A COMPARISON OF WEB SITE ADOPTION IN SMALL AND LARGE PORTUGUESE FIRMS

Tiago Oliveira and Maria F. O. Martins
Instituto Superior de Estatística e Gestão Informação, Universidade Nova de Lisboa
Campus de Campolide, 1070-312 Lisboa, Portugal

Keywords: Web site, adoption, small firms, large firms, information technology.

Abstract: This study compares the impact of different Technology-Organization-Environment (TOE) factors on the web site adoption decision in small and large firms. A survey that was undertaken by the National Institute of Statistics on the use of Information Technologies (IT) by firms in Portugal was used as the empirical basis for this study. We found significantly differences in the factors that determined web site adoption decision in small and large firms. While large firms are mainly influenced by organizational and environmental factors, small firms are also concerned about the technological context. Moreover, the results of our study suggested that, for Portuguese firms, the only factor that is equally important as web site facilitator is competitive pressure.

1 INTRODUCTION

New IT, such as Internet enables firms to do businesses in a different way (Porter, 2001). In order to strength the potential of the Internet, firms are establishing their presence on the Web: in 2005, the overall percentage of enterprises in the EU with a web site is 61%, but notably higher for larger firms (90%) than for small firms (56%). Significantly differences also exist between Member States: while the leader countries, Sweden and Denmark, are already reaching the saturation level for large firms (97%), countries like Portugal (75%) and Latvia (65%) are far away from this adoption level. For small firms, this difference is greater: the web site adoption level is 80% for Sweden compared with the 33% level for Portugal (Eurostat, 2006). Do Portuguese small firm managers realize the strategic value of owning a web-site in the same manner as large firm managers? Or have they encountered specific barriers to its implementation? Some studies have been done to understand the differences in IT adoption among European Countries (Zhu et al., 2003) and much research attempted to comprehend the relationship between firms size and IT adoption decision (Lee and Xia, 2006). Some authors (Grandon and Pearson, 2004, Premkumar, 2003) suggested that the research findings on large businesses cannot be generalized to small and medium-sized enterprises (SMEs) because of the unique characteristics of SMEs as for example the lack of business and IT strategy, limited access to capital resources and poor information skills. While there exist an interesting and growing literature addressing the determinants of IT adoption in the specific context of SMEs (Harindranath et al., 2008, Parker and Castleman, 2007,) and a limited research for microfirms (Clayton, 2000), only a reduced number of studies (Daniel and Grimshaw, 2002) attempt to compare directly the approaches of small and large firms to this new domain. Our work seeks to fill this gap in the literature, by analysing the relative importance of the factors that enable or inhibit web site adoption by small firms compared with large firms. The two main purposes of this study are the following:

- To examine the importance of technology-organisational-environmental (TOE) related factors as fundamental determinants of web site adoption;
- To analyze if the relative importance of such factors is different for small and large firms.

To achieve these research objectives we used a rich data set of 637 large firms and 3155 small firms that are representative of Portuguese economy. The understanding of the determinants of web site adoption, at firm level, may be a useful tool in

Oliveira T. and F. O. Martins M. (2008).
A COMPARISON OF WEB SITE ADOPTION IN SMALL AND LARGE PORTUGUESE FIRMS.
In *Proceedings of the International Conference on e-Business*, pages 370-377
DOI: 10.5220/0001907603700377

addressing the right type of policy measures to stimulate the use of internet business solutions, with the aim of enhancing the competitiveness and productivity of Portuguese firms (Bertschek et al., 2006, Black and Lynch, 2001, Bresnahan et al., 2002, Brynjolfsson and Hitt, 2000, Dedrick et al., 2003, Konings and Roodhooft, 2002, Martins and Raposo, 2005, Zhu and Kraemer, 2002). This is particularly needed in the case of Portugal which, for several reasons, has been suffering from a serious lack of competitiveness in comparison to other industrialized economies. Our work has two important contributions: the first is related to the very limited research on comparing the determinants of IT adoption in small and large firms. Secondly, we present useful results for Portugal where there are few published studies on the subject (Parker and Castleman, 2007). The next section presents the theoretical framework based on TOE approach. Then, the proposed hypotheses are tested using an econometric model. Finally, we present major findings and conclusions.

2 THEORICAL FRAMEWORK AND CONCEPTUAL MODEL

In this study we used the TOE framework, developed by Tornatzky and Fleisher (1990) and applied in many empirical studies related to IT innovations. The TOE model identifies three aspects that influence the adoption and implementation of technical innovations by firms: technological characteristics including factors related to internal and external technologies of firms; organizational factors relating to firm size and scope, characteristics of the managerial structure of the firm, quality of human resources; and environmental factors that incorporate industry competitiveness features. This theoretical background is the one used by Iacovou et al. (1995), Kuan and Chau (2001) and Premkumar and Ramamurthy (1995) to explain electronic data Interchange (EDI) adoption and by Thong (1999) to explain information system (IS) adoption and Hong and Zhu (2006) to explain e-commerce adoption. Empirical findings from these studies confirmed that TOE methodology is a valuable framework to understand the IT adoption decision. In accordance with TOE theory, we developed in the next subsection a conceptual framework for web site adoption (see Figure 1).

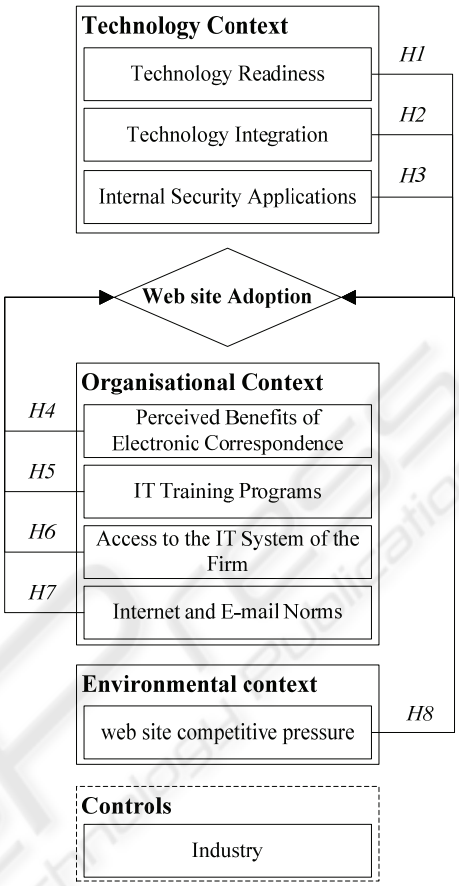

Figure 1: Conceptual framework for web site adoption.

2.1 Technology Context

Technology readiness can be defined as technology infrastructure and IT human resources. Technology readiness "is reflected not only by physical assets, but also by human resources that are complementary to physical assets" (Mata et al., 1995). Technology infrastructure establishes a platform on which internet technologies can be built; IT human resources provide the knowledge and skills to develop web applications (Zhu and Kraemer, 2005). Theoretical assertions on the impact of Technology readiness on IT adoption are supported by several empirical studies, based on data sets representative of all sizes of firms (Hong and Zhu, 2006, Zhu et al., 2003, Zhu et al., 2006). These results where also confirmed within the specific context of SMEs (Al-Qirim, 2007, Dholakia and Kshetri, 2004, Kuan and Chau, 2001, Mehrtens et al., 2001). Therefore, in general we expected that firms with greater technology readiness are in a better position to adopt web sites. However, as suggested by others authors (Daniel and Grimshaw, 2002, Parker and Castleman,

2007, Premkumar, 2003), this factor will probably affect in a different way small and large firms.

H1: The level of technology readiness is positively associated with web site adoption but the impact will vary between large and small firms

Before the internet, firms had been using technologies to support business activities along their value chain, but many were ‘‘islands of automation’’— they lacked integration across applications (Hong and Zhu, 2006). The characteristics of the internet may help eradicate the incompatibilities and rigidities of legacy information systems (IS) and accomplish technology integration among various applications and databases. Evidence from the literature suggests that integrated technologies may enhance firm performance by reducing cycle time, improving customer service, and lowering procurement costs (Barua et al., 2004). We define technology integration as the systems for managing orders that are automatically linked with other IT systems of the firm. This type of factor where also identified by Al-Qirim (2007) for the specific case of SMEs. Therefore, we expect firms with a higher level of technology integration to be those who adopt web sites sooner. However, probably there will be significantly differences between small and large firms (Daniel and Grimshaw, 2002). These reflections lead to the following hypothesis:

H2: The level of technology integration is positively associated with web site adoption, but the impact will vary between small and large firms.

The lack of security may slow down technological progress. For example, for Portugal in 2002 this was the greatest barrier to internet use (Martins and Oliveira, 2005) and in China it is one of the most important barriers to the adoption of e-commerce (Tan and Ouyang, 2004). We expect firms with a higher level of internal security applications to be more probable web site adopters. Within this context, there is no empirical evidence suggesting a same behaviour between small and large firms. Therefore we stipulate the following:

H3: Internal security applications are positively associated with web site adoption, but the impact will probably vary between small and large firms.

2.2 Organization Context

Empirical studies consistently found that perceived benefits have a significant impact in IT adoption. This result is validated for medium to large firms (Beatty et al., 2001), for SMEs (Iacovou et al., 1995, Kuan and Chau, 2001) and for all size firms (Gibbs and Kraemer, 2004). However, as suggested by Daniel and Grimshaw (2002) small firms and large firms perceived these benefits in a different. We examine perceived benefits of electronic correspondence and we postulate that:

H4: Perceived benefits of electronic correspondence is positively related with web adoption, but the impact will vary between small and large firms.

The presence of skilled labour in a firm increases its ability to absorb and make use of an IT innovation, and therefore is an important determinant of IT diffusion (Caselli and Coleman, 2001, Hollenstein, 2004, Kiiski and Pohjola, 2002). Since the successful implementation of new IT usually requires complex skills, we expect firms with more IT training programs to be more likely to adopt web site. However, there will probably be differences between firms due to the limited IT budgets of small firms. We postulate the following:

H5: IT training programs are positively associated with web site adoption, but the impact will vary between small and large firms.

The fact that workers can have access to the IT system from outside of the firm reveals that the organisation is prepared to integrate its technologies. However, this factor is expected to influence in a different way small firms, where the number of employees is small and their presence at the place of work is more important than for large firms. We postulate that:

H6: The level of access to the IT system from outside of the firm is positively associated with web site adoption, but the impact will vary between small and large firms.

Regulatory environment has been acknowledged as a critical factor influencing innovation diffusion (Zhu et al., 2003, Zhu et al., 2004, Zhu et al., 2006). Firms often refer inadequate legal protection for online business activities, unclear business laws, and security and privacy as concerns in using web technologies (Kraemer et al., 2006). We postulate that for small firms, this concern will probably be different from their large counterparts.

H7: The presence of internet and e-mail norms is positively associated with web site adoption, but the impact will vary between small and large firms.

2.3 Environmental Context

Empirical evidence suggests that competitive pressure is a powerful driver of IT adoption and diffusion (Gibbs and Kraemer, 2004, Hollenstein, 2004, Zhu et al., 2004) and this fact is also verified in small business research (Al-Qirim, 2007, Dholakia and Kshetri, 2004, Grandon and Pearson, 2004, Iacovou et al., 1995, Kuan and Chau, 2001). Therefore, we expect the probability of adopting a web site to be positively influenced by the proportion of web site adopters in the industry or sector to which the specific firm is affiliated. However, some studies suggested that competitive pressure will be more significant in causing small firms to adopt an IT than for larger firms, since they need to protect their competitive position (Daniel and Grimshaw, 2002). Therefore, we assume that:

H8: The level of web site competitive pressure is positively associated with web site, but the impact will vary between small and large firms.

2.4 Controls

We control, as usual, for industry or economic sector effects. We used a dummy variable to control for data variation that would not be captured by the explanatory variables mentioned before.

3 DATA AND METHODOLOGY

3.1 Data

The data used in this study were provided by National Institute of Statistics (INE) and result from the survey On the use of Communication and Information Technologies in Firms (Iutice) in 2006. In our study we defined that small firms have less than 50 employees and large firms have more than 250 employees. Our sample consists on 3155 small and 637 large firms and is representative of the Portuguese private sector excluding the financial one

3.2 Methodology

We estimated the following Probit Model:

$$P(y=1/\mathbf{x})=\Phi(\mathbf{x\beta}) \quad (1)$$

Where y=1 if firm decided to adopt a web site, and zero otherwise, **x** is the vector of explanatory variables, **β** the vector of unknown parameters to be estimated, and Φ(.) is the standard normal cumulative distribution. To analyse and compare the influence of each factor on the probability of being a web site adopter, we need to compute the marginal effect of x_j. This effect is obtained, for the continuous variables, using the formula given by:

$$\partial P\left(y=1/\bar{\mathbf{x}}\right)\Big/\partial x_j = \phi\left(\bar{\mathbf{x}}\boldsymbol{\beta}\right)\beta_j \quad (2)$$

For the binary explanatory variables it is given by:

$$\Delta P\left(y=1/\bar{\mathbf{x}}\right)\Big/\Delta x_j = \Phi\left(\bar{\mathbf{x}}\boldsymbol{\beta}\,|\,\bar{\mathbf{x}}, x_j=1\right)-\Phi\left(\bar{\mathbf{x}}\boldsymbol{\beta}\,|\,\bar{\mathbf{x}}, x_j=0\right) \quad (3)$$

where ϕ(.) is the density standard normal distribution.

The vector of explanatory variables (**x**) includes:

A technology readiness (TR) index that was built by aggregating 8 items on technologies used by the firm (on a yes/no scale): computers, e-mail, intranet, extranet, own networks that are not the internet (own exclusive networks), wired local area network (Lange et al.), wireless LAN, wide area network (WAN), and one item standing for existence of IT specific skills in the firm (on a yes/no scale) (Zhu et al., 2004). The first 8 items represent the penetration of traditional information technologies, which formed the technological infrastructure (Kwon and Zmud, 1987). The last item represents IT human resources (Mata et al., 1995). To aggregate the items we used multiple correspondence analyses (MCA). The MCA is a method of "multidimensional exploratory statistic" that is used to reduce the dimension when the variables are binary. For more details see (Johnson and Wichern, 1998). The first dimension explains 50% of inertia. In the negative side of the first axis we have variables that represent firms that do not use IT infrastructures and do not have workers with IT skills. On the positive side we have the variables that represent the use of infrastructures and workers with IT skills. Cronbach's α, the most widely used measure for assessing reliability (Chau, 1999), is equal to 0.8761, indicating adequate reliability. Reliability measures the degree to which items are free from random error, and therefore yield consistent results.

Technology integration (TI) was measured by the number of IT systems for managing orders that are automatically linked with other IT systems of the firm (see appendix). The variable ranges from 0 to 5. This variable reflects how well the IT systems are connected on a common platform.

Internal security applications (ISA) was measured by the numbers of the use of internal security

applications in the firms (see appendix). The variable range from 0 to 6.

Perceived benefits of electronic correspondence (PBEC) was measured by the shift from traditional postal mail to electronic correspondence as the main standard for business communication, in the last 5 years (on a yes/no scale).

IT training programs (ITTP) is also a binary variable (yes/no) related to the existence of professional training in computer/informatics, available to workers in the firm.

Access to the IT system of the firm (AITSF) was measured by the number of places from which workers access the firms information system (see appendix). The variable ranges from 0 to 4.

Internet and e-mail norms (IEN) was measured by whether firms have defined norms about internet and e-mail (on a yes/no scale).

Web site competitive pressure (WEBP) is computed as the percentage of firms in each of the 9 industries that had already adopted a web site two years before the time of the survey, i.e. in 2004. As in Zhu et al. (2003) the rationality underlying our model is that an observation of the firm on the adoption behaviour of its competitors influences its own adoption decision.

Services (SER) is a binary variable (yes/no) equal one if firm belong to the service sector.

4 ESTIMATION RESULTS

The web site adoption model is estimated using maximum likelihood. The estimation results for small and large firms are presented in Table 1.

Goodness-of-fit is assessed in three ways. First, we used log likelihood test, which reveals that our models are globally statistic significant. Secondly the discrimination power of the model is evaluated using the area under the receiver operating characteristic (ROC) curve, which is equal to 90.9% and 78% for small and large firms, respectively. Finally, the R^2 shows that the percentage explained by the model is 41.9% for small firms and 15.7% for large firms. The three statistical procedures reveal a substantive model fit, a satisfactory discriminating power and there is evidence to accept an overall significance of the model.

Hypotheses H1-H9 were tested analysing the sign, the magnitude, the statistical significance of the coefficients and the marginal effects. As can be seen from Table 1, for small firms, the estimation results suggested that all the coefficients have the expected signs and the only independent variable that is not statistically significant is the access to the IT system of the firm (AITSF). We can identify seven relevant drivers of web site adoption for small firms: technology readiness (TR), technology integration (TI) and internal security application (ISA) reflecting the technological context; perceived benefits of electronic correspondence (PBEC), IT training programs (ITTP) and internet and e-mail norms (IEN), representing the organization context; web site competitive pressure (WEBP), concerning the environmental context. For large firms, we identify four significant factors influencing web site adoption decision: technology readiness (TR), IT training programs (ITTP), access to the IT system of firms (AITSF) and web site competitive pressure (WEBP). In both cases, as expected, the economic sector is a relevant factor (SER).

Table 1: Estimated coefficients for web site adoption model.

	Small firms	Large firms
Technological context		
- TR	1.044***	0.346*
- TI	0.069***	-0.028
- ISA	0.170***	0.038
Organizational context		
- PBEC	0.293***	-0.039
- ITTP	0.235***	0.644***
- AITSF	0.044	0.278***
- IEN	0.379***	0.165
Environmental context		
- WEBP	0.011***	0.017***
Controls		
- SER	0.185***	0.306**
Constant	-1.742***	-1.041***
Sample size	3155	637
LL	-1038.5	-223.3
R^2	0.419	0.157
AUC	0.909	0.779

Note: * p-value<0.10; ** p-value<0.05; *** p-value<0.01.

The estimated marginal effects for the determinants of web site adoption model, for small and large firms, are reported in Table 2.

Their comparison reveals that, as expected, most of the marginal effects vary between small and large firms. The exception is the web site competitive pressure impact that is the same for small and large firms. Therefore hypotheses H1-H7 are validated and H8 is not confirmed.

There are three additional aspects to be noted here. Firstly, the technological context is much more relevant for small firms than for large firms. Secondly, within organizational context, perceived benefits and internet e-mail norms are more important to determine web site adoption for small

firms than for their larger counterparts. Finally, the access to the IT system of the firm is relevant only for large firms. As a whole, our results are in accordance with those reported in studies comparing IT adoption in large and small firms (Daniel and Grimshaw, 2002). However, the limited number of research in this specific domain difficult the generalization of the results.

Table 2: Estimated marginal effects for web site adoption model.

	Small firms	Large firms
Technological context		
- TR	0.252***	0.064*
- TI	0.017***	-0.005
- ISA	0.041***	0.007
Organizational context		
- PBEC	0.079***	-0.007
- ITTP	0.061***	0.144***
- AITSF	0.011	0.051***
- IEN	0.100***	0.032
Environmental context		
- WEBP	0.003***	0.003***
Controls		
- SER	0.044***	0.056**

Note: * p-value<0.10; ** p-value<0.05; *** p-value<0.01.

5 CONCLUSIONS

Within the context of an increased use of Internet Business Solutions, such as web sites, this study fills a gap in the literature by comparing the relative importance of the factors influencing the adoption of web sites for small and large firms. The theoretical framework incorporates most of the facilitators and inhibitor factors identified in other studies. The research model evaluates, for small and large firms, the impact of three technological factors, four organizational factors and one environmental factor on the web site adoption decision. Using a representative sample of Portuguese small and large firms, the estimation results for this comparative study reveal that the important determinants of web site adoption decision vary with size of a firm. Other studies in this domain (Daniel and Grimshaw, 2002, Premkumar, 2003) also suggested that the problems, opportunities, and management issues encountered by small business in the IT area are different from those faced by their larger counterparts. However, our study provides a more in depth analysis since it identifies those factors that more or less relevant for large/small firms and quantifies its impact on web site adoption decision. These findings have practical implications for managers and policy makers. Firstly, policy makers should be conscious that the motivations towards the IT adoption are different for small and large firms. Therefore, government initiatives, such as the Technological Plan, for Portugal, must be different for small and large firms, namely those related to procurement incentives. Secondly, managers should be aware that technology readiness constitutes both physical infrastructure and intangible knowledge such as IT skills. This urges top leaders (mainly in small firms) to foster managerial skills and human resources that possess knowledge of these new information technologies. Therefore, there is a business opportunity for IT firms to establish the service that support the small size firms in the technological context. In our opinion this is particularly important in Portugal given the relative importance of small businesses in the economy (Vicente and Martins, 2008). Finally, our study sought to help firms become more effective in moving from a traditional channel to the internet by identifying the profile of early web site adopters.

As in most empirical studies, our work is limited in several ways. The cross-sectional nature of this study does not allow knowing how this relationship will change over time. To solve this limitation the future research should involve panel data. Another limitation of our work is that it only investigates web site adoption decision. To provide a more balanced view of firms' IT adoption decision, other Internet Business Solutions, such as e-commerce should also be examined.

ACKNOWLEDGEMENTS

We would like to acknowledge the National Institute of Statistics (INE) for providing us with the data.

REFERENCES

Al-Qirim, N. (2007) The adoption of eCommerce communications and applications technologies in small businesses in New Zealand. *Electron. Commer. Rec. Appl.,* 6**,** 462-473.

Barua, A., Konana, P., Whinston, A. B. & Yin, F. (2004) Assessing internet enabled business value: An exploratory investigation. *MIS Quart,* 28**,** 585-620.

Beatty, R. C., Shim, J. P. & Jones, M. C. (2001) Factors influencing corporate web site adoption: a time-based assessment. *Information & Management,* 38**,** 337-354.

Bertschek, I., Fryges, H. & Kaiser, U. (2006) B2B or Not to Be: Does E-commerce Increase Labor Productivity? *International Journal of the Economics of Business,* 13**,** 387-405.

Black, S. E. & Lynch, L. M. (2001) How to compete: The impact of workplace practices and information technology on productivity. *Review of Economics and Statistics,* 83**,** 434-445.

Bresnahan, T. F., Brynjolfsson, E. & Hitt, L. M. (2002) Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence. *Quarterly Journal of Economics,* 117**,** 339-376.

Brynjolfsson, E. & Hitt, L. M. (2000) Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives,* 14**,** 23-48.

Caselli, F. & Coleman, W. J. (2001) Cross-country technology diffusion: The case of computers. *American Economic Review,* 91**,** 328-335.

Chau, P. (1999) On the use of construct reliability in MIS research: a meta-analysis. *Information & Management.* 35(4), 217-227.

Clayton, K. (2000) Microscope on micro businesses. *Australian CPA,* 2**,** 46–7.

Daniel, E. M. & Grimshaw, D. J. (2002) An exploratory comparison of electronic commerce adoption in large and small enterprises. *Journal of Information Technology,* 17**,** 133-147.

Dedrick, J., Gurbaxani, V. & Kraemer, K. L. (2003) Information technology and economic performance: A critical review of the empirical evidence. *Acm Computing Surveys,* 35**,** 1-28.

Dholakia, R. R. & Kshetri, N. (2004) Factors Impacting the Adoption of the Internet among SMEs. *Small Business Economics,* 23**,** 311-322.

Eurostat (2006) The internet and other computer networks and their use by European enterprises to do eBusiness. *Statistics in focus.*

Gibbs, L. J. & Kraemer, K. L. (2004) A Cross-Country Investigation of the Determinants of Scope of E-commerce Use: An Institutional Approach. *Electronic Markets,* 14**,** 124-137.

Grandon, E. E. & Pearson, J. M. (2004) Electronic commerce adoption: an empirical study of small and medium US businesses. *Information & Management,* 42**,** 197-216.

Harindranath, G., Dyerson, R. & BARNES, D. (2008), ICT Adoption and Use in UK SMEs: a Failure of Initiatives?, *Electronic Journal of Information Systems Evaluation*, 11(2), 91-96.

Hollenstein, H. (2004) Determinants of the adoption of Information and Communication Technologies (ICT). An empirical analysis based on firm-level data for the Swiss business sector. *Structural Change and Economic Dynamics,* 15**,** 315-342.

Hong, W. Y. & Zhu, K. (2006) Migrating to internet-based e-commerce: Factors affecting e-commerce adoption and migration at the firm level. *Information & Management,* 43**,** 204-221.

Iacovou, C. L., Benbasat, I. & Dexter, A. S. (1995) Electronic data interchange and small organizations: Adoption and impact of technology. *Mis Quarterly,* 19**,** 465-485.

Johnson, R. & Wichern, D. (1998) *Applied Multivariate Data Statistical Analysis,* New Jersey, Prentice Hall.

Kiiski, S. & Pohjola, M. (2002) Cross-country diffusion of the Internet. *Information Economics and Policy,* 14**,** 297-310.

Konings, J. & Roodhooft, F. (2002) The effect of e-business on corporate performance: Firm level evidence for Belgium. *Economist-Netherlands,* 150**,** 569-581.

Kraemer, K. L., Dedrick, J., Melville, N. & Zhu, K. (2006) *Global E-Commerce: Impacts of National Environments and Policy,* Cambridge, UK.

Kuan, K. K. Y. & Chau, P. Y. K. (2001) A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework. *Information & Management,* 38**,** 507-521.

Kwon, T. H. & Zmud, R. W. (1987) Unifying the fragmented models of information systems implementation. In critical *issues in Information Systems Research* (Boland RJ and Hirschheim RA, Eds). IN WILEY, J. (Ed.) New York.

Lange, T., Ottens, M. & Taylor, A. (2000) SMEs and Barriers to Skills Development: a Scottish Perspective. *Journal of Industrial Training,* 24**,** 5-11.

Lee, G. & Xia, W. D. (2006) Organizational size and IT innovation adoption: A meta-analysis. *Information & Management,* 43**,** 975-985.

Martins, M. R. F. & Raposo, P. (2005) Measuring the Productivity of Computers: A Firm Level Analysis for Portugal. *Electronic Journal of Information Systems Evaluation,* 8**,** 197-204.

Martins, M. R. F. & Oliveira, T. (2005) Characterisation of Portuguese Organizations regarding Investment in Information and Communication Technologies – Application of Multivariate Data Analysis Techniques. IN REMENYI, D. (Ed.) *The 12th European Conference on Information Technology Evaluation.* Turku, Finland, Academic Conferences Limited.

Mata, F., Fuerst, W. & Barney, J. (1995) Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quart,* 19**,** 487–505.

Mehrtens, J., Cragg, P. B. & Mills, A. M. (2001) A model of Internet adoption by SMEs. *INFORMATION & MANAGEMENT,* 39**,** 165-176.

Parker, C. M. & Castleman, T. (2007) New directions for research on SME-eBusiness: insights from an analysis of journal articles from 2003 to 2006. *Journal of Information Systems and Small Business,* 1**,** 21-40.

Porter, M. E. (2001) Strategy and the Internet. *Harvard Business Review,* 79**,** 62-78.

Premkumar, G. (2003) A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce,* 13**,** 91-121.

Premkumar, G. & Ramamurthy, K. (1995) The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems. *Decision Sciences,* 26**,** 303-336.

Tan, Z. & Ouyang, W. (2004) Diffusion and Impacts of the Internet and E-commerce in China. *Electronic Markets,* 14**,** 25-35.

Thong, J. Y. L. (1999) An Integrated Model of Information Systems Adoption in Small Businesses. *Journal of Management Information Systems* 15**,** 187-214.

Tornatsky, L. & Fleischer, M. (1990) *The Process of Technology Innovation,* Lexington, MA, Lexington Books.

Vicente, M. R. C. & Martins, M. O. (2008) Information Technology, efficiency and productivity in SMEs: Evidence for Portugal. *paper presented at the Telecom Paris Tech Conference on The Economics of ICT.* Paris.

Zhu, K., Kraemer, K. & XU, S. (2003) Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems,* 12**,** 251-268.

Zhu, K., Kraemer, K. K. L., XU, S. & DEDRICK, J. (2004a) Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of Management Information Systems,* 21**,** 17–54.

Zhu, K. & Kraemer, K. L. (2002) e-Commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector. *Information Systems Research,* 13**,** 275-295.

Zhu, K. & Kraemer, K. L. (2005) Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research,* 16**,** 61-84.

Zhu, K., Kraemer, K. L. & XU, S. (2006) The Process of Innovation Assimilation Assimilation by Firms in Different Countries: A Technology Diffusion Perspective on E-Business. *MANAGEMENT SCIENCE,* 52**,** 1557-1576.

APPENDIX

Technological integration

Did your firm's IT systems for managing orders link automatically with any of the following IT systems during January 2006? (Yes No)

a) Internal system for re-ordering replacement supplies

b) Invoicing and payment systems

c) Your system for managing production, logistics or service operations

d) Your suppliers' business systems (for suppliers outside your firm group)

e) Your customers' business systems (for customers outside your firm group)

Internal security applications

Did your firm use the following internal security applications, during January 2006? (Yes No)

a) Virus checking or protection software

b) Firewalls (software or hardware)

c) Secure servers (support secured protocols such as http)

d) Off-site data backup

e) Subscription of a security service (e.g. antivirus or network intrusion alert)

f) Anti-spam filters (unsolicited e-mails)

Access to the IT system of the firm

Did any of those people access the firm's computer system from the following places during January 2006? (Yes No)

a) From home

b) From customers or other external business partners' premises

c) From other geographically dispersed locations of the same firm or firm group

d) During business travels, e.g. from the hotel, airport etc.