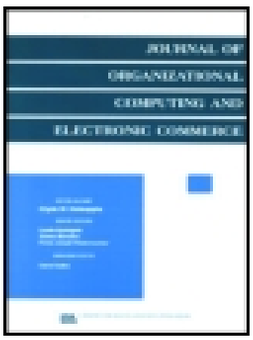

Journal of Organizational Computing and Electronic Commerce

ISSN: 1091-9392 (Print) 1532-7744 (Online) Journal homepage: https://www.tandfonline.com/loi/hoce20

Factors Affecting Information Technology Usage: A Meta-Analysis of the Empirical Literature

Mo Adam Mahmood , Laura Hall & Daniel Leonard Swanberg

To cite this article: Mo Adam Mahmood , Laura Hall & Daniel Leonard Swanberg (2001) Factors Affecting Information Technology Usage: A Meta-Analysis of the Empirical Literature, Journal of Organizational Computing and Electronic Commerce, 11:2, 107-130, DOI: 10.1207/S15327744JOCE1102_02

To link to this article: https://doi.org/10.1207/S15327744JOCE1102_02

Published online: 18 Nov 2009.

JOURNAL OF ORGANIZATIONAL COMPUTING
AND ELECTRONIC COMMERCE *11*(2), 107–130 (2001)

Factors Affecting Information Technology Usage: A Meta-Analysis of the Empirical Literature

Mo Adam Mahmood
Laura Hall
Information and Decision Sciences Department
University of Texas at El Paso

Daniel Leonard Swanberg
American Hospital Supply Corporation
El Paso, Texas

With an estimated investment of over 1 trillion dollars to date on information technology (IT) products and applications, one would hope that there exists a corresponding improvement in organizational performance and productivity. The level of IT usage has widely been accepted as an important indicator of IT success within organizations. This research synthesizes and validates the construct of IT usage using a meta-analysis. It accomplishes that by analyzing the empirical results of various studies over a period of time covering a broad scope of characteristics of both users and information systems (IS), and it examines the relation between these characteristics and the level of IT usage within organizations. In general, the results of this meta-analysis lead to the conclusion that there exists a strong and significant positive relation between the perception of ease of use and the perceived usefulness of an IT system to the actual amount of usage. Another factor that indicates a high level of IT usage is the organizational support of IT within an enterprise. Although the factors of education level, training level, and professional level were found to have a substantial effect on IT usage, the magnitude of these effects were lower than those of the perceptions of the user and organizational support. Managers and IT professionals may have a better chance of avoiding IT system ineffectiveness and even failure by paying attention to the results of this research, especially in view of the fact that it synthesized and validated the results of a significant number of empirical studies published in some of the best IS journals. Rarely do single research experiments provide definitive answers on which to base policy decisions.

information technology (IT) usage construct, meta-analysis, ease of use, perceived usefulness, organizational support

Correspondence and requests for reprints should be sent to Mo Adam Mahmood, Information and Decision Sciences Department, University of Texas, El Paso, TX 79968. E-mail: mmahmood@mail.utep.edu

1. INTRODUCTION

The availability of information technology (IT) within organizations, over the last two decades, has increased tremendously. The rapid growth of the personal computer industry, substantial decreases in computer unit costs, and simultaneous increases in computer power and speed have made vast amounts of information readily available to individuals in organizations. This proliferation of IT products (hardware, software, and communication technology) and applications has been experienced by most organizations and has been increasingly researched in the past.

IT success can have a profound impact on organizational success. With an estimated investment of over 1 trillion dollars to date on IT products and applications, one would hope that there exists a corresponding improvement in organizational performance and productivity. The level of IT usage (voluntary and discretionary), according to DeLone and McLean [1], has been one of the most frequently proposed and accepted measures of IT success within an organization. Snitkin and King [2], for example, found a direct relation between usage and success of an IS. A number of researchers [3–10] have also utilized IT usage as a key component for developing their theoretical model.

The past empirical research studies relating to IT usage fall into four general categories. The first group deals with the actual amount of individual use of an IT system based on the individual's perception of the convenience and usefulness that the system provides in performing his or her job [1]. The level of perceived usefulness and perceived ease of use may be measured irrespective of the type of IT products and applications under consideration. The second category studies the characteristics of the individual end users themselves and the degree to which they employ IT systems [1]. The third type explores, based on the level of maturity of IT systems within an organization, the increased use of specific types of IT applications such as expert systems [11], whereas the fourth focuses on the characteristics of the organizations themselves such as size of the organization and to what level does the organization and its management support the implementation and use of IT systems [12].

The purpose of this research is to synthesize and validate the construct of IT usage. It accomplishes that by analyzing the empirical results of various studies over a period of 15 years (1984 to 1999), covering a broad scope of characteristics of both users and IS, and it examines the relation between these characteristics and the level of IT usage within organizations. The meta-analysis method is employed to gather and combine the results of a number of independent research studies measuring various factors affecting IT usage within organizations over the time period of the study. Combining the results of these studies becomes challenging in view of the fact that some studies have been focused on only a specific type of IT application, such as spreadsheets or graphics programs. Other studies concentrate on the attitudes and characteristics of the individual end users. Yet, other studies have analyzed only the characteristics of the organizations themselves, but no single study, to our knowledge, has yet combined all of these factors to synthesize and validate a comprehensive construct of IT usage. Combining a divergent set of results from a number of studies becomes even more arduous in view of the fact that not all the

studies agree on the effects of identified factors and their impact on IT usage. Some of the studies yield contradictory results associated with some of the factors.

The most overriding and important reason for developing and validating IT usage construct is that IT usage is an important driver of IT success within organizations. By developing a better understanding of the factors affecting IT usage, strategic managers should be able to shape policies within their organizations to maximize the effectiveness of their efforts to stimulate IT usage and in the process increase organizational performance and productivity. The main theoretical reason for undertaking the study is that it takes the management IS discipline a step closer to validating the IT usage construct. Historically, IS research suffered from unclear conceptualizations and validations of the constructs [13].

This research is organized as follows: The next section puts forth the propositions and the conceptual framework for organizing the variables, drawing on relevant literature in the area. The Method section describes the methodology used in the research. The Results section provides the results of the quantitative analysis. The Discussion section discusses these results. This is followed by limitations of this study. The final section concludes the manuscript by providing the implications of the results for future research and practice.

2. RESEARCH MODEL AND HYPOTHESES

This research investigates various dimensions of IT usage because it is an important driver of IT success within organizations. It is, therefore, important to understand how the various factors across many diverse research studies affect the IT usage. The literature in the area reveals that the factors affecting IT usage fall into four major categories: perceived convenience and benefits, individual user characteristics, organizational IT maturity level, and organizational structural characteristics. These are discussed in detail with literature support in what follows.

The literature in the area also identifies 11 measured attributes that have been classified into one of each of the aforementioned factors. The dimensions of perceived ease of use and perceived usefulness, for example, represent the job-related perceived benefits that the individual user believes will follow through the use of a specific IT system, which then affect the usage level of that system. The second category of factors include characteristics of the individual users themselves including education level, professional level, IT skill, IT training, and attitude toward IT systems. These attributes are seen to be indicators of an individual user's propensity to use IT systems. These first two categories are related in that they measure the affect of individuals on the level of IT use within an organization.

The third category of factors includes the IT maturity level of the organization and the level of strategic IT applications already employed by the organization. These dimensions are seen as indicative of an organization's demonstrated historical reliance on IT and potentially predictive of future IT usage. The last dimension consists of the organizational characteristics such as size and existing organizational support for IT. These are postulated to be indicators of an organization's readiness to use IT and, therefore, predictive of IT usage levels. These last two cate-

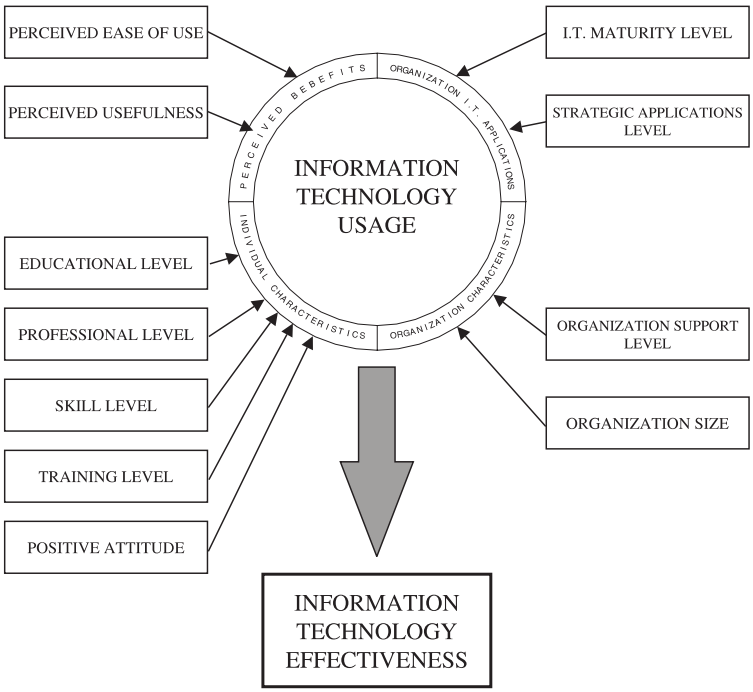

Figure 1. Combined model of information technology (IT) usage and IT effectiveness.

gories are related in that they measure the affect of organizational characteristics on the level of IT use.

The aforementioned attributes and the related factors are synthesized into a theoretical model for grounding this research (see Figure 1). The research model depicts the dimensions of IT usage and their effects on the level of IT success within organizations. The model derives its theoretical foundations from prior research in IT usage and effectiveness.

2.1 Perceived Benefit for the Individual User

The improved ease and convenience of use, both in applications software and systems software, have been found in the literature to correlate to the increasing use of systems. According to a number of researchers, perceived ease of use has a significant effect on intentions to use a specific system [6, 14, 15,]. Jackson et al. [16] and Bajaj and Nidumolu [17], on the other hand, found no relation between ease of use and perceived system usage. Availability of computers and standard software packages such as spreadsheets, databases, and wordprocessors have also been determined to have an impact on both the time and frequency with which IT systems are used by individuals. Vlahos and Feratt [18], based on a research conducted in Greece, indicated that the availability of cost-effective microcomputers is a major factor in increased use. The use of chargeback systems also led to improved efficiency and more active end user involvement [19].

Evidence in the literature mostly suggests that there is a link between the usefulness of a software and its usage. Adams et al. [20] and Szajna [9], for example,

found that usefulness is an important determinant of system use. Barki and Hartwick [21] observed that perceived usefulness is correlated positively to involvement and participation. Igbaria et al. [22] and Davis et al. [6] provided substantial support for the proposition that perceived usefulness is the main motivator of increased use of IT. It is interesting to note that some of the latter studies in the area by Jackson et al. [16] and Bajaj and Nidumolu [17] found no relation between ease of use and perceived system usage.

Some researchers analyzed the relation between perceived effectiveness and usage for specific types of IS. Snitkin and King [2], for example, found that a greater usage is indeed associated with greater perceived effectiveness in their research on personal decision support systems. Lehman & Murthry [23] investigated the perception of usefulness of the specific IT application of business graphics and found the relation between the perceived usefulness and use to be positive. This leads to the first two hypotheses:

H1: Individuals within organizations will increase their usage of IT systems in direct proportion to the perceived ease of use of these systems.

H2: Individuals within organizations will increase their usage of IT systems in direct proportion to the perceived usefulness of these systems.

2.2 Characteristics of Individual IT Users

The question of what motivates particular types of end users to utilize computers has been studied with interesting results that appear to depend on psychological factors of various groups of individuals. Igbaria et al. [22], for example, found that factors such as perceived enjoyment and fun, along with social pressures, were key in determining the level of usage. Training, skill level, and organizational support were also found to be significant factors in this study. Igbaria et al. [24] agreed that perceived fun and usefulness will have a positive effect on the use of IT, but note also that individuals may be somewhat unwilling to use systems if they are unfamiliar with the technology. They also established that acceptance increases with educational level. Howard and Mendelow [25] and Chan and Storey [26] uncovered that training-based skill levels impacted usage levels.

Three studies, performed several years apart, revealed that education and training in IT use is a positive motivating factor in actual increase of usage [27, 28]. Similar results were also uncovered in other countries including Taiwan [29] and Finland [24]. Only one study by Rai and Patnayakuni [30] found no relation between training level and IT usage.

On the other hand, acceptance and usage tends to fall dramatically the higher the professional level of an individual within the organization. The most interesting factor discovered in these and other studies by Lee [31], Mahwhinney and Lederer [32], and Tillquist [33] is that, although IT usage declined in general with higher levels in the organization, those at highest levels of organizations reported virtually no IT usage.

Evidence in the literature mostly suggests that there is a relation between IT usage and the user attitude toward IT systems. Howard and Mendelow [25] and

Culpan [34], for example, found that the attitudes of end users toward computer usage has an impact on usage level. Hartwick and Barki [35] uncovered that the use of a system is strongly influenced by users' intentions to use the system as determined by their attitude toward the system. Lee et al. [36] unearthed significant correlations between IT systems usage and the user acceptance of these systems. This leads to Hypotheses 3 through 7:

H3: IT systems usage increases in direct proportion with higher educational level of the individual user.

H4: IT systems usage increases inversely proportional to the professional level of the individual user.

H5: IT systems usage increases with higher levels of computer related skills of the individual user.

H6: IT systems usage increases with greater amounts of computer system related training of individuals within organizations.

H7: IT systems usage increases with higher levels of positive attitude of the user toward IT systems.

2.3 Organizational IT Maturity and Strategic Applications

As organizations themselves gain experience with the use of IT, a stronger propensity to use IT may be found. Increased usage of specific types of IT systems have also emerged in organizations as IT systems have matured. A type that has increased significantly in recent years is the use of video conferencing systems [37]. Another type that has grown steadily since its inception is e-mail [38]. Much less widespread, but still significant, is the use of supercomputing by corporations [39]. Expert systems are another type of specialized systems that have come into use in a substantial percentage of organizations. In researching their usage, Coakes and Merchant [11] found that, "A factor that did affect usage was the maturity of computer usage within the organization" (p. 230). Based on research that studied the usage of database management systems in 288 Fortune 500 companies, Grover and Teng [40] stated that a positive relation between the age of IS in organizations and usage exists.

The term *IT system maturity* itself has been defined differently in various studies. Boynton et al. [41] defined it in terms of an organization's "high level knowledge." Fisher et al. [42] used the term *structure* to indicate the level of technical infrastructure and sophistication within an organization that correlated to increased levels of microcomputer adoption. Jih and Park [43] used the level of a firm's management information systems (MIS) evolutionary stage as an indicator of IS maturity. VanLengen and Morgan [19] found a positive relation between the maturity level of IT in organizations and the usage level of most types of IT applications, except for the use of IT systems for strategic management, which had a significant nega-

tive relation. Paramount in this category are systems designed for the strategic and competitive use of IT. King and Teo [12] defined such a system as follows: "An IT application is strategic if it changes a firm's product or the way a firm competes in its market industry." The major areas found to help an organization's decision-making process included alignment with business planning, competitive pressure, and management vision and support. Liberatore and Stylianou [44] identified the Strategic Market Assessment System as a significant management decision-making tool. Extejt and Lynn [45] uncovered extensive use of various software systems utilized by union and management negotiators in collective bargaining decision making. Szajna [46] correlated IT usage to actual decision performance and found a positive correlation between the two. Raymond [47] determined that in firms that implement a greater number of administrative applications, users tend to utilize IT more. These lead to Hypotheses 8 and 9:

H8: The proliferation of the use of IT systems employed by an organization increases with the level of maturity of these systems.

H9: Organizations that focus on IT systems for strategic applications rely increasingly on specific IT applications for decision-making purposes.

2.4 Organization Characteristics and IT System Usage

Existing characteristics of organizations prior to implementation of an IT application can have an impact on the level of IT systems use. These include organization size and the level of organizational support for IT systems. Schiffman et al. [28] found organizational support, among other factors, affecting system usage. Igbaria et al. [14] determined that management support had a significant effect on system usage. Baroudi et al. [48] found that organizational support had a direct effect on the use of microcomputers. Igbaria et al. [49] and Fisher et al. [42] also corroborated the importance of management support in the user acceptance of microcomputer technology. Iacovou et al. [50] uncovered a moderately strong relation between organizational readiness and electronic data interchange (EDI) use. On the other hand, Rai and Patnayakuni [30] found no significant relation between top management support for IS function and computer-aided software engineering (CASE) adoption behavior.

Grover and Teng [40] indicated that a positive relation exists between organizational size and the use of a system. Fisher et al. [42] found organizational size as a significant predictor of microcomputer usage. Zeffane [51] revealed that organizations with high usage profile tend to be large and privately owned. Iacovou et al. [50] stated that a large number of smaller organizations lack organizational readiness to use EDI systems. Jih and Park [43] unearthed the fact that the level of contribution of MIS to a firm's success seems to be related to the size of the firm. Coakes and Merchant [11] and Raymond [47], on the other hand, found that organizational size had little significance as a factor affecting IT usage. This leads to Hypotheses 10 and 11:

H10: IT systems usage in organizations increases with an increase in the level of organizational support for these systems.

H11: IT systems usage in organizations increases with greater levels of size of the organization.

3. METHOD

3.1 Meta-Analysis

Meta-analysis is a statistical technique for combining the results of independent studies [52–54]. Meta-analysis has been applied to literature in the social sciences [55], general management [56], and IS [57]. The meta-analysis approach was chosen for this research for several reasons: First, it is the analysis of analyses (in other words, 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 from an individual participant. Rarely do single experiments provide sufficiently definitive answers on which to base policy decisions [53]. Third, a meta-analysis can also include studies over a large time and scope, potentially validating the factors over time. Last, because technology changes over time, the impact of factors at various stages of technological development can be combined.

3.2 Sampling Procedure

The research covers the empirical studies conducted in the IT usage area over the period from 1985 to 1999. An exhaustive electronic search using ABI/INFORM was conducted of a number of sources of research studies in the area, including *Communications of the ACM, Information Systems Research, Information & Management, Human Computer Interactions, Journal of Computer Information Systems, Journal of Management Information Systems, MIS Quarterly, Management Science, Decision Sciences, Academy of Management Journal, IEEE Transactions of Software Engineering, Organization Science, and Harvard Business Review.* Each of these journals (with the exception of *Human Computer Interactions,* which is rated as 23rd, and *Journal of Computer Information Systems,* which is rated as 27th) was rated as 1 of the top 20 research journals in a fairly recent survey by Hardgrave and Walstrom [58]. The remaining top 20 journals were also searched, but no relevant studies on IT usage were found in these journals.

When selecting studies for the meta-analysis, the following criteria were used: (a) empirical studies that measured the effect of one or more of the factors analyzed in this meta-analysis, (b) studies published between 1985 and 1999, (c) studies reporting only quantitative data analysis, and (d) studies reporting the significance level of the data. Studies were excluded if they were known to be drawn from the same data set as another study that has already been included in the analysis. Most of these criteria were dictated by the meta-analysis and, as such, also played a significant role in the selection of the aforementioned journals.

3.3 Coding Procedure

A total of 85 studies were identified in the literature search. Of these, 28 were eliminated because their data did not satisfy one or more of the aforementioned criteria. The remaining 57 studies with data pertaining to the hypotheses tested are included

in this research. For each relation, the corresponding relation that was analyzed, the one-tailed p values, and the number of participants in each study were recorded in Tables 1 through 11. According to Rosenthal's [54] guidelines, when results were reported as "not significant", a p level of .50 and a Z of 0.00 were recorded.

3.4 Analysis Procedure

For each p value in Tables 1 through 11, an associated standard normal deviate score (Z) was also tabulated. The individual Z values were obtained from the table entitled "Areas in One Tail of the Normal Curve at Selected Values" in Croxton [59]. Using these values, the effect size r was estimated for each effect of interest using a method described by Rosenthal [54]. Then, a table entitled, "The Transformation Z for the Correlation Coefficient," in Beyer's [60] 1991 book, *CRC Standard Probability and Statistics Tables and Formulae,* was used to determine the individual Z_r for each study testing a specific relation. To determine the overall level of significance and size of the relation, the combined Z_r and effect size, r, were then calculated using Stouffer's method described in Rosenthal [54].

With these values, three aspects of each relation were tested. First, the overall effect level was checked. The following guidelines were used to classify effect size: large for $r > .50$, medium for $.10 < r < .50$, and small for $r < .10$ [61]. Second, the overall significance level was determined using the individual Z data [54]. Last, the heterogeneity of the data set was measured using chi-square values calculated from the individual Z data [62]. The significance of the chi-square values was determined using p values from Table 3, "Statistical Methods for Research Workers," in Fisher [63].

4. RESULTS

This section presents the meta-analysis results on various effects investigated in this research. More specifically, it provides information on how large and how significant are these effects, and it also provides information on the degree of heterogeneity among the Z scores and effect sizes.

4.1 Results on Perceived Ease of Use

Table 1 shows the tabulated results regarding the perceived ease of use. Sixteen studies measured the effect of perceived ease of use on the amount of usage of IT systems. These studies estimated the amount of IT usage by time and/or frequency of computer use. Where both were indicated, only the time data was recorded in this analysis. The combined normal standard deviate of these studies is $Z = 9.132$. The combined effect size is $r = .678$, a large effect size according to Cohen [61]. The level of significance for the individual study Z data is $p < .0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2(15, N = 16) = 6.052, p < .94$.

4.2 Results on Perceived Usefulness

Table 2 shows the tabulated results regarding perceived usefulness. Twenty-six studies measured the effect of perceived usefulness on the amount of usage of IT

Table 1
Perceived Ease of Use and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Adams, Nelson, & Todd, 1992 (e-mail)	.001	3.092	116	0.287	0.295
Adams, Nelson, & Todd, 1992 (spread sheets)	.100	1.282	73	0.150	0.151
Adams, Nelson, & Todd, 1992 (voice mail)	.001	3.092	68	0.375	0.394
Adams, Nelson, & Todd, 1992 (word processing)	.010	2.325	73	0.272	0.279
Adams, Nelson, & Todd, 1992 (graphics)	.100	1.282	73	0.150	0.151
Davis, Bagozzi, & Warshaw, 1989	.010	2.325	107	0.225	0.229
Davis, 1989	.001	3.092	184	0.228	0.232
Davis, 1989	.001	3.092	80	0.346	0.183
Davis, Guimares, & Igbaria, 1995	.010	2.325	107	0.225	0.229
Davis, Guimares, & Igbaria, 1995	.001	3.092	105	0.302	0.311
Gelderman, 1998	.032	1.855	212	0.181	0.183
Igbaria, Iivari, & Maraggah, 1995	.001	3.092	450	0.146	0.147
Igbaria, Zinatelli, Cragg, & Cavaye, 1997	.050	1.645	358	0.087	0.087
Jackson, Chow, & Leitch, 1997	.050	1.645	111	0.156	0.157
Szajna, 1996	.050	1.645	61	0.211	0.214
Taylor & Todd, 1995	.050	1.645	786	0.059	0.059
Z average		2.283			
No. of studies (*k*)			16		
Combined effect				0.678	0.825
Level of significance					9.132**
Degrees of freedom ($k - 1$)			15		
Level of heterogenity (χ^2)			7.564*		

*$p < .94$. **$p < .0001$.

systems. Some studies calculated the amount of IT usage by time and/or frequency of computer use. Other studies used the amount of chargeback or the number of different tasks completed as indicators of IT usage. The combined normal standard deviate of these studies is $Z = 12.409$. The combined effect size is $r = .798$, a large effect according to Cohen [61]. The level of significance for the individual study Z data is $p < .0001$. The Z scores were not found to be significantly heterogeneous, $\chi^2(29, N = 30) = 24.174$, $p = .72$.

4.3 Results on the Educational Level of the User

Table 3 shows the tabulated results regarding the educational level of the user. Eight studies measured the effect of the level of completed years of education of the individual on the amount of usage of IT systems. The studies assessed the education level by completed levels of traditional education, high school, bachelors degree, masters degree, and doctorate degree. The combined normal standard deviate of these studies is $Z = 4.566$. The combined effect size is $r = .314$, a medium effect according to Cohen [61]. The level of significance for the individual study Z data is $p <$

Table 2
Perceived Usefulness and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Adams, Nelson, & Todd, 1992 (e-mail)	.0010	3.092	116	0.287	0.295
Adams, Nelson, & Todd, 1992 (spread sheets)	.0100	2.325	73	0.272	0.279
Adams, Nelson, & Todd, 1992 (voice mail)	.0010	3.092	68	0.375	0.394
Adams, Nelson, & Todd, 1992 (word processor)	.5000	0.000	73	0.000	0.000
Adams, Nelson, & Todd, 1992 (graphics)	.5000	0.000	73	0.000	0.000
Bajas and Nidumolu, 1998	.5000	0.000	100	0.000	0.000
Davis, Bagozzi, & Warshaw, 1989	.0010	3.092	107	0.299	0.308
Barki & Hartwick, 1994	.0010	3.092	127	0.274	0.282
Igbaria, Baroudi, & Parasuraman, 1996	.0010	3.092	471	0.142	0.143
Davis, 1989	.0010	3.092	184	0.228	0.232
Davis, 1989	.0010	3.092	80	0.346	0.361
Davis, Guimares, & Igbaria, 1995	.0010	3.092	107	0.299	0.308
Davis, Guimares, & Igbaria, 1995	.0010	3.092	105	0.302	0.311
Vlahos & Ferrat, 1995	.5000	0.000	55	0.000	0.000
Liken, Fleischer, Nagamichi, & Zonneyville, 1992	.0010	3.092	190	0.224	0.228
Liken, Fleischer, Nagamichi, & Zonneyville, 1992	.0100	2.325	105	0.227	0.231
Franz & Robey, 1986	.0020	2.879	118	0.265	0.272
McKeen, Guimares, & Wetherbe, 1994	.0010	3.092	151	0.252	0.257
Thompson, Higgins, & Howell, 1994	.0050	2.575	219	0.174	0.176
Igbaria, Parvi, & Huff, 1989	.0010	3.092	471	0.142	0.143
Igbaria, Iivari, & Maraggah, 1995	.0010	3.092	450	0.146	0.147
Jackson, Chow, & Leitch, 1997	.5000	0.000	111	0.000	0.000
Snitkin & King, 1986	.0500	1.645	56	0.220	0.223
Lehman & Murthy, 1989	.0100	2.325	300	0.134	0.135
Taylor & Todd, 1995	.0500	1.645	786	0.059	0.059
Szajna, 1996	.0100	2.325	61	0.298	0.307
Satzinger & Olfman, 1995	.0001	3.710	153	0.300	0.309
Srinivasan, 1985	.1000	1.282	29	0.238	0.243
Igbaria, Zinatelli, Cragg, & Cavaye, 1997	.0500	1.645	358	0.087	0.087
Igbaria, Iivari, & Maraggah, 1995	.0010	3.092	158	0.246	0.251
Z average		2.266			
No. of studies			30		
Combined effect				0.798	1.092
Level of significance					12.409**
Degrees of freedom ($k - 1$)			29		
Level of heterogenity (χ^2)			24.174*		

*$p < .72$. **$p < .0001$.

Table 3
Education Level and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Nelson & Cheney, 1987	.010	2.325	100	0.233	0.237
Igbaria, Parvi, & Huff, 1989	.050	1.645	471	0.076	0.076
Igbaria, 1992	.100	1.282	86	0.138	0.139
Schiffman, Meile, & Igbaria, 1992	.050	1.645	212	0.113	0.113
Igbaria, Iivari, & Maraggah, 1995	.001	3.092	450	0.146	0.147
Mawhinney & Lederer, 1990	.500	0.000	105	0.000	0.000
Lee, 1986	.100	1.282	311	0.073	0.073
Satzinger & Olfman, 1995	.050	1.645	153	0.133	0.134
Z average		1.615			
No. of studies			8		
Combined effect				0.314	0.325
Level of significance					4.566**
Degrees of freedom ($k - 1$)				7.000	
Level of heterogenity (χ^2)				5.518*	

*$p < .599$. **$p < .0001$.

.0001. The *Z* scores were not found to be significantly heterogeneous, $\chi^2(7, N = 8) = 5.518$, $p = .599$.

4.4 Results on the Professional Level of the User

Table 4 shows the tabulated results regarding the professional level of the user. Seven studies measured the effect of the professional level of the user on the amount of usage of IT systems. These studies used the level of management within the organization as the indicator of the professional level of the user. The amount of usage was measured by various indicators of time or frequency of use. The correlations were tested in an inverse relation, that is, the higher the level within the organization of the user, the less the amount of IT usage was measured. The combined normal standard deviate of these studies is $Z = 5.297$. The combined effect size is $r = .398$, a medium effect according to Cohen [61]. The level of significance for the individual study *Z* data is $p < .0001$. The *Z* scores were found to be slightly heterogeneous, $\chi^2(7, N = 8) = 12.15$, $p = .097$.

4.5 Results on the Skill and/or Experience Level of the User

Table 5 shows the tabulated results regarding the skill and/or experience level of the user. Ten studies measured the effect of the computer-related skill or experience level of the user on the amount of IT systems usage. These studies used number of years of systems experience or self-reported skill level of the individual user as the indicator of the skill or experience level of the user. The amount of usage was measured by self-reported indicators of time or frequency of use. The combined normal standard deviate of these studies is $Z = 8.596$. The combined effect size is $r = .572$, a large effect according to Cohen [61]. The level of significance for the individual

Table 4
Professional Level and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Boynton & Zmud, 1994	.001	3.092	132	0.269	0.276
Vlahos & Ferrat, 1995	.050	1.645	55	0.222	0.226
Franz & Robey, 1986	.110	1.222	118	0.112	0.113
Igbaria, Parvi, & Huff, 1989	.001	3.092	471	0.142	0.143
Igbaria, 1992	.100	1.282	86	0.138	0.139
Mawhinney & Lederer, 1990	.500	0.000	66	0.000	0.000
Tillquist, 1996	.041	1.735	73	0.203	0.206
Lee, 1986	.010	2.325	311	0.132	0.133
Z average		1.799			
No. of studies			8		
Combined effect				0.411	0.437
Level of significance					5.089**
Degrees of freedom ($k - 1$)				7.000	
Level of heterogenity (χ^2)				7.485*	

*$p < .37$. **$p < .0001$.

Table 5
Skill Level and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Baroudi, Igbaria & Parasuraman, 1996	.001	3.092	471	0.142	0.143
Baroudi, Olson, & Ives, 1986	.050	1.645	200	0.116	0.117
Chan & Storey, 1996	.010	2.325	256	0.145	0.146
Nelson & Cheney, 1987	.050	1.645	100	0.165	0.166
Davis, Guimares, & Igbaria, 1995	.001	3.092	107	0.299	0.308
Davis, Guimares, & Igbaria, 1995	.001	3.092	105	0.302	0.311
Howard and Mendelow, 1991	.001	3.092	422	0.151	0.152
Thompson, Higgins, & Howell, 1994	.005	2.575	219	0.174	0.176
Igbaria, Parvi, & Huff, 1989	.001	3.092	471	0.142	0.143
Lee, Kim, & Lee, 1995	.010	2.325	236	0.151	0.153
Saleem, 1996	.006	2.536	60	0.327	0.340
Z average		2.592			
No. of studies			11		
Combined effect				0.572	0.650
Level of significance					8.596**
Degrees of freedom ($k - 1$)				10.000	
Level of heterogenity (χ^2)				3.440*	

*$p < .96$. **$p < .0001$.

Table 6
Training Level and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Chan & Storey, 1996	.050	1.645	256	0.103	0.103
Nelson & Cheney, 1987	.500	0.000	100	0.000	0.000
Howard & Mendelow	.010	2.325	422	0.113	0.114
Igbaria, Guimares, & Davis	.001	3.092	105	0.302	0.311
Liken, Fleischer, Nagamichi, & Zonneyville, 1992	.010	2.325	105	0.227	0.231
Igbaria, Parvi, & Huff, 1989	.010	2.325	471	0.107	0.108
Igbaria, 1992	.010	2.325	86	0.251	0.256
Rai & Patnayakuni, 1996	.225	0.755	405	0.038	0.038
Schiffman, Meile, & Igbaria, 1992	.050	1.645	212	0.113	0.113
Mawhinney & Lederer, 1990	.050	1.645	66	0.202	0.205
Z average		1.808			
No. of studies			10		
Combined effect				0.436	0.468
Level of significance					5.718**
Degrees of freedom ($k - 1$)				9.000	
Level of heterogenity (χ^2)				7.175*	

*$p < .63$. **$p < .0001$.

study *Z* data is $p < .0001$. The *Z* scores were not found to be significantly heterogeneous, $\chi^2(10, N = 11) = 3.440$, $p = .96$.

4.6 Results on the Level of Training of the User

Table 6 shows the tabulated results regarding the level of training of the individual user. Nine studies measured the effect of the amount of training of the user on the amount of usage of IT systems. These studies used a measurement of time spent in formal training for specific IT systems to gauge the level of training of the user. The amount of usage was measured by various indicators of time or frequency of use. The combined normal standard deviate of these studies is $Z = 5.718$. The combined effect size is $r = .436$, a medium effect according to Cohen [61]. The level of significance for the individual study *Z* data is $p < .0001$. The Z scores were not found to be significantly heterogeneous $\chi^2(9, N = 10) = 7.175$, $p = .63$.

4.7 Results on the Level of Positive Attitude of the User

Table 7 shows the tabulated results regarding the level of positive attitude of the individual user. Nine studies measured the effect of the level of positive attitude of the user on the amount of usage of IT systems. The level of positive attitude was measured through indicators of perceived enjoyment and general satisfaction with system quality. The amount of usage was measured by indicators of time or frequency of use. The combined normal standard deviate of these studies is $Z = 6.148$. The combined effect size is $r = .462$, a medium effect according to Cohen [61]. The level of significance for the individual study *Z* data is $p < .0001$. The Z scores were not found to be significantly heterogeneous, $\chi^2(12, N = 13) = 16.068$, $p = .19$.

4.8 Results on the Level of IT Maturity Within the Organization

Table 8 shows the tabulated results regarding IT systems maturity level within the organization. Seven studies measured the effect of the maturity level of the IT systems within the organization on the amount of usage of IT systems. The studies measured the maturity of IT systems by the amount of time the systems had been in place, the number of different types of IT applications employed by the organization, and also by the amount of IT tasks that were completed. The combined normal standard deviate of these studies is $Z = 7.399$. The combined effect size is $r = .500$, a medium effect according to Cohen [61]. The level of significance for the individual study Z data is $p < .0001$. The Z scores were found to be heterogeneous, $\chi^2(6, N = 7) = 2.294$, $p = .89$.

4.9 Results on the Strategic Applications of IT Within Organizations

Table 9 shows the tabulated results of the impact of strategic uses of IT systems. Eight studies measured the effect of the use of strategic applications on the amount of usage of IT systems. The studies measured the amount of IT usage by time and/or frequency of computer use. Where both were indicated, only the time data was recorded in this analysis. The combined normal standard deviate of these studies is $Z = 5.336$. The combined effect size is $r = .509$, a large effect according to Cohen [61]. The level of significance for the individual study Z data is $p < .0001$. The Z scores were found to be significantly heterogeneous, $\chi^2(8, N = 9) = 7.047$, $p = .53$.

Table 7
Positive Attitude of the Individual and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Davis, Bagozzi, & Warshaw, 1989	.0010	3.092	107	0.299	0.308
Bajaj & Nidumolu, 1998	.1000	1.280	100	0.128	0.129
Baroudi, Olson, & Ives, 1986	.0500	1.645	200	0.116	0.117
Howard & Mendelow,1991	.0010	3.092	422	0.151	0.152
Jackson, Chow & Leitch, 1997	.5000	0.000	111	0.000	0.000
Nelson & Cheney, 1987	.0500	1.645	100	0.165	0.166
Vlahos & Ferrat, 1995	.5000	0.000	55	0.000	0.000
Thompson, Higgins, & Howell, 1994	.5000	0.000	219	0.000	0.000
Schiffman, Meile, & Igbaria, 1992	0500	1.645	212	0.113	0.113
Lee, Kim, & Lee, 1995	.0010	3.092	236	0.201	0.204
Satzinger & Olfman, 1995	.0100	2.325	153	0.188	0.190
Taylor & Todd, 1995	0500	1.645	786	0.059	0.059
Saleem, 1996	.0034	2.705	60	0.349	0.365
Z average		1.705			
No. of studies			13		
Combined effect				0.462	0.500
Level of significance					6.148**
Degrees of freedom ($k - 1$)			12		
Level of heterogenity (χ^2)			16.068*		

*$p < .19$. **$p < .0001$.

Table 8
Information Technology Maturity Level of the Organization

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Baroudi, Igbaria, & Parasuraman, 1996	.0010	3.092	471	0.142	0.143
Boynton & Zmud, 1994	.0010	3.092	132	0.269	0.276
Coakes & Merchant, 1996	.0002	3.560	225	0.237	0.242
Franz & Robey, 1986	.0300	1.881	118	0.173	0.175
Goslar & Grover, 1993	.0100	2.325	154	0.187	0.190
Grover & Teng, 1992	.0000	3.300	288	0.194	0.197
Jih & Park,1993	.0100	2.325	106	0.226	0.230
Z average		2.796			
No. of studies			7		
Combined effect				0.500	0.549
Level of significance					7.399**
Degrees of freedom ($k - 1$)				6.000	
Level of heterogenity (χ^2)				2.294*	

*$p < .89$. **$p < .0001$.

Table 9
Strategic Applications and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Amini & Schooley, 1993	.500	0	210	0.000	0.00000
Boynton & Zmud, 1994	.010	2.325	132	0.202	0.20520
Coakes & Merchant, 1996	.001	3.092	225	0.206	0.20913
Fisher, Lind, & Zmud, 1989	.100	1.282	21	0.280	0.28742
King & Teo, 1994	.050	1.645	121	0.150	0.15068
King & Sabherwal,1991	.050	1.645	34	0.282	0.28998
Lockley, Newman, & Thornton, 1993	.100	1.282	100	0.128	0.12891
Raymond, 1985	.001	3.092	463	0.144	0.14470
Vanlengen & Morgan, 1993	.050	1.645	39	0.263	0.26977
Z average		1.779			
No. of studies			9		
Combined effect				0.509	0.56200
Level of significance					5.336**
Degrees of freedom ($k - 1$)				8.000	
Level of heterogenity (χ^2)				7.047*	

*$p < .53$. **$p < .0001$.

Table 10
Organizational Support and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Baroudi, Igbaria, & Parasuraman, 1996	.010	2.325	471	0.107	0.108
Boynton & Zmud, 1994	.001	3.092	132	0.269	0.276
Culpan, 1995	.000	3.710	239	0.240	0.245
Davis, Guimares, & Igbaria, 1995	.010	2.325	107	0.225	0.229
Davis, Guimares, & Igbaria, 1995	.050	1.645	105	0.161	0.162
Fisher, Lind, & Zmud, 1989	.010	2.325	21	0.507	0.559
Igbaria, Zinatelli, Cragg, & Cavaye, 1997	.050	1.645	358	0.087	0.087
Liken, Fleischer, Nagamichi, & Zonneyville, 1992	.050	1.645	105	0.161	0.162
Rai & Patnayakuni, 1996	.500	0.000	405	0.000	0.000
Schiffman, Meile, & Igbaria, 1992	.050	1.645	212	0.113	0.113
King & Teo, 1994	.010	2.325	121	0.211	0.215
Z average		2.062			
No. of studies			11		
Combined effect				0.572	0.650
Level of significance					6.839**
Degrees of freedom ($k - 1$)			10		
Level of heterogenity (χ^2)			10.155*		

*$p < .44$. **$p < .0001$.

4.10 Results on the Effects of Organizational Support Level on IT Use

Table 10 shows the tabulated results of the impact of organizational support levels on the individual use of IT systems. Nine studies measured the effect of organizational support level on the amount of usage of IT systems. The studies measured the amount of IT usage by time and/or frequency of computer use. Where both were indicated, only the time data was recorded in this analysis. The combined normal standard deviate of these studies is $Z = 6.839$. The combined effect size is $r = .572$, a large effect according to Cohen [61]. The level of significance for the individual study Z data is $p < .0001$. The Z scores were not found to be significantly heterogeneous, $\chi^2(10, N = 11) = 10.155$, $p = .44$.

4.11 Results on the Effects of Organization Size on IT Use

Table 11 shows the tabulated results of the impact of organizational size on the individual use of IT systems. Six studies measured the effect of organization size on the amount of usage of IT systems. The studies measured the amount of IT usage by time and/or frequency of computer use. Where both were indicated, only the time data was recorded in this analysis. The combined normal standard deviate of these studies is $Z = 3.732$. The combined effect size is $r = .543$, a large effect according to Cohen [61]. The level of significance for the individual study Z data is $p = .0015$. The Z scores were not found to be significantly heterogeneous, $\chi^2(7, N = 8) = 10.125$, $p = .18$.

Table 11
Organizational Size and Information Technology Usage

Study Name	*p Study*	*Z Individual*	*N (Sample)*	*Effect Size (r)*	*Zr*
Coakes & Merchant, 1996	.500	0.000	225	0.000	0.00000
Fisher, Lind, & Zmud, 1989	.010	2.325	21	0.507	0.55900
Franz & Robey, 1986	.030	1.879	118	0.173	0.17500
Goslar & Grover, 1993	.500	0.000	154	0.000	0.00000
Grover & Teng, 1992	.024	1.979	288	0.117	0.11700
Jih &Park,1993	.100	1.282	106	0.125	0.12500
Raymond, 1985	.500	0.000	464	0.000	0.00000
Zeffane, 1992	.001	3.092	24	0.631	0.74333
Z average		1.320			
No. of studies			8		
Combined effect				0.543	0.60800
Level of significance					3.732**
Degrees of freedom ($k - 1$)			7		
Level of heterogenity (χ^2)			10.125*		

*$p < .18$. **$p < .00015$.

5. DISCUSSION

To summarize the meta-analysis results, the usage of IT systems within an organization is strongly affected by the perceived usefulness of the system by the user, the perceived ease of use, skill level, and the level of positive attitude of the individual toward IT systems within the organization. These results were all statistically significant, and most showed a large combined effect size. In all cases, the results across studies were consistent. These results are congruous with the qualitative review of literature in the area. Igbaria et al. [22], for example, stated that "the data show that perceived usefulness has the strongest direct affect on usage" (p. 142).

The effect of individual characteristics such as educational level, training level, and professional level were also significant on IT system usage. Again, the results across studies were consistent. All the relations had a medium effect, although education effect had a direct relation to usage, whereas professional level, as expected, had an inverse relation. Therefore, although more educated individuals tend to use IT to a greater degree, the higher up the organizational ladder that individuals rise, the less they use IT systems. Again, the qualitative review of the literature in the area supports these findings. Igbaria et al. [27] reported that more educated individuals used microcomputers more often and more extensively. They also found that higher level professionals used microcomputers for the same applications but fewer hours. Mawhinney and Lederer [32] found that managers with smaller spans of control used PCs more than managers with larger spans of control. Vlahos and Ferratt [18] revealed that first line supervisors had twice the amount of use as that of mid-level and top-level managers.

The usage of IT systems in organizations is also affected by the organizational characteristics such as IT maturity level, level of strategic applications, organizational support, and organization size. These results were all statistically significant,

and they all showed a large combined effect size. In all cases, the results across studies were consistent. These results are also consistent with the qualitative review of literature in the area. Igbaria et al. [22] found that in organizations where microcomputers are more available, individuals are more likely to exhibit increased usage. The studies by King and Teo [12] and King and Sabherwal [64] support the fact that organizations using IT systems for strategic applications demonstrate a strong effect on the level of IT usage. Igbaria et al. [22] noted that organizational support was highly important in promoting wider usage of microcomputer technology. They also found that organizational support can have a variety of forms including managerial encouragement, educational opportunities, and the availability of user-friendly software.

Ranking the factors analyzed in this meta-analysis by effect size showed four groupings of relative effect size with the highest being perceived usefulness, perceived ease of use, organizational support, and the skill level in that order. The factors with the lowest effect sizes are educational level, professional level, and training level. Strategic applications, organization size, IT maturity level, and positive attitude fall in the middle ground with closely grouped effect sizes (see Table 12).

The highest ranking factors appear to be those that have the most immediate impact on the individual in performing their daily tasks. Usefulness, ease of use, skill level, and organizational support can have a strong affect on an individual propensity toward use of IT systems. The middle level factors also have strong effect levels on usage, indicating the importance of these elements in stimulating IT usage. The lowest level effects are obviously less important than the others, indicating that educational level, professional level, and training level are less likely to result in increased IT usage.

As obvious from the earlier discussion, this research also investigated the heterogeneity of the effect of each of the 11 factors on IT usage across studies. It found all effects to be significantly heterogeneous. This implies that these studies were consistent and significant for the direction of these effects. This makes a strong case for the validity of these results.

Table 12
Relative Effect Sizes of Factors Affecting Information Technology Usage

Effect Size Rank	*Factor*	*Combined Effect Size*
1	Perceived usefulness	0.798
2	Perceived ease of use	0.678
3	Organizational support	0.572
4	Skill level	0.572
5	Organization size	0.543
6	Strategic applications	0.509
7	Information technology maturity	0.500
8	Positive attitude	0.462
9	Training level	0.436
10	Professional level	0.411
11	Education level	0.314
	Average effect size	0.527

6. LIMITATIONS

This research, just like any other empirical study, suffered from a number of limitations. First, the IT products and applications change quite frequently. Certain factors, such as the ease of use of an IT system, may have a different meaning in the minds of users in 1999 as compared to users being evaluated in 1985. A trend analysis may yield interesting results. Such an analysis is, however, beyond the scope of this research.

Second, this research was limited to a certain number of journals and publications and a finite number of empirical research studies. The study was also limited by the coding procedure utilized.

Third, limitations inherently occurred because of the differences in methods and techniques used by the researchers in conducting their studies. The various sample sizes were also an inherent limitation. There were differences in measurement methods among the research studies. Some used only time as an indicator of IT use, whereas others used time and frequency of use. Use was self-reported in some studies and measured by the researchers in others. Some utilized the laboratory approach in conducting their studies, whereas others employed the field approach.

7. CONCLUSIONS

In general, the results of this meta-analysis lead to the conclusion that there exists a strong and significant positive relation between the perception of ease of use and the perceived usefulness of an IT system to the actual amount of usage that will occur. Individual perceptions, therefore, can be considered the foremost driver of IT use in organizations. Another factor that indicates a high level of IT usage is the organizational support of IT within an organization. This suggests that organizations where management dedicates a high level of resources to support IT tend to foster a greater use of IT systems within that organization. Although the factors of education level, training level, and professional level were found to have a substantial effect on IT usage, the magnitude of these effects were lower than those of the perceptions of the user and organizational support. This suggests that, although these factors are important in promoting IT usage, they are probably not as powerful in driving this usage.

7.1 Directions for Further Research

A direction for future research would be to repeat this study 2 or 3 years in the future and compare the results with the results of this study. Another interesting direction would be to perform a trend analysis to find out how these factors have changed over time, and use the trend model to predict future drivers of IT systems usage. Studies could be segregated by time periods, and effect sizes for each factor could be estimated within each period and then compared to that factor's effect size in other periods.

7.2 Implications for Practitioners

This research, by combining and comparing effect sizes of the various factors analyzed in a large number of studies, validated the common perception that increased IT effectiveness in organizations is a result of increased IT usage. Managers and IT professionals could use the results of this research in planning and implementing new IT systems and evaluating existing IT systems. Managers, for example, may be well served to focus on enhancing the perceptions of the individual users in regards to usefulness and ease of use of the proposed IT systems. The high effect level of these factors indicate that the eventual usage and effectiveness level of a proposed IT system will be impacted by them. These factors may also be useful in evaluating existing IT systems.

Managers may employ a number of means to enhance the perceptions of the individual users. Research has shown that user participation and involvement in system development can increase user satisfaction [65]. Both theoretical [66] and empirical research [48] suggest that there is a link between system satisfaction and system usage. Managers should, therefore, get users involved as early as possible in the system design process. Proper user training is an important factor in enhancing the perceptions of the individual users in regards to usefulness and ease of use of the proposed systems [67]. User training should, therefore, be an important part in any system design and implementation. Managerial involvement also plays a significant role in enhancing perceptions of the individual users. Researchers observed a number of cases where systems failed because of the lack of a high-level sponsor and where they succeeded with such a champion [68]. Managers should, therefore, find a champion, preferably among themselves, for the proposed system.

The fact that organizational support and skill level demonstrated a relatively high effect level indicates the importance of establishing a solid base of support within the organizations to realize better usage and effectiveness of IT systems. Managers should then emphasize on placing sufficient resources to support IT systems and elevating the skill level of employees and maintaining a tangible commitment to ongoing support for such systems and employees.

On the other hand, areas of lesser importance to managers and IT professionals include educational level, training level, and professional level. Factors that made up the middle ground in terms of effect size included positive attitude, IT maturity, strategic applications, and organizational size. These factors, however, displayed a large enough effect size, indicating that they are important elements for managers and IT professionals to consider in advancing the use of IT systems. Practical implications from this analysis may include not assuming that the size of a large organization, by itself, will result in the provision of adequate resources to support IT systems usage and not placing degree requirements but emphasizing skills and training on the part of IT system users.

All too often, IT systems in organizations are selected based only on their technical performance and functional capabilities without regard to the perceptions of the users. Also, many times they are implemented and operated with less-than-sufficient levels of organizational support. Perhaps this is why many IT systems are substantially less effective than originally intended. Managers and IT professionals may have a better chance of avoiding IT system ineffectiveness, and even failure,

by paying attention to the results of this research, especially in view of the fact that it synthesized and validated the results of a group of studies. Rarely do single research experiments provide sufficiently definitive answers on which to base policy decisions.

REFERENCES

[1] W. H. DeLone and E. R. McLean, "Information systems success: The quest for the dependent variable," *Information Systems Research,* vol. 3, no. 1, pp. 60–94, 1992.

[2] S. Snitkin and W. King, "Determinants of the effectiveness of personal decision support systems," *Information & Management,* vol. 10, no. 5, pp. 83–89, 1986.

[3] H. C. Lucas, Jr. "User reactions and the management of information services," *Management Informatics,* vol. 2, no. 4, pp. 165–172, 1973.

[4] R. L. Schultz and D. P. Slevin, "Implementation and organizational validity: An empirical investigation," in *Implementing Operations Research/Management Science,* R. L. Schultz and D. P. Slevin, Eds. New York: Elsevier, 1975, pp. 153–182.

[5] F. Davis, "Perceived usefulness, perceived ease of use and user acceptance of information technology," *MIS Quarterly,* vol. 13, no. 3, pp. 319–339, 1989.

[6] F. Davis, R. Bagozzi, and P. Warshaw, "User acceptance of computer technology: A comparison of two theoretical models," *Management Science,* vol. 35, no. 8, pp. 982–1003, 1989.

[7] K. Mathieson, "Predicting user intentions: Comparing the technology acceptance model with the theory of reasoned action with the theory of planned behavior," *Information Systems Research,* vol. 2, no. 1, pp. 173–191, 1991.

[8] F. D. Davis, "User acceptance of information technology: System characteristics, user perceptions, and behavioral impacts," *International Journal of Man–Machine Studies,* vol. 38, no. 3, pp. 475–487, 1993.

[9] B. Szajna, "Empirical evaluation of the revised technology acceptance model," *Management Science,* vol. 42, no. 1, pp. 85–92, 1996.

[10] A. Bhattachacherjee, "Managerial influences on intraorganizational information technology use: A principal agent model," *Decision Sciences,* vol. 29, no. 1, pp. 139–162, 1998.

[11] E. Coakes and K. Merchant, "Expert systems: A survey of their use in UK businesses," *Information & Management,* vol. 30, no. 5, pp. 223–230, 1996.

[12] W. King and T. Teo, "Facilitators and inhibitors for the strategic use of information technology," *Information & Management,* vol. 27, no. 2, pp. 71–87, 1994.

[13] D. Goodhue, "IS attitudes: Toward theoretical and definition clarity," in *Proc. 8th Int. Conf. on Information Systems,* 1986, pp. 181–194.

[14] M. Igbaria, N. Zinatelli, and A. L. M. Cavaye, "Personal computing acceptance factors in small firms: A structural equation model," *MIS Quarterly,* vol. 21, no. 3, pp. 279–305, 1997.

[15] M. Gelderman, "The relation between user satisfaction, usage of information systems and performance," *Information & Management,* vol. 34, no. 1, pp. 11–18, 1998.

[16] C. M. Jackson, S. Chow, and R. A. Leitch, "Toward an understanding of the behavioral intention to use an information system," *Decision Sciences,* vol. 28, no. 2, pp. 357–389, 1997.

[17] A. Bajaj and S. R. Nidumolu, "A feedback model to understand information systems usage," *Information & Management,* vol. 33, no. 5, pp. 213–224, 1998.

[18] G. Vlahos and T. Ferratt, "Information technology use by managers in Greece to support decision making: Amount, perceived value, and satisfaction," *Information & Management,* vol. 29, no. 6, pp. 305–315, 1995.

[19] C. VanLengen and J. Morgan, "Chargeback and maturity of IS use," *Information & Management,* vol. 25, no. 3, pp. 155–163, 1993.

[20] D. Adams, R. Nelson, and P. Todd, "Perceived usefulness, ease of use, and usage of information technology: A replication," *MIS Quarterly,* vol. 16, pp. 227–247, Jun. 1992.

[21] H. Barki and J. Hartwick, "Measuring user participation, user involvement, and user attitude," *MIS Quarterly,* vol. 18, pp. 59–79, Mar. 1994.

[22] M. Igbaria, J. Baroudi, and S. Parasuraman, "A motivational model of microcomputer usage," *Journal of Management Information Systems,* vol. 13, no. 1, pp. 127–143, 1996.
[23] J. Lehman and V. Murthry, "Business graphics trends, two years later," *Information & Management,* vol. 16, no. 2, pp. 57–69, 1989.
[24] M. Igbaria, J. Iivari, and H. Maragahh, "Why do individuals use computer technology? A Finnish case study," *Information & Management,* vol. 29, no. 5, pp. 227–251, 1995.
[25] G. S. Howard and A. L. Mendelow, "Discretionary use of computers: An empirically derived explanatory model," *Decision Sciences,* vol. 22, no. 2, pp. 241–265, 1991.
[26] Y. Chan and V. Storey, "The use of spreadsheets in organizations: Determinants and consequences," *Information & Management,* vol. 31, no. 3, pp. 119–134, 1996.
[27] M. Igbaria, F. Pavri, and S. Huff, "Microcomputer applications: An empirical look at usage," *Information & Management,* vol. 16, no. 4, pp. 187–196, 1989.
[28] S. Schiffman, L. Meile, and M. Igbaria, "An examination of end-user types," *Information & Management,* vol. 22, no. 4, pp. 207–215, 1992.
[29] M. Igbaria, "An examination of microcomputer usage in Taiwan," *Information & Management,* vol. 22, no. 1, pp. 19–28, 1992.
[30] A. Rai and R. Patnayakuni, "A structural model for CASE adoption behavior," *Journal of Management Information Systems,* vol. 13, no. 2, pp. 205–234, 1996.
[31] D. Lee, "Usage pattern and sources of assistance for personal computer users," *MIS Quarterly,* vol. 10, no. 3, pp. 313–325, 1986.
[32] C. Mawhinney and A. Lederer, "A Study of personal computer utilization by managers," *Information & Management,* vol. 18, no. 5, pp. 243–252, 1990.
[33] J. Tillquist, "Participation on electronic bulletin board systems: An empirical analysis of work value congruency," *Information & Management,* vol. 13, no. 1, pp. 107–126, 1996.
[34] O. Culpan, "Attitudes of end users towards information technology in manufacturing and service industries," *Information & Management,* vol. 28, no. 3, pp. 167–176, 1995.
[35] J. Hartwick and H. Barki, "Explaining the role of user participation in information system use," *Management Science,* vol. 40, no. 4, pp. 440–465, 1994.
[36] S. Lee, Y. Kim, and J. Lee, "An empirical study of the relationships among end-user information systems acceptance, training, and effectiveness," *Journal of Management Information Systems,* vol. 12, no. 2, pp. 189–202, 1995.
[37] C. Kydd and D. Ferry, "Managerial use of video conferencing," *Information & Management,* vol. 27, no. 6, pp. 369–375, 1994.
[38] W. Romm, N. Pliskin, and C. Rifkin, "Diffusion of e-mail: An organizational learning perspective," *Information & Management,* vol. 31, no. 1, pp. 37–46, 1996.
[39] M. Amini and R. Schooley, "Supercomputing in corporate America," *Information & Management,* vol. 24, no. 6, pp. 291–303, 1993.
[40] V. Grover and J. T. C. Teng, "An examination of DBMS adoption and success in American organizations," *Information & Management,* vol. 23, no. 5, pp. 239–248, 1992.
[41] A. Boynton, R. Zmud, and G. Jacobs, "The influence of IT management practice of IT use in large organizations," *MIS Quarterly,* vol. 18, pp. 299–315, Sept. 1994.
[42] W. Fisher, M. Lind, and R. Zmud, "Microcomputer adoption—The impact of organizational size and structure," *Information & Management,* vol. 16, no. 3, pp. 157–162, 1989.
[43] K. Jih and S. Park, "Success of management information systems: An empirical investigation," *Journal of Computer Information Systems,* vol. 34, pp. 33–37, Winter, 1993.
[44] M. Liberatore and A. Stylianou, "Using knowledge-based systems for strategic market assessment," *Information & Management,* vol. 27, no. 4, pp. 221–232, 1994.
[45] M. Extejt and M. Lynn, "Trends in computer use in collective bargaining," *Information & Management,* vol. 30, no. 3, pp. 111–117, 1996.
[46] B. Szajna, "Determining information system usage: Some issues and examples," *Information & Management,* vol. 25, no. 3, pp. 147–154, 1993.
[47] L. Raymond, "Organizational characteristics and MIS success in the context of small business," *MIS Quarterly,* vol. 9, no. 1, pp. 37–52, 1985.
[48] J. Baroudi, M. Olson, and B. Ives, "An empirical study of the impact of user involvement on system usage and information satisfaction," *Comm. of the ACM,* vol. 29, no. 3, pp. 232–238, 1986.

[49] M. Igbaria, T. Guimaraes, and G. Davis, "Testing the determinants of microcomputer usage via a structural equation model," *Journal of Management Information Systems,* vol. 11, no. 4, pp. 87–114, 1995.
[50] C. Iacovou, I. Benbasat, and A. Dexter, "Electronic data interchange and small organizations: Adoption and impact of technology," *MIS Quarterly,* vol. 19, no. 4, pp. 465–483, 1995.
[51] R. Zeffane, "Patterns of structural control in high and low computer user organizations," *Information & Management,* vol. 23, no. 3, pp. 159–170, 1992.
[52] B. F. Green and J. A. Hall, "Quantitative methods for literature review." *Annual Review of Psychology,* vol. 35, no. 3, pp. 37–53, 1984.
[53] L. V. Hedges and I. Olkin. *Statistical Methods for Meta Analysis.* New York: Academic, 1985.
[54] R. Rosenthal. *Meta-Analytic Procedures for Social Research.* Newbury Park, CA: Sage, 1984.
[55] R. E. Wood, A. J. Mento, and E. A. Locke, "Task complexity as a moderator of goal effects: A meta-analysis," *Journal of Applied Psychology,* vol. 72, no. 1, pp. 416–425, 1987.
[56] C. R. Schwenk, "Effects of devil's advocacy and dialectical inquiry on decision making: A meta analysis," *Organizational Behavior and Human Decision Processes,* vol. 47, no. 1, pp. 161–176, 1990.
[57] I. Benbasat and L. H. Lim, "The effects of group, task, context, and technology variables on the usefulness of group support systems: A meta analysis of experimental studies," *Small Group Research,* vol. 24, no. 4, pp. 430–462, 1993.
[58] B. C. Hardgrave and K. A. Walstrom, "Forums for MIS scholars," *Comm. of the ACM,* vol. 40, no. 11, pp. 119–124, 1997.
[59] F. E. Croxton. *Tables of Areas in the Two Tails and in One Tail of the Normal Curve.* Englewood Cliffs, NJ: Prentice-Hall, 1949.
[60] W. H. Beyer, Ed. *CRC Standard Probability and Statistics Tables and Formulae.* Boca Raton, FL: CRC, 1991.
[61] J. Cohen. *Statistical Power Analysis for the Behavioral Sciences,* Rev. ed. New York: Academic, 1977.
[62] F. M. Wolf. *Meta-Analysis: Quantitative Methods for Research Synthesis.* Beverly Hills, CA: Sage, 1986.
[63] R. A. Fisher. *Statistical Methods for Research Workers,* Rev. ed. New York: Hafner, 1958.
[64] W. King and R. Sabherwal, "Towards a theory of strategic use of information resources," *Information & Management,* vol. 20, no. 3, pp. 191–212, 1991.
[65] B. Ives and M. H. Olson, "User involvement in information systems development: A review of research," *Management Science,* vol. 30, no. 5, pp. 586–603, 1984.
[66] M. Fishbein and I. Ajzen. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.* Reading, MA: Addision-Wesley, 1975.
[67] G. Davis and M. H. Olson. *Management Information Systems: Conceptual Foundations, Structure, and Development.* New York: McGraw-Hill, 1985.
[68] H. C. Lucas, Jr. *Information Technology for Management,* 6th ed. New York: McGraw-Hill, 1997.