INFORMATION TECHNOLOGY IMPLEMENTATION IN NEWLY INDUSTRIALISING COUNTRIES: THE CASE OF TURKISH MANUFACTURING FIRMS

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ÖZET

Bu çalışmada Türkiye'de faaliyette bulunan büyük ölçekli sanayi işletmelerinde bilişim teknolojileri kullanım düzeyini, amaçlarını bulguları incelenmektedir. Araştırma kapsamındaki işletmelerden elde edilen bulgulara göre: (i) İşletmelerin son üç yılda bilişim anlamlı bir şekilde artmakla beraber, işletmeler henüz bilişim teknolojileri kullanımının başlangıç aşamasındadırlar. (ii) İşletmele yönetiminde etkinlik sağlamaya daha çok önem vermektedirler. (iii) Bilişim teknolojileri kullanımında karşılaşılan temel sorunlar çok hızlı demode olmasıdır. (iv) Bilişim teknolojileri kullanım düzeyi daha yüksek olan işletmelerin performansı, daha düşük düz daha yüksektir.

Anahtar Kelimeler: Bilişim Teknolojileri, İşletme Performansı, İmalat Sektörü.

ABSTRACT

This paper reports the results of a survey into a newly industrializing country, Turkey, which focuses on studying and elucidat Turkish manufacturing firms. A questionnaire was developed and mailed to 300 manufacturing companies. Ninety-six usable qu rate of 32%. The empirical data gathered through the survey shows that the implementation of all individual ITs increased Statistical analyses indicate that improving internal efficiency, getting technology to work, skill levels of workers and rapid char Factor analysis shows that for the time being respondents major aim in IT implementation is improving coordination and cooperat timely and correct information rather than establishing closer ties between entities (suppliers, customers etc.) outside the implementation levels and company performance has been established.

Key Words: Information Technology, Company Performance, Manufacturing Industry.

INTRODUCTION

A major influence forcing companies to manage their business in radically different ways is the changing competitive environment. Due to globalization manufacturing enterprises face severe competition both in domestic and international markets. In such an environment organizational competition depends heavily on obtaining correct and timely information about markets, customers and competitors and exchanging it simultaneously between entities inside as well as outside the organization. Only by doing so, companies will be able to response in time to changes in customer demands and market conditions. From this point of view, it is argued in the literature that ITs owing to their ability to collect, process and distribute information play a significant role in improving the responsiveness of a company to changing needs of markets and thus increasing its competitiveness. Recently, many companies have made large investments in IT with the hope of using it as a competitive weapon and obtaining a sustainable strategic advantage [1]. Güleş [2], through an extensive literature review, gave examples on how a company can use IT to influence an industry's competitive forces to its own benefits. Depending on the specific nature of technology

and the circumstances of the particular firm IT can improve or stabilize a company's competitiveness via reducing labor costs, improving product quality, faster response to customer demands and competitor moves, increasing flexibility, early entry into the market and so on [3].

Based on the above explanations it can be argued that the use of IT to gain competitive advantage has become one of the most popular topics in business and management. In this context, the major aim of this research is to study and elucidate IT implementation by the manufacturing organizations in a developing country, i.e. Turkey. Changes in the level of IT implementation, objectives in IT usage and the relationship between IT implementation level and company performance is major concerns of the research. The paper starts with outlining the research methodology, which is followed by the results and discussions. The paper closes with some conclusions.

A STUDY OF IT IMPLEMENTATION IN MANUFACTURING COMPANIES

Research Aims

As in any country, manufacturing companies established in Turkey play a significant role in the development of the national economy. Due to intensifying competition, many believe that it is vital for manufacturing companies to implement ITs to increase or at least to maintain their competitive position. However, before accepting such an imperative the situation should be explored. To do so this study addresses the following research questions:

a) What is the extent of change in the level of IT implementation by manufacturing companies during the research horizon (1996-1999)?
b) What are the objectives of IT implementation and to which extent have they been achieved during the research horizon?
c) Is there any relationship between the level of IT implementation and the competitive situation in the market as evaluated by companies?
d) Is there any connection between the level of IT implementation and company performance?

Research Methodology and Measurement of Main Variables

The most appropriate research method to be used with a particular research problem depends upon the overall research objectives and characteristics of the population and other numerous factors. In view of the explanatory and exploratory nature of the research objectives, for the purpose of primary data collection, this study adopted a survey based research design. The question of the survey instrument was developed in accordance with previous research [4, 5] and the guidelines lay down by Foddy [6] Oppenheim [7] and Tokol [8]. The questionnaire was developed to obtain data of the following types:

a) Company characteristics
b) IT implementation levels
c) Importance and achievement of IT implementation objectives
d) Evaluation of company performance

Comments made about each of these areas are below.

a) Measurement of Main Variables

Company Characteristics

Data on company characteristics comprised continuous variables like estimated market share, number of employees, and number of years in business, annual sales, market share and categorical variables such as nationality of business, method of acquiring information technologies.

Information Technology and the Level of Implementation

LAN, WAN, MIS, INTERNET and INTRANET are in the scope of the research as ITs. IT implementation level was measured through a method similar to that used by Powell and Dent-Micallef [9]. Respondents were asked to evaluate the IT implementation levels in their company on a five-point scale (where zero represented nil and four very high implementation) for three years ago and currently. They were also asked to indicate the intended level of use for the next years.

Importance and Achievement of IT Implementation Objectives

As the ITs, in the scope of our study, support companies' competitiveness mainly via information management, this research focused on objectives related to increasing the efficiency of information management inside as well as outside the organization. Six objectives, that are general and applicable to all technologies included in the research, were collated from the literature. Companies ranked the relative degree of importance given to these IT implementation objectives on a five-point scale ranging from zero to four (where 0=not at all, 4=very high). Respondents also indicated the level of achievement on each IT implementation objective using a five-point scale ranging from 0, nil achievement, to 4, very high achievement.

Company Performance

Performance was operationalised through company manager's self-assessment on how they evaluated their companies' performance on six competitive priorities relative to their competitors. This method of measurement was employed, as privately held companies in Turkey are reluctant to reveal hard data such as profit margins, market share and cost structure. In using this subjective performance measure, the researchers assumed that respondents (senior managers) had sufficient perspective and information to assess their companies' performance relative to rivals. Dess and Robinson [10] showed that measuring performance (organizational) by asking respondents for their own evaluation was highly reliable in the absence of direct financial data. Companies were offered six competitive priorities (product quality, product customization, speed of new product introduction, price, delivery reliability and customer satisfaction) and were asked to evaluate their companies' performance compared to their rivals on a five-point scale ranging from 1, much lower than competitor, to 5, much higher than competitor.

b) Pilot Study

A pilot study was conducted to confirm that the items of the questionnaire were clear and unambiguous. It was also aiming at highlighting issues of questionnaire structure and question sequence. The pilot study was implemented in an interview manner. Participants of the pilot study included company managers and academicians. All participants were working in related areas, and were asked to critique the survey instrument and make suggestions for improving the questionnaire. To put the questionnaire into its final form the following revisions were made: reducing the question set to a more focused group, rewriting some questions for clarity, rewriting some instructions.

c) Main Study and Sampling

The main criteria used in this research to identify the sample are being: in the process of implementing IT, in business at least for three years, and a manufacturing company. Every effort was made to construct a representative sample to include a wide range of companies regarding firm characteristics, such as company size, market share and including companies operating in

different sectors and cities of the country. By taking into account these criteria questionnaires were distributed to 300 plants listed in the "Capital 500 CD" that comprises 500 manufacturing companies. A total of 96 usable responses were received by the end of March 1999. Thus, the response rate is 32%.

d) Data Analysis

The collected data were coded and entered into SPSS for Windows version 10.0. SPSS is widely used and offers a full range of contemporary statistical methods, plus good editing and labeling facilities. Regarding the type of statistical test the more conservative non-parametric test was preferred over the equivalent parametric test.

RESEARCH FINDINGS AND DISCUSSIONS

In this section the survey results are presented and discussed.

Sample Characteristics

The mean number of employees was approximately 1233, with the smallest company employing 24 and the largest, 23000 employees (see Table 1).

Table 1. Distribution of Respondents According to Company Size in Terms of Employees

Company Size*	***Number of Employees***	***Frequency***	***%***
Small	1-49	3	3.1
Medium	50-199	27	28.1
Large	200 and above	61	63.5
	Missing	5	5.3
Total		96	100.00

*Official Classification of Small and Medium Sized Companies Development Centre, Turkey [11].

Companies had been in business for a mean of 28 years. Only 34 companies gave information on market share. According to this market shares varied from 1.0% to 80% with mean of 28.57%. The majority of companies saw the competitive situation in the market as high (see Table 2).

Table 2. Competitive Situation in the Market

Competitive Situation	***Frequency***	***%***
Very Low	1	1.04
Low	3	3.13
Average	15	15.63
High	44	45.83
Very High	32	33.33
Missing	1	1.04
Total	96	100.00

Information Technology Implementation Level

Respondents were asked to evaluate the IT implementation level on a five-point scale for three years ago and current. Significant increases were registered in the implementation of all individual technologies (see Table 3).

Table 3. Past, Present and Future IT Implementation Levels

Information Technologies	*Three Years Ago (1996)*		*Current Situation (1999)*		*Expected Use (2002)*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
LAN	1.63	1.28	2.77	1.17	3.36	0.97
MIS	1.22	1.14	1.84	1.36	3.05	1.23
WAN	1.00	1.22	2.00	1.24	3.06	1.23
Internet	0.43	0.74	2.15	1.04	3.33	0.71
Intranet	0.30	0.77	1.08	1.37	2.80	1.33

Note: (i) n=96; (ii) mean score is a weighted average derived from the scale 0 none usage to 4 very high usage; (iii) all significant at the level of <. 001.

As seen in Table 3, IT implementation by Turkish manufacturing firms was low for each IT three years ago. The IT least employed by companies was Intranet with a mean score of 0.30 that was followed by Internet (0.43), WAN (1.00), MIS (1.22) and LAN (1.63). When taking into account current levels of IT implementation it is observed that for each IT, implementation levels increased in a statistically significant manner. The implementation level of Intranet is still the lowest with a mean score of 1.08. Additional data not shown in Table 3 indicated that Turkish manufacturing companies have invested in existing and previously unused technologies. An interesting point is that the highest increase in implementation levels occurred for Internet. This can be due to the recent increase of the commercial and promotional use of the Internet both in the world and Turkey. Leaving aside such increases, the relatively low mean scores for current situation demonstrate that usage for all ITs are at the early stages of the implementation cycle. However, companies are in the process of increasing IT implementation levels (see Table 3).

Impact of Competitive Situation As Evaluated by Respondents on IT Implementation Level

To examine whether the competitive situation in the market is related to IT implementation level, using a median cutting rule, the sample was divided into two groups based on company's evaluation of the level of market competition. The mean implementation level was then determined for the companies who evaluated the competitive situation in the market as low and high (see Table 4).

Table 4. Competitive Situation and IT Implementation Level

Information Technology	*Competitive Situation*				*Mann-Withney -U- Test*	
	Low (19)		*High (76)*			
	Mean	*Std.*	*Mean*	*Std.*	*Z*	*P*

		Dev.		*Dev.*		
LAN	2.16	1.26	2.91	1.10	-2.54	0.01
WAN	1.26	1.33	2.01	1.32	-2.16	0.03
MIS	1.63	1.42	2.12	1.17	-1.68	0.09
Internet	2.00	0.82	2.16	1.07	-0.77	0.44
Intranet	0.95	1.02	1.13	1.45	-0.66	0.95

Note:(i) n=96, (ii) number in parentheses shows the number of companies that falls into each category.

Table 4 shows that the two variables (IT implementation level and competition level) are correlated significantly for LAN, WAN and MIS. Such a correlation can be interpreted in a number of ways. One way is to argue that as the severity of competition increases then companies are driven to increase the level of IT implementation. Although the level of Internet and Intranet implementation is also higher for the companies evaluating the competitive situation in the market high, the scores are not significantly different. This can be explained as follows. Regarding Internet it can be argued that the recent popularity of Internet has resulted in a high usage across all companies. With respect to Intranet it can be stated that, the relatively low level of implementation makes it difficult, at present, to establish any relationship between implementation level and competitive situation in the market as evaluated by companies.

Importance and Achievement of IT Implementation Objectives

Table 5 shows respondents' ratings of the importance given to and the level of achievement of IT implementation objectives.

According to Table 5 respondents identified two internal objectives i.e. "establishing most suitable data exchange within organization" (3.40) and "sharing information and establishing coordination between departments" (3.24) as the most important two factors in IT implementation. This indicates that currently companies are mainly focused on increasing the efficiency of internal information exchange and enhancing the coordination and cooperation between departments. When the level of achievement scores (3.04 ad 3.00 respectively) for these objectives are taken into account it could be argued that generally speaking companies have achieved these objectives. As seen in Table 5 the other objectives are more related to improving information exchange between entities outside the company. The mean scores for these objectives are as follows: "accessing information fast and in a cost competitive manner" (3.02); "establishing fast and reliable external data exchange" (2.44); "pursuing innovations (2.35) and establishing efficient communication with suppliers" (2.44).

Table 5. Importance Given To and the Level of Achievement of IT Implementation Objectives

IT Implementation Objectives	***Level of Importance***		***Level of Achievement***	
	Mean	***Std. Dev.***	***Mean***	***Std. Dev.***
Establishing most suitable data exchange within organization	3.40	0.88	3.04	0.83
Sharing information and establishing coordination between departments	3.24	0.83	3.00	0.78
Accessing information fast and in a cost competitive manner	3.02	1.01	2.73	0.99
Establishing fast and reliable external data exchange				

Pursuing innovations				
Establishing efficient communication	2.44	1.14	2.36	1.14
with suppliers	2.35	1.16	2.45	1.08
	2.33	1.16	2.42	1.20

Note: (i) n=96; (ii) scores significantly different on Friedman two-way ANOVA test at <.001 level for both importance and achievement of IT objectives.

In order to identify the underlying pattern that might exist regarding IT implementation objectives, a factor analysis was carried out. The aim was to find support to the above assertion that for the present sampled companies major aim in IT implementation is to increase the efficiency of internal information exchange and enhance the cooperation and coordination of departments. For this purpose, as a first step the correlation matrix for the cited objective was examined and moderately high correlation between some variables were observed. This suggested that a factor analysis might produce some logical groups. Principal component analysis with varimax rotation was performed to define the dimensions (groups) of IT implementation objectives. Based on the eigenvalues and scree plot two factors have been extracted (see Table 6).

Table 6. Factor Scores for IT Implementation Objectives

Objectives	***Factors***	
	1	***2***
Increasing Efficiency of Internal Information Management		
Establishing most suitable data exchange within organization	0.90	
Sharing information and establishing coordination between departments ***Increasing Efficiency of External Information Management***	0.88	
Establishing fast and reliable external data exchange		
Establishing efficient communication with suppliers		
Pursuing innovations		
Accessing information fast and in a cost competitive manner	0.86	
	0.85	
	0.67	
	0.61	
Percentage of Variance (%)	54.2	18.2
n=96 **Total Variance: 72.4%**		
KMO=0.76 **Significance (p):< .001** **Barlett's Test of Sphereticity=222.95**		

Naming the extracted factors was remarkably clear. As seen in Table 6, "establishing most suitable data exchange within the organization" and "sharing information and establishing better

coordination between departments" are loaded together on factor1. This factor was named "Increasing Efficiency of Internal Information Management", and it accounts for 54.2% of the total item variance. Factor two, which was composed of "establishing reliable and fast information exchange with entities outside the organization", " establishing efficient communication with suppliers", "pursuing innovations" and "accessing information fast and in a cost competitive manner" was named "Increasing Efficiency of External Information Management".

Taking into account the results of Table 5 and Table 6 it could be argued that for the time being respondents major objective in IT implementation is improving coordination and cooperation between departments through the exchange of timely and correct information rather than establishing closer ties between entities (e.g. suppliers, customers) outside the organization.

IT Implementation and Company Performance

Table 7 shows respondent's ratings of how they evaluated their companies' performance, on six competitive priorities, compared to their rivals. Overall the ratings were at the high end of the scale indicating that company managers assumed that their companies were performing well than their competitors.

Table 7. Companies' Performance Relative to Competitors

Competitive Priorities	***Mean***	***Std. Dev.***
Product Quality	4.19	0.76
Product Customization	3.96	0.76
Customer Satisfaction	3.87	0.80
Speed of New Product	3.73	0.81
Introduction	3.68	0.80
Delivery Reliability	3.67	0.76
Price		

Note:(i) n=92, (ii) scale ranges from 1, much lower than competitor to 5,much better than competitor, (iii) scores are significantly different on the Friedman two way ANOVA test (p<.001)

In order to examine whether there was any relationship between IT implementation level and company performance as a first step, a direct question, i.e." Did the implementation of IT increased your competitive situation in the market?" was asked. Seventy-five percentage of the company managers answered "yes" and approximately 23% answered "no" to this question. Although the majority of respondents stated that IT implementation had a positive impact on competitiveness, as a second step it was examined whether there was any relationship between the level of IT implementation and company performance. For this purpose, similar to the method used by Dean and Snell [12] and Powell and Dent-Micallef [9] a total performance score was calculated by adding the ratings of companies' self assessment on competitive priorities. * Next, to examine whether the level of IT implementation has an impact on company performance, using a median cutting rule, the sample was divided into two groups as low and high IT users. The mean overall performance score was than established for the low and high IT users (see Table 8).

Table 8. Impact of IT Implementation Level on Overall Company Performance

* Before adding the scores Cronbach Alpha value was calculated. The value was (0,88) thus indicating that the individual values can be added together to calculate a composite performance score.

Information Technologies	IT Implementation Level	Overall Performance		M-W U Test	
		Mean	Std. Dev.	Z	P
LAN	Low (29)	21.24	3.37	-2.85	< .01
	High (63)	23.86	3.65		
WAN	Low (55)	22.56	3.88	-1.24	.10
	High (37)	23.76	3.49		
MIS	Low (54)	22.42	3.66	-1.92	< .05
	High (38)	23.97	3.75		
Internet	Low (56)	22.12	3.67	-2.80	< .01
	High (36)	24.53	3.44		
Intranet	Low (73)	22.73	3.64	-1.58	< .05
	High (20)	24.25	4.01		

Note:(i) n=92; (ii) numbers in parentheses indicates the number of companies that falls into each category.

Table 8 shows that except LAN most of the companies IT implementation level is nearer to the lower end of the scale. However, high IT users' company performance is much better than the low IT users (see Table 8). Thus indicating a positive relationship between IT implementation level and company performance.

CONCLUSION

The following conclusions can be drawn from the research into IT implementation in Turkish manufacturing companies.

Firms in the (Turkish) manufacturing industry have increased their reliance on ITs over the last three years to increase or at least to remain competitive in the market. This includes both increasing the level of existing technologies and investing for the first time in previously unused technologies. Although, IT implementation levels have increased, this need to be tempered by the relatively low mean implementation scores which demonstrate that usage is at the early stages of the implementation cycle. However, respondents indicated that over time they will increase their investment in ITs.

The study revealed that companies, in the scope of the research, are mainly concentrated on improving the efficiency of internal rather than external information management. However, in today's global competitive environment gaining competitive advantage also necessitates obtaining and exchanging timely and correct information between entities outside the organization. In this context, as far as surveyed companies are concerned, it could be argued that they have not yet perceived sufficiently the importance of increasing the efficiency of information management with suppliers, customers and trading partners.

Evidence for a positive relationship between IT implementation level and company performance has been provided in the research, which is concurrent with the connection advocated between the two variables in the literature.

The contribution of this research include: (1) reveal the extent of IT uses, (2) reveal the tendency of IT uses in the next three years, (3) reveal the objectives in IT implementation and (4) reveal the relationship between IT usage and company performance.

The sample, as far as can be ascertained, comprised firms that were representative of companies in Turkey's manufacturing sector, and therefore the results are expected to be generalisable across all manufacturing companies in the country. There is no reason to believe these results are untypical of other developing countries.

REFERENCES

1- Adcock, K., Helms, M.M. and Jih, W.K., Information technology: can it provide a sustainable competitive advantage? Information Strategy: The Executive's Journal Spring, 1993, 10-15.
2- Güleş, H.K., Rekabet üstünlüğü ve bilişim teknolojileri (Competitiveness and information technologies), Verimlilik Dergisi, Milli Prodüktivite Merkezi Yayını, 2000/1, 87-106.
3- Öğüt, A., Bilgi Çağında Yönetim (Management in the Information Age), (Nobel Yayın Dağıtım, Ankara, 2001).
4- Gözlü, S., Transfer of information technology in a developing environment, the turkish case, World Computer Congress, Volume 3, Elsever Science B.V., 1994, 465-470.
5- Akın, B.H., Küresel Rekabet Ortamında Teknoloji Yönetimi ve Bisküvi, Çikolata ve Gofret Sanayinde Teknoloji Yönetimine İlişkin Bir Uygulama (Technology Management in the Global Competitive Environment), (Unpublished Ph.D. Dissertation, Selçuk Üniversitesi, S.B.E., Konya, 1998).
6- Foddy, W. Constructing Questions for Interviewing and Questionnaires: Theory and Practice in Social Research, (Cambridge University Press, Cambridge, 1994).
7- Oppenheim, A.N., Questionnaire Design, Interviewing and Attitude Measurement, (New Edition, Printer Publishers, London, 1992).
8- Tokol, T., Pazarlama Araştırması (Marketing Research), Uludağ Üniversitesi Yayını (Uludag University publication), (8th edition, Bursa, 1996).
9- Powell, T.C. and Dent-Micallef, A., Information technology as competitive advantage: The role of human, business and technology resources, Strategic Management Journal, (18) 5, 1997, 375-405.
10- Dess, G.G. and Robinson, R.B., Measuring organizational performance in the absence of objective measures: The case of the privately held firm and the conglomerate business unit, Strategic Management Journal, 1984, 265-273.
11- Müftüoğlu T., Türkiye'de Küçük ve Orta Ölçekli İşletmeler: Sorunlar ve Öneriler (Small and Medium Sized Enterprises in Turkey: Problems and Suggestions), (2nd Edition, A.Ü. Siyasal Bilgiler Fakültesi Yayını (publication of Ankara University Faculty of Political Sciences), Ankara, Turkey, 1989).
12- Dean, J.W. and Snell, S.A., The strategic use of integrated manufacturing: An empirical examination, Strategic Management Journal, 17, 1996, 459-480.