). The Cronbach’s Alpha was not computed for the Technological Capabilities latent variable since one of the variables on its construct, IT Expertise, is unobservable. The structural equation model confirmed the validity of the factors hypothesized to the extent that all p-values of the independent variables’ betas presented in Tables 5 and 6 are quite significant.

![Structural diagram for IT Expertise and Technological Capabilities measurement model developed in AMOS](image)

\[
\begin{array}{c|c|c|c}
\text{Standardized Regression Weight (betas)} & \text{z-stat} & \text{p-value} \\
\hline
\text{B2B Know How} \rightarrow \text{Technological Capabilities} & 0.369 & - & - \\
\text{IT Expertise} \rightarrow \text{Technological Capabilities} & 0.556 & 3.477 & *** \\
\text{IT Infrastructure} \rightarrow \text{Technological Capabilities} & 0.628 & 2.957 & 0.003 \\
\end{array}
\]

Table 5. Technological Capabilities measurement model (*** means p-value < 0.001)

\[
\begin{array}{c|c|c|c}
\text{% of employees who can:} & \text{Standardized Regression Weights} & \text{z-stat} & \text{p-value} \\
\hline
\text{Send email internally \rightarrow IT Expertise) } & 0.771 & - & - \\
\text{Send email externally \rightarrow IT Expertise) } & 0.956 & 13.857 & *** \\
\text{Browse internet sites \rightarrow IT Expertise) } & 0.748 & 12.391 & *** \\
\text{Browse intranet sites \rightarrow IT Expertise) } & 0.562 & 7.881 & *** \\
\text{Communicate via video-conferencing \rightarrow IT Expertise) } & 0.369 & 5.677 & *** \\
\end{array}
\]

Table 6. IT Expertise measurement model (*** means p-value < 0.001)
6.2 Hypotheses Testing using the t-Test

The data analysis evaluates the validity of the hypotheses proposed at two levels: it evaluates the direction and the significance of the differences between the average value of each variable for the EPS adopters and non-adopters. Once the sign of the difference is consistent with the hypothesis proposed and the value of the difference significant, we consider that there is a statistically significant relationship between the hypothesized variable or construct and the EPSs adoption or intent of adoption. The results of the t-test for homogeneity of means are shown in Table 6, together with the Levene’s test for equality of variances.

<table>
<thead>
<tr>
<th>Variables hypothesised as EPS adoption related</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-Test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>H1 – Technological capabilities</td>
<td>1,655</td>
<td>0,200</td>
</tr>
<tr>
<td>H2 – Firm scope</td>
<td>9,427</td>
<td>0,002</td>
</tr>
<tr>
<td>H3 – Firm size</td>
<td>22,364</td>
<td>0,000</td>
</tr>
<tr>
<td>H4 – Adoption by competitors</td>
<td>49,554</td>
<td>0,000</td>
</tr>
<tr>
<td>H5 – Partner readiness</td>
<td>4,151</td>
<td>0,043</td>
</tr>
<tr>
<td>H6 – Perceived success of competitive adopters</td>
<td>72,466</td>
<td>0,000</td>
</tr>
</tbody>
</table>

Table 7. Preliminary hypotheses testing: There is support to associate EPSs adoption with hypotheses H1, H3, H4, H5, and H6.

In order to decide in which hypothesis should we apply the heteroscedastic t-test versus the homocedastic t-test, we computed the Levene’s test for equality of variances. The only independent variable that did not reject the null hypothesis of variance homogeneity was the technological capabilities, so that was the only variable in which we used the homocedastic t-test. Since all hypotheses specified the direction of the expected relationship between the adoption or intent of adoption of EPSs and each of the independent variables, the t-test was performed considering a single tail area of rejection. The differences of the independent variables’ means were statistically significant for all independent variables, except for the scope of the firm. So we have to give up on this variable and consider that, in what refers to the impact of firm scope on the likelihood to adopt EPSs, this research is inconclusive.

On the other hand, the statistically significant differences of the average of the independent variables’ values for the firms that have adopted or intend to adopt EPSs form the firms that do not, provide evidence that there is a statistically significant relationship between the independent variable and the likelihood of adopting EPSs. So, we realized that the firms that adopted or intend to adopt EPSs have, on average, more technological capabilities (H1), larger firm size (H3), more competitors adopting this technology (H4), suppliers better prepared to use an EPS (H5), and perceive more success on the competitors that adopted EPSs (H6). Once the firms that adopted or intent to adopt EPSs have, on average, higher values on the independent variables mentioned, the firms with higher values on these independent variables are more likely to have adopted, or intent to adopt, an EPS. So, we have preliminary support for the following hypotheses: (H1) Firms with higher levels of technological capabilities are more likely to adopt EPS; (H3) Larger firms are more likely to adopt EPS; (H4) Firms perceiving that competitors are adopting or using EPS are more likely to adopt EPS; (H5) Firms perceiving that trading partners are ready to adopt EPS are more likely to adopt EPS and (H6) Firms perceiving success of competitors that have adopted EPS are more likely to adopt EPS.
6.3 Hypotheses Testing using the Logistic Regression

The former analysis does establish a set of relationships between the dependent variable, the adoption or intention to adopt EPS, and these independent variables. However, it does not attribute a weight to each of the independent variables, and does not combine the contribution of each of the independent variables towards explaining EPS adoption or intent of adoption. According to Sharma (1996) when we want to find a relationship between one dependent binary variable and a set of independent variables, we can use logistic regression or discriminant analysis. However, since the independent variables are a mixture of categorical and continuous variables, the multivariate normality assumption will not hold (Sharma, 1996). In these cases we should use logistic regression, as it does not make any assumptions about the distribution of the independent variables. So the logit model is:

$$\text{logit}(p)=\ln\left(\frac{p}{1-p}\right)=\beta_0 + \beta_1 * FS + \beta_2 * FSZ + \beta_3 * AOC + \beta_4 * SOC + \beta_5 * TPR + \beta_6 * TC + \sum_{i=1}^{3}(a_i * IE_i)$$

where $p = \Pr (EAI = 1)$, is the probability of adoption and FS, FSZ, AOC, TPR, TC, IE are the variables previously defined on Tables 2 and 3. The $\beta_i$s ($i = 0..6$) are the regression coefficients and $IE_i$ ($i = 1,2,3$) represent each one of the economic sectors considered on the analysis (manufacturing, commerce and services). Based on this, we computed a logistic regression to explain the EPS adoption, based on the independent variables that showed to be correlated with the dependent variable.

Even though the regression provided a Nagelkerke R-square of 0.52, one of the coefficients, the impact of the perceived success of competitor adopters on the likelihood to adopt EPS, had a sign opposite to what the hypothesis and the correlation coefficient would suggest. Such situation is due to multicollinearity (Pearson Correlation factor between SOC and AOC is 0.511; p-value < 0.001), so we had to give up on this independent variable in order to get reliable results. Therefore, the model tested in the logistic regression is that technological capabilities, firm size, perception of supplier readiness to adopt EPS, and the perceived extent of adoption among competitors, may explain why some firms adopted or intent to adopt EPSs while others do not. The logistic regression was able to classify correctly 84.1% of the cases in the training dataset, provided a Nagelkerke R-square of 0.52, the same as the former equation with one more variable and multicollinearity, and a Hosmer and Lemeshow significance of 0.96. The signs of all betas were according to the hypotheses and preliminary testing with the correlation coefficients and all betas, except for the belonging to the industry sector variable, are statistically significant. Since the non-significance of the belonging to the industry sector does not raise a major problem to the reliability of the regression results, we accepted these results whose betas and significance are shown in Table 7. So this provides further evidence to support the hypotheses that: (H1) Firms with higher levels of technological capabilities are more likely to adopt EPS; (H3) Larger firms are more likely to adopt EPS; (H4) Greater perceived extent of adoption of EPS among its competitors will lead to greater intent to adopt EPS; and (H5) Firms perceiving that trading partners are ready to adopt EPS are more likely to adopt EPS. This confirms most of the results of the preliminary testing and integrates the impact of this set of variables in a model, a logistic regression that, based on the variables above, classified correctly 84.1% of the sample cases and provided a Nagelkerke R-square of 0.52.

<table>
<thead>
<tr>
<th>Independent variables on the logistic regression</th>
<th>$\beta_i$</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 – Technological capabilities</td>
<td>2.066</td>
<td>0.000</td>
</tr>
<tr>
<td>H3 – Firm size</td>
<td>0.417</td>
<td>0.032</td>
</tr>
<tr>
<td>H4 – Perceived extent of adoption among competitors</td>
<td>0.408</td>
<td>0.010</td>
</tr>
<tr>
<td>H5 – Trading partner readiness</td>
<td>1.045</td>
<td>0.000</td>
</tr>
<tr>
<td>Control binary variable – firm operating in the industry sector</td>
<td>-0.087</td>
<td>0.854</td>
</tr>
<tr>
<td>Control binary variable – firm operating in the commerce area</td>
<td>1.631</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Table 8. Logistic regression explaining the likelihood of EPS adoption. Regression coefficients and their significance levels.
7 CONCLUSIONS AND MANAGERIAL IMPLICATIONS

We identified several factors that have an influence on EPS adoption. Based on Table 8, technological capabilities, with a regression coefficient of 2.066 and a p-value of 0.000, seems to be quite important to determine EPS adoption. Additionally, firm size (b=0.417; p=0.032), perceived extent of adoption among competitors (b=0.408; p=0.010) and trading partner readiness (b=1.045; p=0.000) do influence significantly the EPS adoption intention. In what concerns to firm scope we got evidence suggesting it is not relevant. These are important results because once the factors that foster electronic procurement systems adoption are identified, economic agents may act accordingly and develop better programs in order to achieve their objectives. In fact, these results can be used as an input for the governments to design more appropriate policies and programs towards technological development of the firms. The implementation of better programs may have a positive effect on the percentage of firms using electronic procurement systems, resulting on efficiency gains in the economy as a whole. Furthermore, EPS’s vendors and consultants can use these results to develop better marketing and sales plans and focus their strategies on companies which propensity to adopt EPS is large enough to deserve a sales effort. These considerations answer research question (i) raised on Section 2. Taking into account the confirmation of hypotheses H1, H3, H4 and H5 and putting their variables in the logit model, we are now able to calculate the probability of a certain company to adopt an EPS, which answers research question (ii). Table 6 points out the differences between adopters and non adopters of EPS. EPS adopters present more technological capabilities than non adopters (mean difference = 0.35681 and significance of 0.000), bigger firm size, higher perception of extent of EPS adoption among competitors and perceive trading partners as more able to do business electronically than non EPS adopters do. All this allow us to respond to research question (iii).

8 LIMITATIONS AND FUTURE RESEARCH

Our results are constrained by missing answers to some questions. When asking people about their perception regarding EPS penetration on competitors, a great number responded that did not know. The same happened for their perception of EPS success on competitors. However we tried to minimize this limitation in two ways: (1) calling people always that it was possible in order to get that information and (2) calculating and using the average value of the variable when executing statistical tests. Additionally, we do not get empirical data from small and medium companies. Indeed, we only get data from the largest firms operating in Portugal, so readers should be cautious in generalizing these results. This research is only a first step in order to understand EPS adoption, implementation and firm performance impacts. In fact, a complete study should include the EPS implementation and impact on firm’s performance. However, such study should be longitudinal instead of cross-sectional. Since we do not know whether the results would apply if we extend the sample to smaller firms, there is an opportunity to broaden this research in the future. Indeed, smaller firms have specificities that must be addressed in order to extend to them the current research model.

References