



THE IMPACT OF IT ON INDIVIDUALS: A META-ANALYSIS

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INTRODUCTION

As the use of information technology (IT) continues to escalate, its impact on individuals will also continue to take on more and more importance as a workplace issue. While research has been conducted as to how IT can best be implemented in the workplace, study of how that technology impacts individuals is still in its infancy. In the past decade, research studies in the area have mainly focused on the design and regard of technology, and less so on how technology impacts individuals (Torkzadeh and Gemoets, 1998-1999). Nevertheless, IT is having an increasing impact on individuals' job productivity and job satisfaction. For instance, the use of IT may have adverse consequences for individuals, including added stress, lower job satisfaction and decreased efficiency (Joshi and Lauer, 1998). Such effects can in turn negatively impact business expenditures, especially if negative side effects undermine the original objective of implementing new IT applications, that being to increase performance and productivity.

The impact of IT on individuals can also make a significant difference in organizational competitiveness. The magnitude and pace of economic globalization demands that adopted new technologies increase an organization's performance and productivity. Organizations must, therefore, implement IT applications with which individuals feel comfortable and find satisfaction in using. If that does not occur, organizations may find their survival at risk. This research study focuses on how individuals are impacted by technology in ways that must be understood if businesses are to succeed in a fiercely competitive digital economy. Three related factors are investigated. First, the authors were interested in determining whether knowledge of IT prior to implementation of a new application is more likely to improve individual productivity than the alternative of first implementing the application, then providing training once the application is installed. This could be important information for businesses that are considering investments in IT, providing some insight into how to proceed with new IT installations.

A second objective of the study was to determine whether knowledge of IT, either through training or on-the-job usage, results in greater job satisfaction or, conversely, if IT creates more workplace stress and anxiety. This answer to this question is important to businesses in their attempt to understand how their employees might react to new systems.

The final objective of this research was to determine whether usage of IT results in more satisfaction with IT. Should this be the case, businesses might be encouraged to find ways to create incentives for IT usage in an effort to have a successful implementation of a system.

A meta-analysis methodology, using relevant research conducted in the recent past, was used to investigate the questions poised above. While the studies cited below more often focused on how end users make IT systems successful, they also included

investigations into the impact of IT systems on individual productivity, job satisfaction, and satisfaction with IT. IT is defined, for the purpose of this study, as including expert systems, group support systems, decision support systems, executive support systems and various software programs, among others. Individuals are defined to include end users such as executives, managers, groups of individuals, and small business owners.

This paper is organized as follows. The next section puts forth the propositions and the literature review. This is followed by the results of the meta-analysis. The final section concludes the manuscript by discussing the implications of the results for future research and practice.

LITERATURE REVIEW AND HYPOTHESES

The present research focused on how individuals are impacted by technology. More specifically, it evaluated how knowledge of IT affects individuals' productivity, whether knowledge of IT results in increased employee job satisfaction, and whether usage of IT results in greater satisfaction with IT.

Knowledge of IT and Productivity

Review of the relevant literature indicated that knowledge of IT was generally found to be a factor in increased productivity by individuals. Productivity was defined to include an increase in the accuracy of completing the task, higher output, and an increase in the amount of work completed (Yoon and Guimaraes, 1995). Productivity was also measured by problem solving, decision rationalization, horizontal integration, vertical integration and customer service (Torkzadeh and Gemoets, 1998-1999). In addition, productivity was defined in terms of information access and decision quality (Saunders and Miranda, 1998), as well as discussion quality and meeting efficiency (Davison, 1999). These studies shared research into end users' outcomes from the IT system, and how well the systems performed in achieving a desired goal.

Research by Yoon and Guimaraes (1995) focused on expert systems that were thought to have a significant impact on users' jobs by providing problem-solving expertise on specific tasks, therefore improving individual productivity. An expert system was defined as one that automated routine decision-making activities and allowed users to have more time for creative work. Based on the responses of 69 expert systems project managers, Yoon and Guimaraes found, among other things, that previous user knowledge of computer systems was directly related to a desirable impact by the expert systems on the users' jobs.

Torkzadeh and Gemoets (1998-1999) researched productivity through performance-related evaluations that focused on outcomes. They evaluated IT success in terms of task productivity, task innovation, customer satisfaction, and management control. These four dimensions were considered to be indicative of

how IT accomplishes work. Two sample sets of highly experienced IT users were used in the study: 180 IT users in the Southwest U.S. and 152 IT users in Mexico. The analysis revealed high correlations for the five dimensions of system-use (problem solving, decision rationalization, horizontal integration, vertical integration, customer service), which all related to productivity.

Saunders and Miranda (1998) looked at the efficiency of group support systems (GSS) across meeting environments in helping group members acquire information and make quality decisions. Information acquisition and decision quality were defined as indicative of meeting productivity. GSS are designed to speedily and easily provide electronic access to databases outside conference facilities. They possess attributes that ease information acquisition and sharing. A total of 179 individuals participated in the study. The study included measurement of the frequency with which groups accessed information through the GSS, compared with traditional meeting groups. As predicted, the findings showed a strong correlation between use of GSS and the extent to which group members accessed information. Groups using GSS accessed information more frequently than traditional meeting groups.

Fedorowicz and Villeneuve (1999) investigated whether IT users perceived their systems to be useful and efficient. A survey of 228 practitioners with interest in object-oriented tools found these tools to be useful and efficient. Overall results indicated that respondents strongly preferred object-oriented tools to other approaches for application development. Results also indicated that these promoted job efficiency to a greater extent than other techniques.

The above-cited studies lead to the first hypothesis:

H1: Knowledge of IT will have a positive impact on individual productivity.

Knowledge of IT and Job Satisfaction

As stated, one purpose of this research was to attempt to gain some insight into whether technology is resulting in increased individual job satisfaction. The authors believe that this factor is going to become an even more important issue in the coming years, both for employers and employees. Employers will need to understand how new technologies affect how employees view their jobs, favorably or unfavorably. This factor can indeed be an important aspect in employee retention. Indeed, Torkzadeh and Gemoets (1998-1999) point out that it may now be more important to question how IT is impacting people rather than to ask how it is designed.

In their research Igbaria and Tan (1997) defined job satisfaction as including positive quality of work life. They pointed out the conflicting findings in previous studies of the effects of IT on workers and their jobs. They cited arguments by some that computerization has increased the intellectual content of work, as well as arguments by others that computerization has worsened the quality of work life and decreased its variety. They also noted that some researchers have found that office automation has enriched and enhanced the quality of work for middle managers. Overall, they maintain that contradictory results abound as to the impact of IT on individuals.

Yoon and Guimareas (1995) defined job satisfaction in part as the creation of a desirable impact on users' jobs. They also investigated whether various characteristics of IT users, which were considered relevant to the success of expert systems, were actually related to a desirable impact by expert systems on users' jobs. Using responses of 69 project managers, they found that user satisfaction was directly related to a desirable impact by expert systems on users' jobs.

The second hypothesis of this research is:

H2: Knowledge of IT will have an impact on individual job satisfaction.

Usage of IT Versus Individual's Satisfaction With IT

The final objective of this study was to seek an understanding of whether the use of IT resulted in individual job satisfaction with the IT system. Although a number of related studies have been performed in an effort to learn how to best design systems to meet user requirements, the present research was restricted to studies that focused on individual satisfaction with the system used, rather than the success of systems, although these two factors were often highly correlated (Lee, Kim, and Lee, 1995). The study by Lee, Kim, and Lee, involving 236 IT users, found that user acceptance of IT systems was positively related to system utilization and that user acceptance of IT systems was positively related to user satisfaction of the systems. IT acceptance was defined as the willingness of user(s) to utilize IT systems. They also found that user satisfaction with IT systems was positively related to user job satisfaction.

Igbaria and Tan (1997) found that user satisfaction and IT usage reflect the interaction of IT with the user. Usage and satisfaction, then, are defined as interacting. It was also found that individual attitudes are strongly related to acceptance of IT, and that attitudes influence behavior toward a system.

Khalil and Elkordy (1999) also investigated relationships between IT usage and positive impacts on user satisfaction with a system. Using a sample of 120 mid- and low-level managers, they found that an increase in user satisfaction with the quality of systems was related to increased usage of the systems, but only to a point; that is, satisfaction occurred only from an average amount of usage. They also noted that users expressed satisfaction with IT systems only when the systems met users' objectives.

Mckeen, Guimaraes, and Wetherbe (1994) analyzed 151 independent systems development projects in an investigation of IT user satisfaction. They found that user participation had a direct relationship with user satisfaction. The degree of satisfaction was found to depend upon the complexity of the system or tasks. Greater complexity of tasks or of the system was related to a stronger relationship between user participation and user satisfaction.

These studies lead to the third and final hypothesis:

H3: Usage of IT will have a positive effect on individuals' satisfaction with IT.

METHOD

Meta Analysis

Meta analysis is a statistical technique for combining the results of independent studies (Green and Hall, 1984, Hedges and Olkin, 1985; Rosenthal, 1984). Meta analysis has been applied to literature in the social sciences (Wood, Mento and Locke, 1987), general management (Schwenk, 1990), and information systems (Benbasat and Lim, 1993). The meta-analysis approach was chosen for the present research for several reasons: first, it enables the synthesizing of literature by combining the findings of a number of studies. Second, each data point used for analysis is obtained from an individual study rather than from an individual subject. Rarely do single experiments provide sufficiently definitive answers upon which to base policy decisions (Hedges and Olkin, 1982). Third, a meta-analysis also can include studies over a large time and scope, potentially validating the factors over time. Lastly, since technology changes over time, the impact of factors at various stages of technological development can be combined.

RESULTS

This section presents the results of a meta-analysis of the previous studies cited in this research. More specifically, it provides information on how large or how significant these effects are and provides information on the degree of heterogeneity among z scores and effect sizes.

Knowledge of IT and Productivity

Table 1 reflects the results regarding productivity. Four studies measured the impact of IT on productivity. It appears that productivity is strongly affected by knowledge of IT ($Z = 6.187$). These results were found to be statistically significant. The effect size for this particular relationship, according to Cohen (1977), fell into the medium-size range. The results across studies were found to be consistent. These results are congruous with the qualitative review of the literature in the area. Torkzadeh and Gemoets (1998-1999) found a high correlation between IT and "task productivity," which was checked among a variety of applications including those for engineering, accounting, desktop publishing and human resources. Productivity, then, in this study, was defined quite differently than it was in the study by Saunders and Miranda (1998). Saunders and Miranda found that GSS groups are significantly different than traditional groups to the extent that they accessed information, which is a sign of productivity. In their study, GSS groups accessed information a mean of 29 times, compared with a mean of 17 times for traditional face-to-face groups.

Table 1. Knowledge of IT and Productivity

Study Name	P (study)	Z (individual)	N (sample)	Effect Size (r)	Z r
Yoon and Guimaraes (1995)	0.05	1.645	69	0.198	0.201
Torkzadeh and Gemoets, 1998-1999	0.01	2.325	332	0.128	0.128
Saunders and Miranda, 1998	0.0001	3.680	179	0.275	0.282
Fedorowica and Vileneuve, 1999 (shortening the learning curve)	0.001	3.092	228	0.205	0.208
Fedorowica and Vileneuve, 1999 (save development time)	0.001	3.092	228	0.205	0.208
Z avg =		2.767			
Number of Studies		k =	5		
Combined Effect				0.430	0.459
Level of Significance					6.187
		p <	0.0001		
Degrees of Freedom (k - 1) =			4		
Level of Heterogeneity		$\chi^2 =$	2.499		
		p <	0.593		

Knowledge of IT and Individual Job Satisfaction

The 1995 study by Yoon and Guimaraes investigated the impact of expert systems on users' jobs. Among other findings, the research found that certain user characteristics, or user knowledge of expert systems, would have an effect on user jobs. The study also looked at usage, finding that usage alone is not enough to guarantee satisfaction, but that usage must be combined with knowledge to achieve satisfaction. Because the Igarria and Tan (1997) and Torkzadeh and Gemoets studies cited above did not specifically investigate relationships between IT and job satisfaction, the Yoon and Guimaraes research was the sole investigation into this relationship. Therefore, a meta-analysis could not be conducted. However, based solely on the Yoon and Guimaraes study, it appears that there is a relationship between knowledge of IT and users' job satisfaction. This finding must obviously be considered as only tentative.

Usage of IT and Individual Satisfaction with IT

Meta-analysis results indicated that usage of IT is positively related to user satisfaction with IT ($Z = 4.330$) (Table 2). These results were found to be statistically significant. The effect size for this particular relationship, according to Cohen (1977), fell into the medium size range. The results across studies were found to be consistent. This is interesting, in view of the divergence in the studies analyzed. Igarria and Tan (1997) found system usage affecting individual satisfaction, but not to the degree that they found the converse – individual satisfaction affecting usage. McKeen, Guimaraes and Wetherbe (1994) found that user participation has a significant positive relationship with user satisfaction. They reported that this result was slightly stronger than earlier research. Contradictorily, Lee, Kim and Lee (1995) did not find that knowledge or acceptance of IT had a significant direct effect on an individual's satisfaction, although they did find an indirect relationship.

Table 2. Usage of IT and Satisfaction with IT

Study Name	p (study)	Z (individual)	N (sample)	Effect Size (r)	Z r
Igarria and Tan	0.09	2.365	371	0.123	0.123
Khalil and ElKordy, 1999	0.01	2.325	120	0.212	0.216
Lee, Kim nad Lee J., 1995	0.05	1.645	236	0.107	0.107
McKeen, Guimaraes and Wetherbe, 1994	0.01	2.325	151	0.189	0.192
Z avg =		2.165			
Number of Studies		k =	4		
Combined Effect				0.309	0.319
Level of Significance					4.330
		p <	0.0001		
Degrees of Freedom (k - 1) =			3		
Level of Heterogeneity		$\chi^2 =$	0.362		
		p <	0.9487		

CONCLUSIONS

Although the present research was somewhat limited by the research studies we uncovered in the area, sufficient studies were available to provide some insights into IT's impact on individuals. These insights were derived by quantitatively synthesizing available research in the area. It appears that knowledge of IT impacts individual productivity, with the implication that businesses should provide employees with the training to become more knowledgeable in IT. Because many systems require a sizeable investment, an important consideration will often be whether it is likely that the investment will provide a satisfactory return on the investment. A strong link between IT and productivity helps allay this concern.

Additional research is necessary to determine with more certainty the effect of IT on individual job satisfaction. It is safe to say that the effect of IT on job satisfaction will become a stronger issue as U.S. labor markets remain tight and employers must not only recruit and hire new employees, but also must do those things necessary to retain employees.

Finally, the study leads to the conclusion that IT usage does result in satisfaction with IT, although the strength of that satisfaction may vary. This implies that, with proper training and the requirement that employees use IT, employees should lead to satisfaction with the IT. This finding is especially important in view of the

fact that it is derived, through the use of meta analysis, by resolving some inconsistencies that are present in the existing literature.

Concerns of how IT effects individuals will continue to grow in importance in the coming years as employers become more concerned about maintaining their workforces. Also, as more small businesses use IT, software vendors will likely become more concerned about how their product will be perceived by small business owners. In the long run this will increase productivity and increase employee satisfaction with their IT systems. This is especially important if businesses wish to survive and flourish in this digital economy. More research, however, needs to be done to demonstrate whether or not knowledge of IT is related to job satisfaction.

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