AN EMPIRICAL STUDY OF SMALL AND MEDIUM-SIZED ENTERPRISE INFORMATION COMMUNICATION TECHNOLOGIES (ICTS)

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ABSTRACT

The purpose of this study is to gather information about the use of ICTs among SMEs by firm size and industry sector and to determine the factors, which are related to the development created by the effective and efficient use of ICTs. In order to study the wide range of ICTs, they are separated in five main categories (Information systems, Enterprise systems, Electronic Business & Commerce, Telecommunications networks and Identification, Data Capture & Telemetric Technologies). The empirical analysis is based on a joint methodology of fully structured questionnaires and personal interviews in 54 Greek SMEs at four different industrial Sectors (Other Services, Manufacturing, Trade and Hotels).

JEL: M1; O3

KEYWORDS: ICT, SMEs, effective-efficient use, strategic management, process planning

INTRODUCTION

It is commonly accepted that our era is characterized by the intense globalization of markets and the constantly increasing competition. Within this global competitive environment, the small and medium sized enterprises (SMEs) are required to wage their own fight, a fight for modernization, for survival and for distinction. The SMEs are a component element of the structure of all economies and societies of our planet. Quite a few studies, research institutions and, of course, researchers have come to the conclusion that small and medium sized enterprises significantly contribute to economic development, production, competitiveness, employment, as well as decentralization and social coherence. They also function as the seedbed of new enterprises, innovative products and applications, flexible business forms, servicing of local needs and a zoning plan for the distribution of employment and income (Storey, D.J. 1994, Singh, R. & Garg, S. 2008, Thomson, A. & Gray, C. 1999).

Most small and medium sized enterprises use information and communication technologies. Relevant research has shown that the use, mainly of computers, serves administrative and functional uses, such as the rendering of accounts, payroll, the drawing up of a budget, inventory, and other similar functions (Bridge & Peel, 1999). The basic condition that arises for the use of computers, but also of all technologies, old or new, electronic or not, is not only their acquisition by the SMEs, but also their correct and functional use (El Louadi, 1998).

In this particular study, what is examined on the first level is the use of Information and Communication Technologies (ICT) among SMEs regarding firm size and industry sector and on a second level, the factors on which the development created by the effective-efficient use of ICT is dependent. For the categorization of the SMEs, what was used was the definition provided by the European Commission

(2003). According to this new definition, in article 2 the complete definition of small and medium sized enterprises is given, after having determined that the basic condition for an enterprise to be recognized as a small and medium one is to respect the limits regarding Staff headcount and financial ceilings (annual turnover or annual balance sheet). The definition categorizes SMEs in the following three categories:

1. The category of micro, small and medium-sized enterprises (SMEs) are made up of enterprises, which employ fewer than 250 persons and, which have an annual turnover not exceeding 50 million EUR, and/or an annual balance sheet total not exceeding EUR 43 million.
2. Within the SME category, a small enterprise is defined as an enterprise which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.
3. Within the SME category, a micro-enterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.

The remainder of the paper is organized as follows. Section 2 briefly discusses the relevant literature. Data selection and research methodology are described in Section 3. Section 4 provides analysis and interpretations of the empirical results and Section 5 concludes the paper.

LITERATURE REVIEW

In today's competitive environment, there are three basic reasons, which prove why the efficient use of information systems constitutes a primary condition in the competitiveness of SMEs. First of all, the competitive tension within each market entails that enterprises operate under pressure and therefore, seek out cleverer and more innovative methods in relation to those of their competitors. Secondly, the basic flow of all enterprises is turning inflow into profitable outflow. This means that the producers are directly dependent on the collaboration with their suppliers, their customers and their distribution network. Thirdly, information technology is the one that shows the way towards the internationalization of an enterprise. Researchers such as Quelch and Klein (1996) predicted the significant benefits that stem from the adoption of ICTs in the internationalization effort of SMEs, and they actually came to the conclusion that the creation of the Internet overthrew the traditional methods and practices of global marketing even within the developing economies. Furthermore, they were led to the conclusion that, as distribution channels tend to be less developed, direct and/or efficient in the emerging markets than in the American market, the Internet offers a unique opportunity to overthrow the present situation (Hamill, J.1997, Hamill, J. & Gregory, K. 1997, Poon, S. & Jevons, C. 1997, Bennett, R. 1997, Samiee, S. 1998).

The efficient-effective use of ICTs can contribute also in other ways to the development of the SMEs. The best known ways are microeconomic theory, the theory of transaction cost and the theory of representation. According to the microeconomic theory, the new technologies are considered to be the production factors which substitute capital and labour. The result is the requirement of less capital and labour for the production of the same result. According to the theory of transaction cost, enterprises exist because they can perform transactions internally in a cheaper way than with domestic enterprises in the market. The enterprise is profitable when it enters a market that it has not itself created. Information systems contribute to the reduction of the cost of participating in a market – that is the transaction cost- by making its active engagement within it more attractive. Traditionally, enterprises expand in size to reduce the transaction cost. Information systems reduce by definition the cost for a given size, providing at the same time the opportunity for the increase of income without a further increase in size, or even, in many cases, the opportunity for its reduction (Cordella. A. 2006, Cheung, Steven N. S. 1987, Niehans, J. 1987). Finally, as far as the theory of representation is concerned, the enterprise is a network of contracts among the interested individuals, and not a unified entity that seeks maximization of profit. The owner of the enterprise employs interested individuals by relinquishing authority and delegating responsibility. These

individuals need to be managed, supervised and controlled, which entails a certain cost, the cost of representatives or interested individuals. As organizations grow, the cost of representatives or interested individuals grows. Information systems "put pressure" on the cost curve downwards, thus averting the expansion of organizations at the expense of the cost of representatives or interested individuals (Wickramasinghe, N. 2006).

One of the obstacles hindering the effective use of ICTs in the SMEs is the lack of official planning, programming and methodology. Most of the planning time is wasted on survival techniques that the SME will develop, and as a result, the time allocated to information technology projects is minimal or non-existent (Pollard & Hayne, 1998). This was also shown by the study conducted for the Technology and the Internet in the SMEs by Dandridge and Levenburg (2000), in which many small and medium-sized enterprises are shown as having websites just because they have to. A second serious obstacle is lack of experience in ICTs, as well as in the possibilities offered in the intra-business procedures. Moreover, apart from the technical knowledge and possibilities, the bibliography focuses its attention on the importance of the use of these technologies (Chapman et al., 2000, Yap et al., 1992). The use includes, in essence, the strategic understanding of the opportunities in the market, provided by the new ICTs, their application in the enterprise and, of course, their ability to successfully lead to the creation of competitive advantages (Tetteh & Burns, 2001). A substantial obstacle to the successful use of ICTs for the SMEs is also the lacking understanding of the benefits offered.

On the other hand, neither do the investments on information technology alone suffice to render the enterprises and their executives more efficient, if they are not accompanied by supportive values, structures and attitudes within the organization, and by other complementary assets (K. Laudon & J. Laudon, 2006). Research has shown that the enterprises which invest in complementary assets, such as new business processes, executive behavior, and the organizational culture – training, achieve better performances (Brynjolfsson, 2003, Brynjolfsson & Hitt, 2000, Davern & Kauffman, 2000).

RESEARCH METHODOLOGY

A joint methodology of fully-structured questionnaire and in-depth interviews was selected as the primary research instrument in order to gain as broad a view as possible of the issues surrounding application of ICT, among a spectrum of SMEs from 4 out to 51 Greek geographical areas (States/provinces) which fulfilled the criteria of GDP-sharing, working population and total number of population. A total of 100 companies was selected and letters were sent out requesting an interview, while follow-up telephone calls by the researcher negotiated access to each business. Fifty-four SMEs were positive responded. The main reason that the authors have attempted to use a combination of techniques was to minimize bias and error and overcome any ambiguities.

The survey questionnaire was divided into four parts. Part one deals with the adoption and use of ICTS and part two covers questions addressed to evaluate the degree of emphasis placed on strategic and operational planning of ICTs and whether the strategic process was systematic and formal. Part three covered the financial information and the last part was based on general information about each firm.

Personal interviews were conducted with the person deemed to be most knowledgeable on the ICTs developments within the firm. For that reason, the interviewees ranged from director or owner-manager and IT personnel to general managers. Only one interview per company was conducted. A mix of closed and open-ended questions was included to conduct the structured interviews. This provided a collection of quantitative and qualitative data, and enabled comparisons based on rating, ranking and individual contextual analysis. On average, the interviews lasted one hour and 15 minutes based on a fully

structured questionnaire. Completed questionnaires were coded and analyzed using the SPSS 17.0 (Statistical Package for Social Sciences).

A stratified random sample of SMEs was drawn from four industry sectors according to classification of economic activity by NACE (rev. 1.1).The criteria of total selection of industry sectors and SMEs, according to their two-digit NACE code allocation, were the attendance index of SMEs in each industry sector, contribution index of each industry sector in Gross Value Added and E-Business Index. The data for two first indices were found by National Statistical Service of Greece and ICAP databases while the last Index was adopted by *European E-Business Report 2003* (Robinson, S. 2003). The final allocation of our sample (n=54) according to industry sector and firm size is illustrated as follows (Table 1):

Table 1: Distribution of Interviews by Firm Size and Sector

Industry Sector	**Sub-sector – Two Digits Allocation**	**Micro Firms (0-9)**	**Small Firms (10-49)**	**Medium Firms (50-249)**	**Total**
Other Services	K 70, K 72, K74	13	8	2	23
Manufacturing	D15, D 22	2	5	2	9
Wholesale Trade	G 52	7	3	3	13
Hotels	H 55	1	6	2	9
Total		**23**	**22**	**9**	**54**

This table shows the final allocation of our sample (n=54) according to industry sector and firm size.

Finally, the ICTs examined were classified into five main categories. Each category includes those technologies that are more frequently used. More specifically, the main categories of ICTs, as well as the technologies – systems included in each category are the following:

Table 2: ICT Classification

Main ICT Categories	**Technologies - Systems**
Enterprise Systems	Enterprise Resource Planning - ERP Customer Relationship Management - CRM Supply Chain Management - SCM
Information Systems	Transaction Processing Systems - TPS Management Information Systems - MIS Decision-Support Systems - DSS Executive Support Systems - ESS
Digital Technologies	E-Business (includes transactions of enterprise activities only) E-Commerce (includes transactions of commercial activities only)
Telecommunication Networks	Wired Wireless
Identification and Data Capture Technologies & Telematics Technologies	Portable Data Collection, Hand Held Readers, Magnetic & Smart Card Readers, RFID etc.

This table shows the main categories of ICT and the technologies-systems that are included in each ICT category.

It should be re-emphasized that the research was conducted as part of a PhD research; therefore, the survey sample size was necessarily limited, due to financial and time constraints but the authors believed that it would shed some light on the current perceptions of SMEs about the application of ICTs.

EMPIRICAL RESULTS

First, we examine the statistical information from the use of each ICT by Firm Size. Next, we investigate the significance of the differences between firm size, industry sector and each ICT. Finally, we explore the development of SMEs, which was created through the adoption – use of ICTs. The development was evaluated based on the increase in income stemming from the ICTs after the adoption – use of ICTs.

Statistical Information from the Use of Each ICT by Each SME Category

The application study of the information systems TPS, DSS, MIS and ESS produced the following results. First, the information system TPS is used by the 100% of the SMEs of all three categories. The general use of the TPS is totally justified because the specific information system supports the administrative executives in the monitoring of the basic activities and transactions of the enterprise (i.e.: sales, receipts, deposits, payroll, credit decisions and the flow of materials in a factory). Second, the DSS is used only by the small enterprises at a rate of 36.4% and not at all by the micro and the medium-sized ones. The low application of the system by the small firms and the absence of its application by the micro and medium-sized firms were justified by the interviewees through the use of the MIS. More specifically, they claimed that the DSS, as well as the MIS, both serve the administrative level of the firm, and therefore, they prefer to choose the MIS due to limited financial resources. It is true that the MIS is applied by the 34.8% of micro, the 50% of small and the 77.8% of medium firms. Finally, the Executive Support Systems – ESS is used only by the category (10-49) of the SMEs, and not at all by the small and medium firms. The micro firms are expected not to use the ESS because these systems serve the strategic level of decision making of the firm, and their creation is recommended to financially and operationally bigger firms. On the other hand, the absence of use of the ESS by the medium firms constitutes an element for further study because the firms of this size are usually interested in examining strategic matters and long term trends both in their internal and their external environment, which is not confirmed in the specific case.

The Enterprise Resource Planning system is applied at a small rate by the micro firms (13%), while its rate of use by the small firms (59.1%) and the medium ones (88.9%) increases dramatically. With the use of ERP applications, the SMEs achieve the complete and utterly programmed utilization of their resources, by having a complete picture of the people the firm deals with, their human resources, their inventory of products, machinery, storage rooms, etc. It is for these reasons that its wide use is observed especially in the two big categories where the needs for completion of information both horizontally and vertically are greater. The specialized use of the ERP and its adoption cost constitute constraints according to the answers given by the micro enterprises.

The enterprise system CRM is applied at a rate of 34.8% by the micro, of 45.5% by the small ones and of 55.6% by the medium firms. The use of CRM is deemed particularly low in all three categories of SMEs, especially if we take into account that the handling of customers is directly related to the development and the profitability of every enterprise. For the use of the CRM, what is required is the completion of business processes, changes in the organizational processes and in data management, so as to achieve inter-operational completion throughout the enterprise. Sales, marketing and customer service, which may be considered as separate operations, have to be completed. Employees, business partners and third service organizations must share the customers. Many SMEs underestimate the degree to which all company departments can contribute to customer relations, as well as the degree of the required completion. Technology cannot handle customer relations if these administrative and organizational matters are not resolved first. (Day, G. 2003).

For the analysis of the enterprise system for the supply chain management (SCM) the SMEs, which belong to the Sector "Other Services" were not included, as these do not use the specific system due to the nature of their business activity. The study, in the remaining three sectors (manufacturing, wholesale trade and hotels) showed that the SCM is used by the 40% of the micro, and the 28.6% of the small and the 28.6% of the medium firms, which of course surprises us because the micro firms use the SCM more than the small and medium ones, while we would expect the opposite. Even in this case, the application rates are particularly low because the specific enterprise system is not restricted simply to the execution of

orders, but it is connected to strategic matters, such as the ability to create and deliver new products or to create and materialize as new business models (Kopczak & Johnson, 2003).

In general, the SCM is used by the 32.3% of the SMEs, while the CRM by the 42.6% and the ERP by the 44.4%. These three percentages give the indication of low use of the enterprise systems by the SMEs despite their usefulness on both an operational and administrative level, as well as on a strategic one.

For the Technologies of e-business and e-commerce, high rates of use were observed. More specifically the technologies of e-Business are used by the 100% of SMEs of all three categories. This use of e-Business is justifiable because it provides the SMEs with the opportunity to conduct faster and with fewer mistakes their business activities. The technologies of e-commerce are used by the 73.9% of the micro, the 86.4% of the small and the 77.8% of the medium-sized firms. The rates are very high in all three categories, which prove the SMEs interest in approaching new markets and creating new commercial activities at a low cost.

As for the Telecommunication Networks Technologies, the SMEs were asked if they use wired networks and/or wireless networks, or if they do not use Telecommunication Network Technologies at all. According to the given answers, the micro-firms at a rate of 52.2% do not use communication networks. This rate decreases to 18.2% in the small firms and to 22.2% in the medium firms. From the percentages in the three categories arises that one out of three SMEs (33.3%) does not use network technologies at all. This percentage is particularly high; especially if we take into account that information sharing in this day and age is considered to be of vital importance for the development and the competitiveness of enterprises. Finally, as for the use of Identification and Data Capture Technologies & Telemetric Technologies, an increase of application from a category to category is observed, starting from 39.1% by the micro, 63.6% by the small and 77.8% for the Medium Sized ones. The increased use of these technologies is to be expected as they cover daily executive needs by simplifying processes, which in the past were time-consuming, and clerical errors.

From the personal interviews, we observed that the perception of SMEs of the use of ICTs has a dual character, which arises from the executive use of technology, that is the use which directly relates to operational use, and managerial use that lead the enterprise to a higher level of effectiveness and efficiency. The adoption of ICTs starts, of course, from the executive use of every technology that is imported to the organization, and its results are tangible in the short run, while the management use of ICTs sets mid-term goals, and for this reason, its results are tangible on the long run. It is only logical that the SMEs, particularly the micro ones, are more interested in technologies that offer immediate tangible results and less so in results, which will require time to produce results, even if these results will elevate the entire enterprise to a higher business level.

Analysis of Association between ICT and SMEs

To test whether or not the use of each ICT depends on the firm size, we performed a Chi-square test for independence between the two categorical variables. It was found that there is dependence between the two only in the following three cases.

- Firm size and ERP
- Firm size and wired networks
- Firm size and wireless networks

Table 4 tells us that the Pearson Chi-Square statistic equals 18.296 with 2 degrees of freedom (d.f.) and its related p-value is less than 0.0005 (0.000 on the output). It follows that we can reject H_0: Firm size and ERP are statistically independent at the 0.05 level of significance, since the p-value is less than 0.05.

Table 3: Firm Size & ERP, Wired Networks, Wireless Networks Contingency

			ERP		Wired Networks		Wireless Networks		Total
			Applied	Not Applied	Applied	Not Applied	Applied	Not Applied	
Firm Sizes	0-9	Count	3	20	10	13	9	14	23
		% within Firm Size	13.0%	87.0%	43.5%	56.5%	39.1%	60.9%	100.0%
		Adjusted Residual	**-4.0**	4.0	**-2.6**	2.6	**-2.6**	2.6	
	10-49	Count	13	9	17	5	17	5	22
		% within Firm Size	59.1%	40.9%	77.3%	22.7%	77.3%	22.7%	100.0%
		Adjusted Residual	1.8	-1.8	1.8	-1.8	**2.2**	-2.2	
	50-249	Count	8	1	7	2	6	3	9
		% within Firm Size	88.9%	11.1%	77.8%	22.2%	66.7%	33.3%	100.0%
		Adjusted Residual	**2.9**	-2.9	1.0	-1.0	.5	-.5	
Total		Count	24	30	34	20	32	22	54
		% within Firm Size	44.4%	55.6%	63.0%	37.0%	59.3%	40.7%	100.0%
Industry Sectors by NACE									
Industry Sectors (by NACE)	Other Services K 70, K 72, K 74	Count			17	6			23
		% within Firm Size			73.9%	26.1%			100.0%
		Adjusted Residual			1.4	-1.4			
	Manufacturing D15, D 22	Count			3	6			9
		% within Firm Size			33.3%	66.7%			100.0%
		Adjusted Residual			**-2.0**	2.0			
	Trade G 52	Count			6	7			13
		% within Firm Size			46.2%	53.8%			100.0%
		Adjusted Residual			-1.4	1.4			
	Hotels H 55	Count			8	1			9
		% within Firm Size			88.9%	11.1%			100.0%
		Adjusted Residual			1.8	-1.8			
Total		Count			34	20			54
		% within Firm Size			63.0%	37.0%			100.0%

This table shows the count, percentage use and the adjusted residuals of ERP, Wired and Wireless Networks within each firm size as well as the count, percentage use and the adjusted residuals of Wired Networks within the different four industry sectors.

The Chi-square test tells us that there is some departure from statistical independence, but it says nothing about the nature of this departure or how strong it is. Post hoc analyses of the contingency table cells are based on adjusted residuals that are calculated by dividing the residual (i.e., the difference between observed and expected cell frequency) by the standard error of the contingency table cell. The adjusted residuals (table 3) of the categories 0-9 and 50-249 are greater than 1.96 in their absolute magnitude, indicating significant deviations from the independency assumption. In addition, the sign of the adjusted residuals supports the association model since the micro firms that use ERP and medium-sized firms that do not use ERP are both fewer in number than would be expected by chance, as indicated by the negative sign, while the micro firms that do not use ERP and medium-sized firms that use ERP are both more than would be expected by chance, indicated by the positive sign.

Table 4: Chi-Square Statistic for Firm Size and ERP, Wired Networks and Wireless Networks. Fisher's Exact Test for Industry Sector and Wired Networks

					Monte Carlo Sig. (2-sided) 95% Confidence Interval		
	Statistic	**Value**	**df**	**Asymp. Sig. (2-sided)**	**Sig.**	**Lower Bound**	**Upper Bound**
Chi-Square Statistic for Firm Size & ERP	Pearson Chi-Square	18.296(a)***	2	.000			
	Likelihood Ratio	20.334***	2	.000			
	Linear-by-Linear Association	17.645	1	.000			
	N of Valid Cases	54					
Chi-Square Statistic for Firm Size & Wired Networks	Pearson Chi-Square	6.523(b)**	2	.038			
	Likelihood Ratio	6.579**	2	.037			
	Linear-by-Linear Association	5.016	1	.025			
	N of Valid Cases	54					
Chi-Square Statistic for Firm Size & Wireless Networks	Pearson Chi-Square	7.021(c)**	2	.030			
	Likelihood Ratio	7.169**	2	.028			
	Linear-by-Linear Association	4.020	1	.045			
	N of Valid Cases	54					
Fisher's Exact Test for Industry Sectors & Wired Networks	Pearson Chi-Square	8.740[d]	3	.033	.031[e]	.027	.034
	Likelihood Ratio	9.105	3	.028	.042[e]	.038	.046
	Fisher's Exact Test	8.359**			.036[e]	.032	.039
	Linear-by-Linear Association	.000[f]	1	.993	1.000[e]	1.000	1.000
	N of Valid Cases	54					

This table shows the statistical results of the Chi-square test between firm size and ERP, firm size and wired networks and firm size and wireless networks and the statistical results of the Fisher's exact test between industry sectors and wired networks.

a. 1 cell (16.7%) has expected count less than 5. The minimum expected count is 4.00.
b. 1 cell (16.7%) has expected count less than 5. The minimum expected count is 3.33.
c. 1 cell (16.7%) has expected count less than 5. The minimum expected count is 3.67.
d. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 3.33.
e. Based on 10000 sampled tables with starting seed 2000000.
f. The standardized statistic is .009.
* The value is significant at the 0.1 level.
** The value is significant at the 0.05 level.
*** The value is significant at the 0.01 level.

Looking at the data in Table 4, it appears that the Pearson Chi-Square statistic equals 6.523 with 2 d.f. and its related p-value is 0.038. It follows that we can reject H_0: Firm size and Wired networks are statistically independent at the 0.05 level of significance, since the p-value is less than 0.05. The adjusted residuals of the category 0-9 are 2.6 (greater than 1.96) in their absolute magnitude, indicating significant deviations from the independency assumption.

Similarly, examining the data taken from Table 4 the Pearson Chi-Square statistic equals 7.021 with 2 d.f. and its related p-value is 0.030. It follows that we can reject H_0: Firm size and Wireless networks are statistically independent at the 0.05 level of significance, since the p-value is less than 0.05. The absolute values of the adjusted residuals of the categories 0-9 and 10-49 are 2.6 and 2.2 (greater than 1.96), indicating significant deviations from the independency assumption.

Then, the four Industry sectors were examined as to the use, or absence thereof, of the ICTs. More specifically, we wanted to statistically examine the importance of the influence of the Industry sector in relation to the use of the ICTs. It was found that there is a statistically significant association only between the Industry sectors (by NACE) and wired networks.

For the examination between the four sectors and the wired networks, *Fisher's Exact Test* was used as an alternative to the Chi-square test. Recall, that when using Chi-square test, no cell in the contingency table should have an expected count less than 1, and no more than 20% of the cells should have an expected count of less than five; otherwise a Fisher exact test will be more appropriate.

Looking at the data in Table 4, it appears that the Fisher's Exact Test statistic equals 8.359 and its related p-value is 0.036. It follows that we can reject H_0: Industry sector and Wired networks are statistically independent at the 0.05 level of significance, since the p-value is less than 0.05. The adjusted residuals (table 3) of Manufacturing are 2.0 (greater than 1.96) in their absolute magnitude, indicating significant deviations from the independency assumption. In addition, from the comparison of rates of use of wired networks in the four sectors of SMEs, it arises that these are used mostly in the hotel and other services sectors, while in the sectors of wholesale trade and manufacturing, they are used significantly less.

Development of SMEs through the Effective – Efficient Use of ICTs

The development of SMEs, which arose from the effective – efficient use of ICTs, was evaluated based on the increase in the SMEs' income, which was generated by the adoption-application of ICTs. This is income, which would not have been generated if the application of ICTs by the SMEs was not effective – efficient.

The potential for development of the SMEs was evaluated with the help of a model of logistic regression, where the dependent variable is the increase in income of an enterprise after the use of the ICTs (yes, no), and where the independent variables are the presence of a specific ICT strategy for their use (yes, no), the potential of approaching new markets or segments after the adoption of ICTs (yes, no) and the investment in ICTs in 2006 (in thousands of euros).

The table 5 of the analysis is the most important as it provides us with the parameters of the final model together with the equivalent inductive verifications and their validity boundaries. Based on the Wald criterion, a significant influence on the shaping of the dependent variable values stems from the variables *ICT-Strategy* (p-value = 0.003) and *Approach New Markets* (p-value = 0.007), that is the presence of a specific ICT strategy and the potential for approaching new markets or segments. The variable InvestICT_Scale_2006 moves away from the model since its p-value is equal to 0.375.

The reason for maintaining the *InvestICT* variable is to show that the development of the SMEs stemming from the effective – efficient application of ICTs is the result of the adoption of a specific Information and Communication Technologies strategy, and not just the result of the investment in information technology. In reality, it is proven that the development of the SMEs stemming from the effective application of technologies is a matter of strategic planning and the need of approaching new markets-segments thereof.

Table 5: Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-4.660***	1.5892	-7.774	-1.545	8.597	1	.003	.009	.000	.213
[ICT-Strategy=1= YES]	3.809***	1.2833	1.294	6.325	8.811	1	.003	45.123	3.648	558.147
[ICT-Strategy=NO]	0[a]	.	.	.	.	.	.	1	.	.
[Approach_NewMarkets=YES]	3.769***	1.3881	1.048	6.490	7.372	1	.007	43.337	2.853	658.322
[Approach_New Markets=NO]	0[a]	.	.	.	.	.	.	1	.	.
C4.5_InvestICT_Scale_2006	0.000006811	0.00000 76693	- 0.000008221	0.0000218 4	.789	1	.375	1.000	1.000	1.000
(Scale)	1[b]									

This table gives the estimated value of the second category of ICT-Strategy = NO and Approach New Markets = NO when the covariate is equal to 0. The ICT-Strategy=YES and Approach New Markets=YES coefficients subtract the ICT-Strategy=NO and Approach New Markets=NO predicted value from the ICT-Strategy=YES and Approach New Markets=YES predicted values, respectively. Adding one of these coefficients to the intercept estimate gives the estimated value for that level of ICT-Strategy and Approach New Markets, again when the covariate is equal to 0.
a. Set to zero because this parameter is redundant.
b. Fixed at the displayed value.
**** The estimated regression coefficients are significant at the 0.01 level.*

According to the estimated parameters, through the presence of a specific ICT strategy, the odds of income increase for an enterprise with ICT strategy are 45 times ($e^{3.809} = 45.123$) the odds for an enterprise without ICT strategy, irrespective of the potential of approaching new markets or segments. In addition, the odds of income increase of an enterprise that has the potential to approach new markets or segments is equal to $e^{3.769} = 43.337$ times the odds for an enterprise which has not the ability to approach new markets, irrespective of the adoption of a new strategy.

Therefore, the model that is evaluated through the sample data for the development of the SMEs stemming from the use of ICTs, has the following form:

$$\ln\left[\frac{p}{1-p}\right] = -4.660 + 3.809(\text{ICTStrategy} = \text{YES}) + 3.769(\text{App.NewMarkets} = \text{YES}) + 0.000006811(ICTinvest)$$

Where p is the estimated probability of income increase of an enterprise following the use of ICTs, *ICT-Strategy = YES* is the dummy variable which indicates the presence of a specific strategy (in contrast to the SMEs, which do not have a specific strategy for the use of ICTs) and *Approach New Markets = YES* is the dummy variable which indicates the potential of approaching new markets or segments following the adoption of ICTs (in contrast to the other SMEs).

Following the evaluation of the logistic model parameters, what remains is the evaluation of its fit to the sample data. A significant measure of good fit is the goodness of fit test (table 6).

Table 6: Goodness-of-Fit Statistics

	Value	df	Value/df
Deviance	**21.958**	**36**	.610
Scaled Deviance	21.958	36	
Pearson Chi-Square	39.264	36	1.091
Scaled Pearson Chi-Square	39.264	36	
Log Likelihood	-10.979		
Akaike's Information Criterion (AIC)	29.958		
Finite Sample Corrected AIC (AICC)	31.101		
Bayesian Information Criterion (BIC)	36.713		
Consistent AIC (CAIC)	40.713		

This table compares the predicted values of the outcome variable with the actual values. It is the fit of the observed values (Y) to the expected values (Ŷ). The bigger the difference (or "deviance") of the observed values from the expected values, the poorer the fit of the model.

The value of the deviance is equal to $21.958 > X^2_{0.95,36} = 50.998$ and the p-value is equal to $0.9683 > 0.05$. This constitutes an indication that the fit of the logistic regression model that was applied is satisfactory.

An additional measure for the evaluation of the fit of the model to the sample data is achieved through the ratio of the maximum values of the likelihood ratio statistic for the complete model (L_F) and the model which includes only the fixed term (L_0). The value of the ratio is $-2\ln\left(\frac{L_0}{L_F}\right) = 31.883$ (Model Chi-square) with 3 degrees of freedom (p-value < 0.001). We can conclude, that is, that the two independent variables, when combined in the form of the logistic model, significantly contribute to forecast the values of the dependent variable.

CONCLUSION

The purpose of this paper was the examination of the use of ICTs within the operation of SMEs, the association between firm size and ICTs and between industry sectors and ICTs, as well as the contribution of ICTs to the development of the SMEs sector. In addition, an important research objective of this chapter is the role of business strategy in the development and operation of SMEs through the use of ICTs.

From the data which arose from the research in Greek SMEs and according to the categorization of ICTs applied (see Table 2), it was revealed that the SMEs use quite a few and various technologies. More specifically, the micro enterprises (0-9 employees) are more interested in technologies, which produce direct and tangible results and less so in those which produce results that will require quite a lot of time to materialize, while the small enterprises (10-49 employees) and the medium enterprises (50-249 employees) have the tendency to integrate their business processes through the use of ICTs.

From the research conducted, as well as from the results which arose in this chapter, we come to two major findings. The first one is that the perspective of SMEs regarding the use of ICTs is threefold as it arises from the operational use of technology, namely the use that is directly related to elementary activities-transactions and aims at the development within the firm (internal horizontal development), from the managerial use which relates to functions on an administrative level (internal vertical development) and from the strategic use, that is the use leading the firm to the unification of the internal environment of the firm with the external environment of the market.

The second finding is that the adoption-use of ICTs is not so much linked to the size of SMEs, but rather to the functions and the objectives that each firm sets. It is natural that the more firm-size increases, the

more its potential, as well as its needs for the use of advanced technologies also increases, without their constituting the determining factor for their implementation. The determining factors for the effective implementation of ICTs are the drawing up of a specific ICT-Strategy, as well as the need to approach new and/or distant markets, which in the past were impossible without the use of ICTs. Naturally, investment on ICTs has its purpose and its role in the successful development of SMEs, but we now have to grasp the fact that we have transcended to the next level of technology use, which does not concern itself with whether the businesses, the societies and/or the people should invest in technology (this is a given fact), but rather with which technologies they will invest in, how they will use them, which purpose or purposes they wish to serve, and finally, to where they will be led through the use of each technology.

The logistic regression model of SMEs can be used for further academic research in other sectors and sub sectors of SMEs, as well as by the administrators of SMEs as a guide to the successful use of ICTs, which depends on the strategic factor and on the factor of extension-globalization in new markets. In essence, the logistic regression model, which was created, shows the SMEs that their development in today's economic-business era is the result of logical planning and programmed action that is expressed through the implementation of a specific ICT strategy, as well as through the need to expand business activities beyond the usual geographical borders.

At this point, we should not omit to mention that the findings of the specific study are limited to the following four sectors of economic activity, namely 'Other Services', 'Manufacturing', 'Trade' and 'Hotels' as well as to the following seven sub-sectors ICT 'Service-K72', 'Business Services-K74', 'Real Estate Services-K70', 'Publishing & Printing-D22', 'Food-Beverages-D15', 'Retail Trade-G52', and 'Tourism-H55'. Therefore, the findings that arose from the study can be generalized only for the SMEs belonging to these seven sub-sectors.

As it is known, technology constantly evolves and with it must evolve those who are related to it. Therefore, this particular study lends itself to further research, initially in more industrial sectors and sub sectors (two-digit NACE codes) in order to identify as many ICT factors affecting SMEs as possible, and secondly, to investigate the way (qualitative elements) in which SMEs create and develop their ICT-Strategy. Research is already in progress by the authors in the above directions.

REFERENCES

Bennett, R. (1997) "Export marketing and the internet: experiences of web site users and perceptions of export barriers among UK businesses," *International Marketing Review*, Vol. 14(5), p. 324-344

Bridge, J. & Peel, M.J. (1999) "Research note: A study of computer usage and strategic planning in the SME sector," *International Small Business Journal,* Vol. 17(4), July-September, p. 82-87

Brynjolfsson, E. (2003) "The IT Productivity Gap," *Optimize Magazine,* July, Issue 21

Brynjolfsson, E. & Hitt L. (2000) "Beyond Computation: Information Technology, Organizational Transformation and Business Performance," *Journal of Economic Perspectives,* Vol. 14(4), p. 23-48

Chapman, P., James-Moore, M., Szczygiel, M. & Thompson D. (2000) "Building internet capabilities in SMEs," *Logistics Information Management,* Vol. 13(6), p. 353-360

Cheung, Steven N. S. (1987) "Economic organization and transaction costs," *The New Palgrave: A Dictionary of Economics,* Vol. 2, p. 55-58

Cordella, A. (2006) "Transaction costs and information systems: does IT add up?'. *Journal of Information Technology,"* Vol. 21, p. 195-202

Dandridge, T. & Levenburg, N.M. (2000) "High Tech Potential? An Exploratory Study of Very Small Firms' Usage of the Internet," *International Small Business Journal,* Vol. 18(2), January-March, p. 81-91

Davern, M. & Kauffman, R. (2000) "Discovering Potential and Realizing Value from Information Technology Investments," *Journal of Management Information Systems,* Vol. 16(4), p. 77-82

Day, G.S. (2003) "Creating a Superior Customer-Relating Capability," *MIT Sloan Management Review,* Vol. 44(3), p. 77-82

El Louadi, M. (1998) "The relationship among organization structure, information technology and information processing in small Canadian firms," *Canadian Journal of Administrative Sciences,* Vol. 15(2), June, p. 180-199

European Commission (2003) "Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises," *Official Journal of the European Union,* 2003/361/EC, May, p. 36-41

Hamill, J. (1997) "The internet and international marketing," *International Marketing Review*, Vol. 14(5), p. 300–323

Hamill, J. & Gregory, K. (1997) "Internet marketing in the internationalization of UK SMEs," *Journal of Marketing Management*, Vol. 13(1–3), p. 9–21

Kopczak, L. & Johnson, E. (2003) "The Supply-Chain Management Effect," *MIT Sloan Management Review,* Vol. 44(3), p. 27-34

Laudon, K.C. & Laudon P.L. (2006) *Essentials of management information systems: managing the digital firm.* 6th Edn. USA: Prentice Hall

Niehans, J. (1987) "Transaction Costs," *The New Palgrave: A Dictionary of Economics*, Vol. 4, p. 677-80.

Pollard, C.E. & Hayne, S.C. (1998) "The Changing Faces of Information Systems Issues in Small Firms," *International Small Business Journal,* Vol. 16(3), April-June, p. 70-87

Poon, S. & Jevons, C. (1997) "Internet-enabled international marketing: a small business network perspective," *Journal of Marketing Management*, Vol. 13(1–3), p. 29-41

Quelch, J.A. & Klein, L.R. (1996) "The internet and international marketing," *Sloan Management Review*, Spring, p. 60–75

Robinson, Simon (2003) "Measuring e-business readiness: Challenges for statistics and research. In: European Commission (2003b)," *The European E-Business Report 2003 edition,* Report by the e-Business Watch. Luxembourg: Office for Official Publications of the European Communities. ISBN 92-894-5119-X. p. 187-192

Samiee, S. (1998) "Exporting and the internet: a conceptual perspective," *International Marketing Review*, Vol. 15(5), p. 413-426

Singh, R., Garg, S. & Deshmukh, S. (2008) "Strategy Development by SMEs for Competitiveness: A Review," *Emerald Group Publishing Limited,* Vol. 15(5), p. 525-547

Storey, D.J. (1994). *Understanding the Small Business Sector*. London: International Thompson Business Press

Tetteh, E. & Burns, J. (2001) "Global strategies for SME business: applying the SMALL framework," *Logistics Management Information,* Vol. 14(½), p. 171-180

Thomson, A. & Gray, C. (1999) "Determinants of Management Development in Small Business," *Journal of Small Business and Enterprise Development,* Vol. 6(2), p. 113-127

Wickramasinghe, N. (2006) "Expanding the explanatory power of agency theory for the knowledge economy," *International Journal of Management and Enterprise Development,* Vol. 3(5), p. 510-520

Yap, C.S., Soh, C.P.P. & Raman, K.S. (1992) "Information Systems success factors in small businesses," *Omega, International Journal of Management Science,* Vol. 20(5), p. 597-609

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