

## ICT Capability and Innovation Utilization in Turkish SMEs: The Case of Machinery Industry

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### Abstract

*Global competition requires usage of local and global research and innovation networks; transfer of innovative ability to new products, services and processes. Large scale companies have the ability to cope with the dynamics of the fierce global competition whereas, SMEs (small and medium sized enterprises) most of the time face challenges in the process of adopting and utilizing innovation. Information and communication technologies (ICT) adoption capacity provides an initial step towards innovation utilization among SMEs, facilitates improving innovative capacities by supporting R&D investments and paves the way for new product and technology generation. In the light of the recent tendencies that highlight policies and actions promoting the innovative capacity of the manufacturing sector, this pilot study aims to measure the innovation awareness and utilization levels of a sample of SMEs located in an Organized Industrial Zone (OIZ) in Istanbul. The pilot study indicates that the SMEs with higher ICT adoption capabilities have higher innovation utilization rates. These SMEs also benefit from increasing exports and technologically new or significantly improved goods and services. Although the findings can not be generalized, they can also shed light on the existing positive correlation between utilization levels of different innovation types.*

### 1. Introduction

The fierce global competition necessitates Small and Medium-Sized Enterprises (SMEs), the highly significant actors in the development of national economies, to adopt and utilize innovation. Innovation is regarded as a substantial process leading to productivity increase and economic growth as well as maintaining sustainable competitive power.

Relevantly, today the most widely supported definition of innovation is the one published by the OECD in Frascati Guide and updated in Oslo Guide in 2005. Innovation is defined as realization of new or significantly improved product, service or process; a new marketing or an organizational method in management practices, organization or external relations (Oslo Guide OECD, 2005). Innovation definition of OECD, which is valid in EU, is also adopted by Turkey in 2005.

Turkey is at the early stages of innovation orientation; furthermore, innovation is a novel concept for the majority of SMEs. Global Innovation Scoreboard –GIS, 2006 Report ranks Turkey as lagger along with a number of countries like Greece, China, Portugal, Bulgaria, India, Romania (Hollanders and Arundel, 2006). Based on the World Economic Forum rankings among 80 nations, Turkey ranks 56<sup>th</sup> in innovation and 49<sup>th</sup> in knowledge and communication background. European Trend Chart on Innovation (2007) identifies the main challenges of innovation in Turkey as the lack of innovation drivers and knowledge creation. The recently published policy document on Regional Innovation Strategy (2008) creates a new approach to innovation in Turkey by undertaking special actions to improve awareness among SMEs and to increase their innovation capacities to cope with the competitive global markets.

Innovation is captured among the strategic priorities of Turkey (TUBITAK, 2004). The policy documents; 2007-2013 Ninth Development Plan, Information Society Strategy and National Innovation Initiative (NII) (2006) set innovation as the prior pillar of development and encourage the use of ICT in innovation related actions (DPT, 2006).

In Turkey, both the industrial policies and the SME strategies focus on SMEs operating in manufacturing industry and aim at improving innovative capacities by supporting R&D investments and new product and technology generation. Determinant issue of competition is defined as knowledge and innovation in Turkish manufacturing sector. This study aims to measure the innovation awareness and utilization levels of a sample of SMEs located in an Organized Industrial Zone (OIZ) in Istanbul to find out whether the ICT adoption capacity enhances innovation utilization in SMEs. The aim is to find out the relationship between ICT capacity and innovation utilization based on the hypothesis that there is a positive link between the ICT utilization and the progress in innovation. To be more specific, the study investigates the current ICT penetration, the relationship between the SMEs' innovation utilization and ICT adoption along with the relationship between the utilization of different innovation types.

The study contributes to gathering information and knowledge on certain innovation indicators related to a sample of SMEs in machinery and equipment sector in Istanbul. After the revision of the pilot study's questionnaire and the application of the survey on a large scale sample, it is expected that the study would generate further contributions to policy makers, SMEs, related NGOs and industrial associations. The exploitation of the results would increase awareness in terms of ICT usage and innovation. In the long run SME performance would improve as depicted in the study by the positive link between ICT usage, innovation and performance.

The paper proceeds with literature survey. It is followed by an application section which includes methodology, findings and discussion. The paper ends with the conclusion section.

## 2. Literature survey

Related literature on innovation in Turkey includes a number of sectoral and/or regional analyses; however, a majority of these studies are for large enterprises. Nevertheless, structuring the SMEs with an innovative vision in the knowledge economy will have a prominent impact on the economy. SMEs constitute 99% of the enterprises in Turkey. They make up 32.3% of the total value added compared to 81% in the EU. Furthermore, capacity utilization rates in Turkey and the EU are 80% and 25% respectively. Financially, SMEs in the EU utilize 45% of total credits whereas SMEs in Turkey utilize only 4%. Therefore, increasing SMEs' added value in Turkish economy and basing this increase on knowledge and innovation would have a significantly positive impact on the efficiency and competitive power of the Turkish economy.

Related empirical studies in Turkey have generally been constrained to specific sectors (Gülmez, 2002; Özkan et. al. 2003; Koca and Çetin, 2005; Armağan, 2004) and involved issues like productivity of the manufacturing sector, new product development, distribution channels. SME related multi conceptual and multi regional studies hardly exist. Although SME focused governmental institutions like Small and Medium Sized Enterprise Support and Development Agency (SMESDA -KOSGEB in Turkish) and State Institute of Statistics (SIS) provide some data, it usually becomes impossible to lead parametric studies. The main reason behind this is the lack of continuity in certain data parameters. Among the restricted number of studies, Kalkan and Keskin (2005) looks at the usage intensity of knowledge management tools in 218 SMEs. The study finds low rates of usage and lack of an efficient information management process. Özkan et. al.

(2003) emphasizes the significance of R&D studies and use of diversified markets in high capacity utilization rates. Güleş and Bülbül (2003) detect a significant positive correlation between firm innovativeness and performance. Payzın et al. (1998), using a sample of eight large and twenty small firms, conclude that the ratio of R&D expenses to total sales is higher for large firms, leading to higher new product development (NPD) propensity. In a study of supply chain and innovation management concerning four sectors in Turkish manufacturing industry (Ulusoy, 2003) it becomes apparent that innovation is significant in increasing competitive power in Turkish manufacturing firms. Kaya et al. (2004) emphasizes the need for a higher rate of advanced technology usage for increasing performance. Güleş et al. (2003) emphasizes the significant positive correlation between levels of information technology used and firm performance based on a study in Konya.

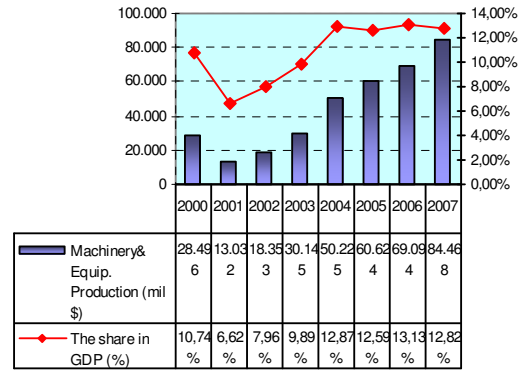
Related international literature on innovation and SMEs can be studied in two groups: Analysis of country innovation experiences at regional or sectoral levels; determination of factors and development of methods that influence the product development or innovation process. March-Chorda, Gunasekan and Lloria-Aramburo (2002) mention the lack of sufficient research related to innovation strategies of SMEs compared to large firms. Similarly, Bessant (1999) attracts attention to the increasing importance of SME's and innovation concepts and emphasizes the lack of sufficient research. His research concludes with the SMEs' need of a technological background structured within the national innovation system. A number of studies (Thomas, 2003; Thomas et. al. 2004) state the importance of web sites and the Internet for SME innovation support. Scupola (2003) further emphasizes the positive impact of the use of internet based technologies on increasing market power and competitiveness of SMEs and states the need for such studies in the literature. Scupola's study points to the importance of managerial and technological aspects as well as external factors such as supply chain members in acceptance and implementation of innovation. Tie-Jun and Jin (2006) study the relationship between SME innovation capability and the firms' internal and external resources and detect some significant factors such as total R&D expenditure and number of technological know-how. Maylor (2001) discovers significant positive correlation between new methods and tools and NPD performance in a study of 46 manufacturing firms in England. They further emphasize the simultaneous use of new tools rather than using them one by one.

There is a great body of literature on the theory of innovation (Potts and Mandeville, 2007; Mytelka and Smith 2002; Lyytinen and Rose, 2003; VIWTA 2004; Borrás 2004). Most theories concerning innovation and the diffusion of innovations have been developed in the context of the manufacturing industry (Widén and Hansson, 2007). The studies of information society (IS) innovation and adoption are evaluated under the scope of the Swanson's theory of IS innovation. Swanson defines IS innovation as involving both a technological component (hardware and software) and an organizational dimension captured by differentiated features as new forms of work, business processes or organization methods. Therefore IS innovation activities bear an extended coverage from new IS products or services, new types or forms of information and communication technologies used, to the new types of organizational arrangements to manage and deliver IS services (Lyytinen and Rose, 1993).

There is a close connection between theory and policy in national innovation approaches. It is observed that most of the time innovation theory, innovation practice and policy making are an integrated, co-evolving and interactive process (Mytelka and Smith, 2002, VIWTA, 2004, Borrás, 2004). This also complies with the Turkish model where the policy documents tend to generate a theoretical framework. National innovation theories are rather new in Turkey and they are built upon the current national innovation strategies which are set by two policy documents; the Information Society Strategy and the National Innovation Initiative. Both of the documents focus on the advancement of innovation orientation among the SMES especially by supporting the ICT capability and utilization and they present science and technology as the main instruments in the development towards a knowledge-based economy.

**3. Manufacturing Industry in Turkey**

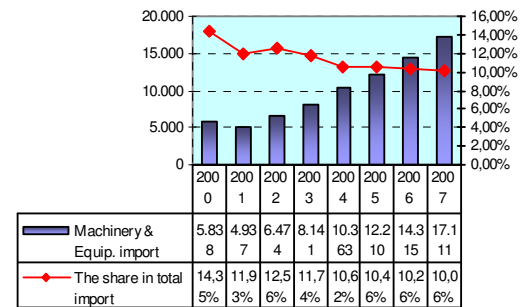
Machinery and equipment industry is selected in this study because this industry has a particular importance for Turkey due to its promising export and manufacturing potential. The industry has grown continuously much above the average of manufacturing industry in the post-crisis period (after 2001). The total production in machinery and equipment industry increased from 28.5 billion USD in 2000 to 84.5 billion USD in 2007, constituting a share of 13% in GDP (Figure 1).



Source: Turkish Statistical Institute

Fig 1. Production in Machinery and Equipment Industry

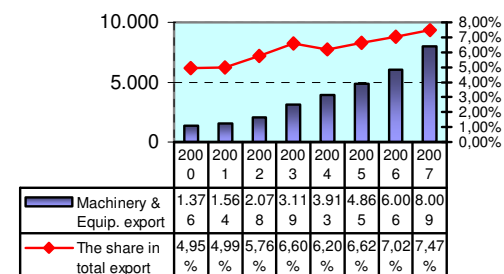
Import of machinery & equipment industry climbed up from 5.8 billion USD in 2000 to 17.1 billion USD in 2007 with a share in total manufacturing imports ranging between 10% and 12.5%. It has an important share in the context of imported intermediate goods. The share of the machinery and equipment imports in total imports is given in Figure 2.



Source: Turkish Statistical Institute

Fig 2. Import of Machinery and Equipment Industry

However, the share of the machinery and equipment exports constitutes only 5-7% of total manufacturing exports. Total amount of exports increased significantly from 1.3 billion USD in 2000 to 8 billion USD in 2007 (Figure 3).



Source: Turkish Statistical Institute

Fig 3. Export of Machinery and Equipment Industry

Additionally, the machinery and equipment industry is one of the information and technology intensive industries, along with chemistry, electronics and software industry in Turkey and provides a huge potential for the use of innovation and advanced technologies to enhance competitiveness of traditional industries. Therefore, it is of interest to determine the current awareness and utilization of innovation and technology of the SMEs in Istanbul. The Ninth Development Plan (2007-2013) of Turkey poses innovation as the most important feature of the competitive economic structure and foresees a vital shift in the national manufacturing industry towards innovation for to achieve competitiveness in the sectors of medium and high level technology.

#### 4. Methodology

Previous research has revealed the importance of the link between ICT capability and innovation utilization. Relevantly, basic research questions directed to the SMEs in machinery and equipment industry in an OIZ in Istanbul are:

- How well are the SMEs endowed with ICT and internet facilities?
- What is the relationship between the SMEs' innovation utilization and ICT adoption?
- What is the relationship between the utilization of different types of innovation?

The research is designed as a two-stage field survey. This paper presents the pilot study conducted at the first stage. The objectives of the pilot study are to measure the awareness and utilization of innovation as well as the relevant correlations for a group of SMEs. In addition, the results are expected to form a basis and help to improve the main questionnaire that will be conducted in a more expanded field study at the second stage.

For the pilot study, a field survey was undertaken in February-March 2008. Research data were collected by a questionnaire, Innovation Utilization Questionnaire (IUQ), that was generated by face-to-face interviews and phone calls. Face-to-face

interviews would especially be helpful to retrieve respondents' comments about the sample survey questionnaire. A group of SMEs was chosen from machinery industry in one of the OIZ in Istanbul. The selection of the SMEs participating in the pilot study is completed with the guidance of expert opinion. The secretary-general of the machinery sector association is interviewed as an expert in order to gather the initial list of SMEs and the contact information of a number of SMEs that would be willing to take the survey as a test group is attained from this source.

A convenience based sample among the researchers' network was used at the first stage of the study to increase the response rate and to "encourage open disclosure". SMEs are usually very reluctant to share information about their internal financial and organizational structure. However, access to SMEs through this network has facilitated the process and created a cooperative attitude. 36 questionnaires of the 40 were responded. The response rate was 90%, as it is expected. This is also in line with the network approach that is observed in innovation literature (Thomas et al., 2004).

IUQ consisted of a demographic information section and a two-part ICT and innovation survey. The demographic section gathered information on the organizational, financial and operational characteristics of the SMEs. In part I, the questions are addressed to gather information about ICT and internet infrastructure of the SMEs, as well as to determine the aim of integrating ICT in their businesses including e-commerce. In Part II, the owners/managers of the SMEs were asked whether they are engaged in any type of product or process innovation utilization in the last two years. Process innovation is defined via four indicators: marketing, production, management, finance and further classified into sub-indicators (Table 1). Innovation related indicators are derived from KOSGEB Innovation Survey, the European Innovation Trend Chart, Regional Innovation Strategies (RIS) and UK Innovation Survey.

Table 1. Sub-indicators of Process Innovation

<b>Marketing</b>	<b>Production</b>	<b>Management</b>	<b>Finance</b>
Systemic market research	Computer based manufacturing	SWOT Analysis	Annual budget plan
Participation in fairs	Sales planning	Performance management	Monthly budget control
Forecasting customer demand	Personnel backup	In-house training	Cost-benefit analysis
Periodic measurement of customer satisfaction	Statistical process control	Information Management Systems	R&D and innovation credits
After sales support services,	Waste management		R&D and innovation investment

Changing in design and packaging,	Break even analysis		
Improved sales and distribution methods	Technological R&D		
Providing, R&D and innovation intense export.	Material requirement planning (MRP)		
	New logistics/distribution methods		

### 5. Findings and Discussion

As a first step, the demographic profiles of the SMEs are analyzed to provide the related frequencies. The average age of the SMEs surveyed is 15 years. The size of the SMEs varies between micro and small sized enterprises with 42% and 58% respectively. Annual turnover of the majority of the SMEs surveyed (58%) is slightly more than 400,000 USD. Export and import rates among the respondents are 70% and 27%, respectively. Even though in some of the innovation researches, it is claimed that there is a direct link between the education levels and the innovation capability of the company (Tie-Jun and Jin, 1998), our pilot study shows that university education is not a significant factor in companies' innovation utilization.

Secondly, some major ICT and innovation related frequencies are summarized. Referring to Part I of the Questionnaire, the frequencies about ICT capability of the SMEs are presented. Accordingly, all the respondents own all the basic ICT tools such as fix line, mobile phones, and personal computers. Among the respondents, 87% have internet access, and 24% have intranet connection. Website ownership is quite high (82%) whereas e-mail address ownership is lower than the expected (70%). Reasons for using internet are classified as improvement in competitiveness and productivity (42%), supply chain relations (33%), e-commerce (27%) and increasing production (21%). Referring to Part II of the Questionnaire, the frequencies about process innovation utilization of the SMEs are given in Table 2.

Table 2. Process Innovation Utilization Frequencies

Marketing related Process Innovation Indicators	(%)	Production Related Process Innovation Indicators	(%)
Systemic market research	39	Computer based manufacturing	30
New product development	49	Sales planning	49
National fair participation	79	Personnel backup	15
International fair participation	46	Statistical process control	9
Customer demand forecast	42	Waste management	12
Periodical measurement of customer satisfaction	42	Break even analysis	18
After sales services	55	Technological R&D	18
Changes in design and packaging	27	Material requirement planning (MRP)	42
Improved sales and distribution methods	15	New logistics/distribution methods	12
R&D and innovation intense export	15		

Two of the most important marketing related innovation indicators are national fair participation and after sales services. Sales planning and MRP are the major production related innovation indicators. In the process innovation utilization part, majority of the SMEs surveyed participate in national fairs (79%) and undertake after sale services (55%) whereas in the product innovation utilization sales planning (49%), MRP (42%) and

computer based manufacturing (30%) remain to be the most common three factors that SMEs realize. Thirdly, referring to Parts I and II of the Questionnaire, correlation analyses are conducted between ICT tools and innovation indicators as well as among innovation indicators. Table 3 summarizes the correlation between ICT tools and innovation indicators (Table 3).

Table 3 Correlation between ICT Tools and Innovation Indicators

ICT Tools	Innovation Indicators	Correlation
Internet connection	Material requirement planning (MRP)	39%*
	Computer based manufacturing	26%

	Technological R&D	21%
e-mail address	Systemic market research	56%**
	Technological R&D	20%
	Computer based manufacturing	17%
Website	Technologically new or significantly improved products	38%*
	International fair participation	36%*
	Systemic market research	31%
	Computer based manufacturing	26%
	Sales planning	21%
	Technological R&D	21%

\*significant at 5% level

\*\*significant at 1% level

Findings indicate a positive relation between ICT utilization and innovation capability. MRP, computer based manufacturing and technological R&D is positively correlated with internet connection. E-mail address ownership is positively correlated with technological R&D; computer based manufacturing and systemic market research. Systemic market research has significant positive correlation (56%) with e-mail address ownership at 1% significance level. The survey shows that there is a significant positive correlation (38%) between website ownership and the ability of the SMEs in producing technologically new or significantly improved products (goods & services). This correlation is significant at 5% significance level. In addition, international fair participation has also significant positive correlation (36%) with website ownership.

Correlation analysis is also conducted within process innovation groups of marketing and production. Within marketing sub-indicators, systemic market research is positively correlated

with improved sales & distribution methods (40%) as well as R&D and innovation intense export (40%) at 5 percent significance level. This indicates that systemic market research is an important channel to improve sales and to expand distribution methods, leading to an increase in R&D and innovation intense export. Within production sub indicators, Computer based manufacturing is significantly correlated with statistical process control (55%), technological R&D (39%), MRP (48%), and new logistics/distribution methods (42%). Statistical process control is correlated with waste management (79%), technological R&D (84%), MRP (47%) and new logistics/distribution methods (62%). The findings are meaningful in the sense that computer based manufacturing system integrates important production factors that lead to improvement in design and productivity as well as innovation in production. These improvements are viable through technological R&D investments which are also validated by the findings.

Finally, correlation between product and process innovations are also analyzed (Table 4).

Table 4. Correlation between Product Innovation and Process Innovation

Product Innovation Indicators	Process Innovation Indicators	Correlation
Technologically new or significantly improved products (goods & services)	Investment in R&D and innovation	86%**
	Computer based manufacturing	75%*
	Statistical process control	49%**
	Technological R&D	59%*
	Material requirement planning (MRP)	61%*
	New logistics/distribution methods	50%*
	International fair participation	52%**
	National fair participation	44%*
	R&D and innovation intense export	32%
	Standards Institute of Turkey Certificate ownership	58%**

\*significant at 5% level

\*\*significant at 1% level

In product innovation, technologically new or significantly improved products (goods & services) production is significantly positively correlated with investment in R&D and innovation (86%), utilization of computer based manufacturing (75%),

statistical process control (49%), technological R&D (59%), MRP (61%), new logistics/distribution methods (50%), international fair participation (52%), national fair participation (44%) and Standards Institute of Turkey Certificate

ownership (58%). The only non-significant positive correlation exists between R&D and innovation intense export and technologically new or significantly improved products (goods & services) production. A considerable number of significant correlations among the two types of innovation indicate that SMEs that are open to one type of innovation are also more likely to utilize other types of innovation.

## 6. Conclusion

This study aims at measuring innovation awareness and utilization levels of a sample of SMEs located in the Organized Industrial Zone (OIZ) in Istanbul to find out whether the ICT adoption capacity enhances innovation utilization in SMEs. The findings simply show that the ICT adoption capability is directly connected with the innovation utilization. All of the SMEs that have produced technologically new or significantly improved product (goods & services), own websites. Website ownership is regarded as the very first step of inclusion of ICT to the traditional business environment. Other significant findings of the study are that both the product and process innovation utilization are correlated. An SME that utilizes one type of innovation is most likely to utilize other types too. Product and process innovation utilizations are also closely related to the transfer to computer based manufacturing. Once the SMEs make this decision and integrate computer to their manufacturing systems, it is observed that they are much more confident in ICT use and they have greater propensity to adopt ICT.

The pilot study indicates that the SMEs that have better ICT adoption capabilities (computer based production systems, internet access and website ownership), have benefited from this by both increasing their exports and production technologically new or significantly improved goods and services.

Today, the major challenge in the process of innovation utilization is the inability of SMEs to cope with the dynamics of the global competitive market. It is a certain need to create greater awareness among SMEs on the benefits of ICT in enhancing their innovative capabilities in the new economy. SMEs may position ICT adoption as a strategic tool in solving their innovation challenges and flourishing their innovation capabilities. Best practices of the SMEs that have already succeeded in innovation utilization may create benchmarks for the others in the same industry.

## 7. Acknowledgement

The study is supported by Bogazici University Scientific Research Projects Fund (Project #: 07HN202).

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