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Variables affecting information technology end-user satisfaction: a meta-analysis of the empirical literature

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The level of end-user satisfaction with information technology (IT) has widely been accepted as an indicator of IT success. The present research synthesizes and validates the construct of IT end-user satisfaction using a meta-analysis. It accomplishes this by analysing the empirical results of 45 end-user satisfaction studies published between 1986 and 1998 and by focusing on relationships between end-user satisfaction and nine variables: perceived usefulness, ease of use, user expectations, user experience, user skills, user involvement in system development, organizational support, perceived attitude of top management toward the project and user attitude toward information systems (IS) in widely divergent settings. The present analysis found positive support for the influence of all nine variables on end-user IT satisfaction but to varying degrees. The most significant relationships were found to be user involvement in systems development, perceived usefulness, user experience, organizational support and user attitude toward the IS. This has implications for IS analysis and design as well as user training and the development of training support packages.

KEYWORDS: end-user satisfaction; information technology; meta-analysis.

1. Introduction

As investment in information technology (IT) continues to increase the consequences of failure become more acute (Ditsa, 1997; Venkatesh, 1999). This has been well recognized in the areas of systems and software development where there has been increasing emphasis on quality management and fail-safe systems; however, despite such improvements, catastrophic failures continue to shock the market and at great cost to both

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developers and users. This suggests that the causes of failure are still poorly understood and remedies leading to success somewhat thin on the ground. A number of researchers have suggested that user satisfaction (the "forgotten" ware) is one of the key factors leading to information systems (IS) success (Lyytinen, 1988; Schiffman, Meile & Igbaria, 1992; Szajna & Scamell, 1993; Ditsa & MacGregor, 1995; Gelderman, 1998; Al-Khaldi & Wallace, 1999) but the factors which lead to the realization of user expectations and hence satisfaction are often difficult to isolate due to their complex inter-relationships. Ditsa and MacGregor (1996) examined a wide range of user satisfaction models and identified the following key factors.

- The quality of the information from the IS.
- The user interface features of the IS.
- The support provided by DP staff, vendors or manuals.
- The involvement of the user in the planning, development and implementation of the IS.
- The user attitudes toward the IS.

Common definitions for these are not always available and methods, techniques and sampling characteristics tend to vary with study. This may be why results from end-user satisfaction studies are quite variable with some giving support to the influence of one factor such as user attitudes while others find little or no support for the same variable.

The present study attempts to reduce some of the confusion surrounding the extent to which user profiles, organizational support and user involvement act as determinants of user satisfaction by examining the results of 45 previous empirical studies over the last 12 years, and then performing a meta-analysis on nine variables (identified in these studies) to measure the extent to which their influence is supported. The results from this analysis will help support the effective implementation, management and utilization of IS.

The present research is organized as follows: Section 2 puts forth the research model and hypotheses. Section 3 describes the sampling procedure used in the research. Section 4 provides the results of the quantitative analysis and is followed by a discussion. The final section concludes by evaluating the implications of the results for future research and practice.

2. Research model and hypotheses

There is a wealth of literature related to user satisfaction and user satisfaction models. However, despite substantial findings there still appears to be little demand for these to be incorporated into IS design and implementation (Ditsa & MacGregor, 1996). One reason could be that despite the inclusion of sociological factors many of the models are technology or procedurally driven (Sprung, 1990; Clegg, 1993) and hence reduce the user to a component rather than the active participant. A further reason may be the poverty of such literature. While one could probably produce evidence of several thousand studies on end-user satisfaction, little attempt has been made to synthesize and evaluate these results and incorporate findings into more comprehensive and meaningful frameworks. Finally, there is an implicit assumption in many of these studies that users will have a higher level of satisfaction if they interact with IS which incorporate specific organizational and psychological parameters. Clegg (1993), however, suggests that many of these aspects are pushed onto users rather than being demanded by them. This should

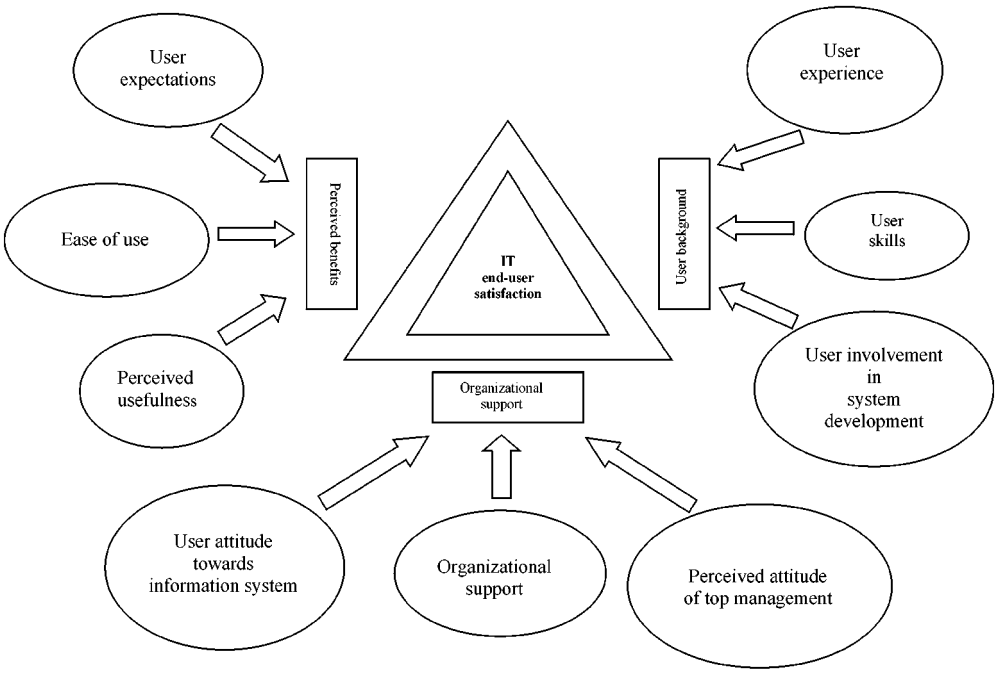

FIGURE 1. Research model of factors affecting IT end-user satisfaction.

lead researchers to question what social issues are at work and, in the first instance, to consider those which prevail in all user interactions.

The literature in the area reveals that the factors affecting IT end-user satisfaction fall into three major categories: perceived benefits and convenience, user background and involvement and organizational attitude and support. The literature in the area also identifies nine variables that have been classified into one of each of the aforementioned factors. The dimensions of perceived benefits and convenience, for example, represent the job-related 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 factor includes user-related characteristics such as user experience, user skills and user involvement in system development. These characteristics are seen to be indicators of an individual user's propensity to use IT systems. The third category of variables includes organizational support, and user and top management attitude toward IS projects. These reflect an organization's readiness to use IT.

The aforementioned variables and the related factors are synthesized into a theoretical model for grounding the present research (Figure 1). The research model depicts the dimensions from prior research in IT end-user satisfaction and effectiveness.

2.1. PERCEIVED BENEFIT AND CONVENIENCE

Among all the variables that may contribute to system use, research suggests that perceived usefulness and perceived ease of use are especially important (Davis, 1989;

Venkatesh & Davis, 1996; Snitkin & King, 1996) as a way to predict or measure user satisfaction with IS. Indeed Parasuraman and Boroudi (1996) state that perceived usefulness is the strongest motivator for system acceptance. User satisfaction is strongly related to the perceived value of the IS (Mawhinney & Lederer, 1990; Vlahos & Ferratt, 1995) and users form intentions toward an IS based on an appraisal of how it will improve their job performance (Davis, Bagozzi & Warshaw, 1989; Igbaria, Iivari & Maragahh, 1995; Igbaria, Parasuraman & Baroudi, 1996; Blili, Raymond & Rivard, 1998). Perceived value is based on how well the IS supports the user in the decision process. A user who perceives an IS as providing value, is more likely to be satisfied with the IS than one who does not. If perceived usefulness is a quality of the IS, the users were more likely to accept the IS.

Lack of user friendliness hinders user acceptance (Davis *et al*., 1989). An application that the end-user perceives as easy to use is more likely to be accepted by users (Davis, 1989). Igbaria, Guimaraes and Davis (1995) examined two constructs related to beliefs: perceived ease of use and perceived usefulness. The authors found that if the users perceive the system to be easy to use, they need less effort to use it, and will have more time for other activities, which may contribute to overall job performance. Davis (1989) claims that, all else being equal, an application that the end-user perceives as being easier to use than another is more likely to be accepted. Igbaria *et al.* (1995) believe that organizations need to design systems that are compatible with the end-user's abilities because perceived ease of use plays a major role in affecting the use of IT, mainly indirectly through its influence on perceived usefulness and enjoyment.

Evaluating the level of user expectations has necessarily led researchers into the mine field of behavioral theory with studies addressing physiological issues such as cognitive dissonance, consumer behavior and social psychology as factors in assessing and evaluating user satisfaction in the areas of IS design, implementation and operation. Szajna and Scamell (1993) define user expectations on IS as "a set of beliefs held by the targeted users of an information system associated with the eventual performance of the information system and with their performance using the system" (p. 494). Within the applications environment, expert systems are increasingly being studied from the user expectation viewpoint with strong correlation being found between expectations, improved performance and satisfaction levels (Yoon & Guimaraes, 1995; Guimaraes, Yoon & Clevenson, 1996). These lead to the first three hypotheses.

Hypothesis 1: There will be a positive relationship between perceived usefulness and end-user satisfaction.

Hypothesis 2: There will be a positive relationship between ease of use and end-user satisfaction.

Hypothesis 3: Subjects with high expectations will have higher user satisfaction scores than subjects with moderate (realistic) expectations.

2.2. USER BACKGROUND AND INVOLVEMENT

How user experience affects user participation and satisfaction is hard to measure because so many variables can influence the outcome. Several studies combine user-led participation and development with training and experience (Guimaraes, Lu & Igbaria,

1992; Lawrence & Low, 1993; Yoon & Guimaraes, 1995). Other studies address the increasing use of packaged software, how users influence software selection and how effectively software is used in an organization (Montazemi, Gupta & Cameron, 1996). Experience in mainframe and microcomputer-based business graphics was compared in one study (Lehman, Wetering & Vogel, 1986) while Thompson, Higgins and Howell (1994) look at experience on personal computers. Palvia (1996) selected the specific environment of small business which has been somewhat neglected in end-user studies and examined the satisfaction of small business users in IT.

A number of studies already described in the preceding sections have looked at the level of skills which end-users have brought to the EUC environment but an additional major component of EUC is the design and implementation of EUC training programs. Lee, Kim and Lee (1995) focus on measuring relationships among end-user IS acceptance, training and effectiveness. Saarinen (1996) looks at IS success in relation to user's skills while Yoon and Guimaraes (1995) examined 10 major expert systems and the factors likely to affect user jobs from a skill base. Henry and Martinko (1997) observed that users' skill and ability are directly related to performance and job satisfaction.

Developers can attempt to install systems but ultimately, it is the end-user who is most likely to know his requirements. End-users who are involved in the development process are likely to perceive the system as both important and personally relevant, and develop the feeling that the system is good (Hartwick & Barki, 1994). Guimaraes, Igbaria and Lu (1992) found more satisfaction with IS among users involved in designing and specifying their requirements. End-users seem to know how the information provided by the IS fits the organization and how it assists in solving business problems. Lawrence and Low (1993) found that, from the user perspective, the gaining popularity of user-led development was looked at as a means to positively influence company's economic and organizational benefits. Baroudi, Olson and Ives (1986) observed that user involvement in system development leads to increased user information satisfaction. McKeen and Guimaraes (1997) conducted a study in which it was demonstrated that the type of participation that results in satisfaction is contingent on the need for participation. User involvement is more critical where task and/or system complexity are high. In the case of expert systems, user requirements are unknown in the early stages and evolve during an iterative development process (Yoon & Guimaraes, 1995). This led the authors to find that a high level of user involvement may be necessary to help communications between users and developers/domain experts. McKeen and Guimaraes (1997) list benefits of user participation in systems development that includes: a more accurate and complete definition of user information requirements, knowledge about the company and organizational unit the system is intended to support, reduction of unnecessary system features, a better user understanding of the system features, a better user understanding of the system, user/IS department bargaining and conflict resolution about design issues, feelings of ownership, a decrease in user resistance to changes caused by the system, and greater user commitment to the system and its success. These lead to Hypotheses 4–6.

Hypothesis 4: There will be a positive relationship between the number of years of personal experience with computers and user satisfaction.

Hypothesis 5: There will be a positive relationship between (self-reported) computer skills and user satisfaction.

Hypothesis 6: There will be a positive relationship between user involvement in system development and end-user satisfaction.

2.3. ORGANIZATIONAL SUPPORT AND ENCOURAGEMENT

Research on end-user support and its influence on IS satisfaction has also been studied. End-users may lack knowledge of software and hardware; thus, adequate support is a must in order to realize productivity gains. Colleagues and software manuals provide the majority of end-user support (Bowman, 1993), and end-user satisfaction increases when such support needs are provided (Mirani & King, 1994). Guimaraes *et al.* (1992) believe that user training is directly related to user satisfaction. It is believed that training programs are likely to increase user confidence in his ability to use computers and that lack of training is a major reason for the lack of IS success (Igbaria *et al.* 1995). A study conducted by Satzinger and Olfman (1995) indicates that users as well as potential end-users are receptive to computer support for group work and they need to experience group support technology before realizing its potential. Organizations should provide more end-user induction and training programs, as well as promote user computing (systems development). In the research conducted by Nelson and Cheney (1987), managers perceive a need for training in areas such as, but not limited to, operating systems, graphic techniques, hardware and packaged application software.

Top management support for a project where IS success is dependent on user involvement is critical according to Guimaraes, *et al.* (1992). In addition, top management's need to create an environment suitable for change is essential in motivating end-user satisfaction (Lawrence & Low, 1993; Igbaria *et al.*, 1995). Yoon and Guimaraes (1995) also believe that management support is essential in providing the necessary resources for effective use of IS and in exhibiting interest in employees' satisfaction with IT.

Users' positive attitudes toward computers have been found to be a likely indicator of software products acceptance and there is strong support for a dependency between attitudes and satisfaction (Schiffman *et al.*, 1992; Satzinger & Olfman, 1995). Davis *et al.* (1989) address the ability to predict users computer acceptance from a measure of their intentions in terms of their attitudes. Further, Lee *et al.* (1995) and Thompson *et al.* (1994) found that where attitudes affect systems utilization, influencing these attitudes will have an effect on utilization. In summary, a review of these studies supports the following hypotheses.

Hypothesis 7: There will be a positive relationship between organizational support (training) and end-user satisfaction.

Hypothesis 8: There will be a positive relationship between end-user's perception of top management support and end-user satisfaction.

Hypothesis 9: There will be a positive relationship between attitude toward information systems and user satisfaction.

3. Data analysis methodology

3.1. SAMPLING PROCEDURE

A review of the relevant literature published over the period from 1986 to 1998 was conducted. The following publications were selected.

- Communications of the ACM
- Decision Sciences
- Information and Management
- Journal of Computer Information Systems
- Journal of Management Information Systems
- Management Science
- MIS Quarterly

Each study was examined to ascertain that the following criteria applied.

(1) Empirical studies that measure one or more of the factors analysed in this meta-analysis on user satisfaction.
(2) Empirical studies published from 1986 to 1998.
(3) Studies had to be supported by quantitative data.

Forty-five studies were identified in the literature research. These studies, with data pertaining to the hypotheses tested, are tabulated in Tables A1 and A2 (Appendix A). The studies are listed and measures pertaining to the hypotheses, in this analysis, are identified for the appropriate study by an "X". For each study, the p values and their standard normal deviate scores (Z) were tabulated in Tables 1–9. The table *Areas in One Tail of the Normal Curve at Selected Values* (Croxton, 1949) was utilized in obtaining the individual Z values. Using a method described by Rosenthal (1994), these values were used in estimating the effect size for each study. Using the table *The Transformation Z for the Correlation Coefficient* (*CRC Standard Probability and Statistics Tables and Formulae*), the individual Zr for each study was determined. The method of Rosenthal (1984) was utilized to calculate the combined Zr and effect size, r.

Three aspects of each relationship were tested. The overall effect level was tested. The following guidelines were utilized to classify effect size, large for $r > 0.50$, medium for $0.10 < r < 0.5$ and small for $r < 0.10$ (Cohen, 1977). The overall significance level was then determined using the individual Z data (Rosenthal, 1984). Finally, the degree of heterogeneity was measured using χ^2 values calculated from the individual Z data (Wolf, 1986). The larger the χ^2 value, the greater the heterogeneity of the data set. Utilizing p values from Table 1, *Statistical Methods for Research Workers* (Fisher, 1936), the significance of the χ^2 values was determined.

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 these effects are and also provides information on the degree of heterogeneity among the z scores and effect sizes.

TABLE 1
Perceived usefulness

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Yoon and Guimaraes (1995)	0.01	2.325	69	0.280	0.288
Davis (1989)	0.001	3.092	120	0.282	0.290
Vlahos and Ferratt (1995)	0.05	1.645	55	0.222	0.226
Davis *et al.* (1989)	0.001	3.092	107	0.299	0.308
Thompson *et al.* (1994)	0.005	2.575	69	0.310	0.321
Mawhinney & Lederer (1990)	0.001	3.092	66	0.3806	0.000
Igbaria *et al.* (1996)	0.01	2.325	471	0.107	0.108
Igbaria *et al.* (1995)	0.001	3.092	107	0.299	0.308
Igbaria *et al.* (1995)	0.01	2.325	450	0.110	0.110
Blili *et al.* (1998)	0.001	3.092	505	0.138	0.138
Z_{avg}		2.666			
Number of studies		$k = 10$			
Combined effect				0.580	0.663
Level of significance					8.429
		$p < 0.0001$			
Degress of freedom $(k - 1)$		9			
Level of heterogeneity		$\chi^2 = 2.307$			
		$p < 0.97$			

4.1. PERCEIVED USEFULNESS

Table 1 reflects the results regarding perceived usefulness. Ten studies measured the effect of perceived usefulness on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 8.429$. The combined effect size is $r = 0.580$, a large effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 2.307$, $p < 0.97$.

4.2. PERCEIVED EASE OF USE

Table 2 reflects the results regarding ease of use. Four studies measured the effect of ease of use on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 5.034$. The combined effect size is $r = 0.404$, a medium effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 0.441$, $p < 0.92$

4.3. USER EXPECTATIONS

Table 3 reflects the results regarding user expectations and attitudes. Seven studies measured the effect of user expectations on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 4.463$. The combined effect size is $r = 0.458$, a medium effect size according to Cohen (1977). The level of significance for the

TABLE 2
Ease of use

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Davis (1989)	0.001	3.092	120	0.282	0.290
Igbaria *et al.* (1995)	0.01	2.325	107	0.225	0.229
Davis *et al.* (1989)	0.01	2.325	107	0.225	0.229
Igbaria *et al.* (1995)	0.01	2.325	450	0.110	0.110
Z_{avg}		2.517			
Number of studies		$k = 4$			
Combined effect				0.404	0.429
Level of significance					5.034
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		3			
Level of heterogeneity		$\chi^2 = 0.441$			
		$p < 0.92$			

TABLE 3
User expectations

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Szajna and Scamell (1993)	0.14	1.080	159	0.086	0.086
Lawrence and Low (1993)	0.18	0.915	155	0.073	0.074
Davis (1989)	0.17	0.955	120	0.087	0.087
Yoon and Guimaraes (1995)	0.01	2.302	69	0.277	0.285
Guimaraes *et al.* (1996)	0.05	1.645	114	0.154	0.155
Venkatesh and Davis (1996)	0.001	3.100	120	0.283	0.291
Galleta, Ahuja, Hartman, Teo and Peace (1995)	0.035	1.810	32	0.320	0.332
Z_{avg}		1.687			
Number of studies		$k = 7$			
Combined effect				0.458	0.495
Level of significance					4.463
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		6			
Level of heterogeneity		$\chi^2 = 3.892$			
		$p < 0.7$			

individual study *Z* data is $p < 0.0001$. The *Z* scores were not found to be heterogeneous to a significant degree, $\chi^2 = 3.892$, $p < 0.70$.

4.4. USER EXPERIENCE

Table 4 reflects the results regarding user experience. Twelve studies measured the effect of user experience on end-user satisfaction. The combined normal standard deviate of

TABLE 4
User experience

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Lehman *et al.* (1986)	0.037	1.787	200	0.126	0.127
Lawrence and Low (1993)	0.18	0.915	96	0.093	0.094
Palvia (1996)	0.029	1.895	100	0.190	0.192
Montazemi *et al.* (1996)	0.211	0.803	30	0.147	0.148
Ryker and Nath (1995)	0.12	1.175	101	0.117	0.117
Yoon and Guimaraes (1995)	0.01	2.325	69	0.280	0.288
Guimaraes *et al.* (1992)	0.05	1.645	118	0.151	0.153
Thompson *et al.* (1994)	0.005	2.575	219	0.174	0.176
Venkatesh and Davis (1996)	0.001	3.100	40	0.490	0.536
Chan and Storey (1996)	0.05	1.645	256	0.103	0.103
Igbaria, Pauri and Huff (1989)	0.001	3.100	471	0.143	0.144
Blili *et al.* (1998)	0.001	3.100	505	0.138	0.139
Z_{avg}		2.005			
Number of studies		$k = 12$			
Combined effect				0.565	0.640
Level of significance					6.947
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		11			
Level of heterogeneity		$\chi^2 = 7.665$			
		$p < 0.75$			

these studies is $Z = 6.947$. The combined effect size is $r = 0.565$, a large effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 7.665$, $p < 0.75$.

4.5. USER SKILLS

Table 5 reflects the results regarding user skills. Nine studies measured the effect of user skills on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 5.396$. The combined effect size is $r = 0.443$, a medium effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 0.323$, $p < 0.27$.

4.6. USER INVOLVEMENT IN SYSTEM DEVELOPMENT

Table 6 reflects the results regarding user involvement in system development. Ten studies measured the effect of user skills on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 8.447$. The combined effect size is $r = 0.661$, a large effect size according to Cohen (1977). The level of significance for the individual

TABLE 5
User skills

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Lehman *et al.* (1986)	0.002	2.875	200	0.203	0.206
Lawrence and Low (1993)	0.5	0.000	59	0.000	0.000
Palvia (1996)	0.115	1.200	100	0.120	0.121
Lee *et al.* (1995)	0.01	2.325	236	0.151	0.153
Yoon & Guimaraes (1995)	0.01	2.325	69	0.280	0.288
Thompson *et al.* (1994)	0.005	2.575	219	0.174	0.176
Guimaraes *et al.* (1996)	0.05	1.645	114	0.154	0.155
Saarinen (1996)	0.440	0.150	48	0.022	0.022
Igbaria *et al.* (1995)	0.001	3.092	107	0.299	0.308
Z_{avg}		1.799			
Number of studies		$k = 9$			
Combined effect				0.443	0.476
Level of significance					5.396
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		8			
Level of heterogeneity		$\chi^2 = 0.323$			
		$p < 0.27$			

TABLE 6
User involvement in system development

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
McKeen, Guimaraes and Wetherbe (1994)	0.001	3.092	151	0.252	0.257
Lawrence and Low (1993)	0.001	3.092	155	0.248	0.254
Guimaraes *et al.* (1992)	0.01	2.325	118	0.214	0.217
Hartwick and Barki (1994)	0.001	3.092	105	0.302	0.311
Baroudi *et al.* (1986)	0.05	1.645	200	0.116	0.117
Yoon and Guimaraes (1995)	0.01	2.325	69	0.280	0.288
McKeen and Guimaraes (1997)	0.001	3.092	151	0.252	0.257
Park, Jih and Roy (1993–1994)	0.010	2.325	106	0.226	0.230
Saleem (1996)	0.0004	3.400	60	0.439	0.471
Choe (1998)	0.01	2.325	450	0.110	0.110
Z_{avg}		2.671			
Number of studies		$k = 10$			
Combined effect				0.661	0.794
Level of significance					8.447
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		9			
Level of heterogeneity		$\chi^2 = 2.772$			
		$p < 0.96$			

TABLE 7
Organizational support

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Guimaraes *et al.* (1992)	0.05	1.645	118	0.151	0.153
Nelson and Cheney (1987)	0.01	2.325	100	0.233	0.237
Mawhinney and Lederer (1990)	0.05	1.645	66	0.202	0.205
Thompson *et al.* (1994)	0.005	2.575	69	0.310	0.321
Satzinger and Olfman (1995)	0.05	1.645	153	0.133	0.134
Lehman and Murthy (1989)	0.01	2.325	300	0.134	0.135
Igbaria *et al.* (1996)	0.01	2.325	471	0.107	0.108
Igbaria *et al.* (1989)	0.010	2.325	471	0.107	0.108
Igbaria *et al.* (1995)	0.001	3.092	107	0.299	0.308
Blili *et al.* (1998)	0.001	3.092	505	0.138	0.138
Z_{avg}		2.299			
Number of studies		$k = 10$			
Combined effect				0.525	0.584
Level of significance					7.271
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		9			
Level of heterogeneity		$\chi^2 = 2.620$			
		$p < 0.97$			

study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 2.772$, $p < 0.96$.

4.7. ORGANIZATIONAL SUPPORT

Table 7 reflects the results regarding organizational support. Ten studies measured the effect of organization support on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 7.271$. The combined effect size is $r = 0.525$, a large effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 2.620$, $p < 0.97$.

4.8. PERCEIVED ATTITUDE OF TOP MANAGEMENT TOWARD THE PROJECT

Table 8 reflects the results regarding perceived attitude of top management towards the project. Four studies measured the effect of perceived attitude of top management towards the project on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 5.066$. The combined effect size is $r = 0.462$, a medium effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 1.467$, $p < 0.70$.

TABLE 8
Perceived attitude of top management toward the project

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Guimaraes *et al.* (1992)	0.001	3.092	118	0.285	0.293
Lawrence and Low (1993)	0.001	3.092	118	0.285	0.293
King and Teo (1994)	0.01	2.302	121	0.209	0.212
Yoon and Guimaraes (1995)	0.05	1.645	69	0.198	0.201
Z_{avg}		2.533			
Number of studies		$k = 4$			
Combined effect				0.462	0.499
Level of significance					5.066
		$p < 0.0001$			
Degres of freedom ($k - 1$)		3			
Level of heterogeneity		$\chi^2 = 1.467$			
		$p < 0.7$			

TABLE 9
User attitude toward information system

Study name	*P* (study)	*Z* (individual)	*N* (sample)	Effect size (*r*)	*Zr*
Lee *et al.* (1995)	0.001	3.092	236	0.201	0.204
Hartwick and Burki (1994)	0.001	3.092	105	0.302	0.311
Davis *et al.* (1989)	0.001	3.092	107	0.299	0.308
Thompson *et al.* (1994)	0.01	2.325	69	0.280	0.288
Satzinger and Olfman (1995)	0.01	2.325	153	0.188	0.190
Z_{avg}		2.785			
Number of studies		$k = 5$			
Combined effect				0.524	0.582
Level of significance					6.228
		$p < 0.0001$			
Degrees of freedom ($k - 1$)		4			
Level of heterogeneity		$\chi^2 = 0.706$			
		$p < 0.95$			

4.9. ATTITUDE TOWARDS INFORMATION SYSTEM

Table 9 reflects the results regarding attitude towards IS. Five studies measured the effect of attitude towards IS on end-user satisfaction. The combined normal standard deviate of these studies is $Z = 6.228$. The combined effect size is $r = 0.524$, a large effect size according to Cohen (1977). The level of significance for the individual study Z data is $p < 0.0001$. The Z scores were not found to be heterogeneous to a significant degree, $\chi^2 = 0.706$, $p < 0.95$.

5. Discussion

5.1. PERCEIVED BENEFIT AND EXPECTATIONS

To summarize the meta-analysis results, end-user information satisfaction is strongly affected by perceived benefit and expectations characteristics such as perceived usefulness, ease of use and user expectations. These results were found to be statistically significant. The effect size for perceived usefulness, according to Cohen (1977), fell into the large size range while the effect size for the remaining two variables fell into the medium size range. In all cases the results across studies were consistent. These results are congruous with the qualitative review of the literature in the area. Although ease of use is important, the usefulness of the IS is even more important (Davis *et al*., 1989; Davis, 1989; Igbaria *et al*., 1995). Individuals are likely to have positive attitudes about IS if they believe that using the system will increase their performance and productivity (Mawhinney & Lederer, 1990; Vlahos & Ferratt, 1995; Igbaria *et al*., 1996). Igbaria *et al.* (1995) found that usefulness was significantly correlated to usage. It seems that end-users primarily adopt an application based on perceived benefits, and secondly on how easy or hard it is to achieve those benefits. It seems that users will tolerate the difficulties of using a system because of the functions it performs for them. At the same time, no amount of use can compensate for lack of needed functionality.

The results of the present research on user expectations are also congruous with the qualitative review of the literature in the area. Szajna and Scamell (1993) investigated the association between unrealistic expectations and user satisfaction. Although, their results showed that users with relatively high expectations had user satisfaction scores higher than those with moderate expectations, their study determined that expectations should be kept to a realistic level. As users with unrealistic expectations get an accurate picture of the IS, they become dissatisfied with the IS and may discontinue using the system. It would seem that information on potentials and limitations of the IS would keep user expectations in line and increase user satisfaction.

5.2. USER BACKGROUND AND INVOLVEMENT

Meta-analysis results also indicated that end-user information satisfaction is strongly affected by user background, and variables such as user experience, user skills and user involvement were also found to be significant. Again, the results across studies were consistent and were found to be statistically significant. The effect size for user experience and user involvement in system development, according to Cohen (1977), fell into the large size range while the same for user skills fell into the medium size range. The results of the present research smooth out the previously contradictory evidence found, with regard to the influence of user experience and user skills, in the qualitative review of the literature. This is done by quantitatively synthesizing the contradictory evidence in the area. Blili *et al.* (1998) found that EUC success seemed to be a function of the user's experience and ability. On the other hand, Lawrence and Low (1993) found that previous experience with computers and user satisfaction was not significantly correlated. Palvia (1996) found only mild support in his study of small business users. Chan and Storey (1996) found that users who were more likely to be satisfied with the software package

were not necessarily those that received formal computer training but rather self-taught. In the DSS environment, experience was found to be a critical success factor (Guimaraes *et al*., 1992). The findings of the present research would indicate that it is a highly significant factor in relation to user satisfaction.

The findings of the present research also indicate that the factor of user skills is significantly correlated with user satisfaction. Lee *et al*. (1995), Igbaria *et al*. (1995) and Thompson *et al*. (1994) found a strong correlation between end-user skills and end-user IS acceptance. Lawrence and Low (1993), on the other hand, believe that previous computer skills are not significantly correlated with user IS acceptance. This is supported by Compeau, Higgins and Huff (1999), who find self-efficacy (an ability held by the user with regard to computer skills) to be a strong and significant predictor of affect, anxiety and use of a system both pre- and post-implementation.

The results of the present research on user involvement are congruous with the qualitative review of the literature in the area. The importance of this factor is supported by McKeen *et al*. (1994) and McKeen and Guimaraes (1997), who indicate that a strong relationship exists between user participation and user satisfaction during systems development. Participation in system development results in system acceptance by users due to a sense of contribution and control, feeling of ownership toward the system and a better understanding of the system's capabilities (Baroudi *et al*., 1986; Park *et al*., 1993–1994; Saleem 1996). Guimaraes *et al*. (1992) investigated the determinant factors of decision support systems success and found that user involvement, among others, is a factor that influences DSS success. Yoon and Guimaraes (1995) collected data on 69 expert systems and concluded that while user involvement is not as important for expert system success as it is for other system types, user involvement in development is related to user satisfaction.

5.3. ORGANIZATIONAL SUPPORT AND ENCOURAGEMENT

Meta-analysis results also indicated that end-user information satisfaction is strongly affected by organizational support and encouragement variables such as organizational support, perceived attitude of top management toward IS project and user attitude towards IS. Again, the results across studies were consistent and were found to be statistically significant. The effect size for organizational support and user attitude, according to Cohen (1977), fell into the large size range while that for top management attitude fell into the medium size range. The results of the present research on organizational support are congruous with the qualitative review of the literature in the area. It has generally been found essential for MIS, for example, to provide effective user support and to encourage end-users to use their systems in order to achieve end-user acceptance of the IS (Lehman & Murthy, 1989; Lawrence & Low, 1993; Igbaria *et al*., 1995). Blili *et al*. (1998) found that one way to ensure EUC success was for IS managers to provide better software, hardware and support services, especially to those users who have the most uncertain tasks. They believe that appropriate training programs for end-users may play a crucial role in EUC success. Igbaria *et al*. (1995) suggest that EUC support is more important than management support. This would be consistent with the present study's findings where the effect size of perceived attitude of top management toward the project fell into the medium size range. Management support can be in the form of

TABLE 10
Relative effect sizes of factors affecting user satisfaction

Effect size rank	Factor	Combined effect size
1	User involvement in system development	0.661
2	Perceived usefulness	0.580
3	User experience	0.565
4	Organizational support	0.525
5	User attitude toward information systems	0.524
6	Perceived attitude of top management toward the project	0.462
7	User expectations	0.458
8	User skills	0.443
9	Ease of use	0.404
	Average effect size	0.514

encouragement to use the system, providing a wider selection of user-friendly software, and applying IT to support a wide variety of business tasks (Igbaria *et al*., 1996).

The results of the present research on user attitude towards information systems are also congruous with the qualitative review of the literature in the area. Lee *et al*. (1995) indicate, in their study, statistical findings pointing to a strong relation between end-user IS acceptance and end-user IS satisfaction. A need exists to take a proactive approach in both adopting new IT and supporting the use of technology. Positive feelings toward the technology, among other factors, should be stressed (Davis *et al*., 1989; Thompson *et al*., 1994). In assessing the circumstances where group work support technology would be successful, Satzinger and Olfman (1995) stress that at the very least, implementers should try to identify users with positive attitudes toward computers and group work prior to implementation.

Of medium value to IS success is the perceived attitude of top management toward the IS project. Lawrence and Low (1993) found management support to be positively correlated with user satisfaction. Involving end-users would appear to involve much more than establishing a user group to lead and manage the development. Users must be made to feel involved and adequately represented in the systems development process in addition to receiving adequate training (Guimaraes *et al*., 1992). These findings are supported by Yoon and Guimaraes (1995) in a study of expert systems developed at IBM's manufacturing center. It seems that management support is essential not just to obtain the personnel and monetary resources but also to mitigate users' negative attitudes toward the system, and to overcome user resistance.

Table 10 shows the ranking of the factors analysed in this meta-analysis by effect size. The results produced two groupings of relative effective size, with the highest being user involvement in system development, perceived usefulness, user experience, organizational support and attitude toward the IS. The factors with lower effect sizes are the perceived attitude of top management toward the project, user expectations, user skills and ease of use.

As obvious from the earlier discussion, the present research also investigated the heterogeneity of the effect of each of the nine variables on IT user satisfaction across studies. It found all effects to be not 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.

6. Conclusions

In summary, the results of the present meta-analysis lead to the conclusion that greater levels of user satisfaction will result from greater user involvement in system development which in turn is likely to lead to the design of systems which are perceived to be useful and hence viewed more positively by users with enhanced experience. This will influence expectations and skills and should lead to the development of systems which are easier to use. Of course for all this to happen, an overall end-user support mechanism must be in place.

End-users need to regard the IS they are currently using and the information provided by the IS as relevant and useful for their job performance if they are to accept such systems. This would suggest that managers should first, identify end-users' specific job performance needs and their job satisfaction factors. Secondly, the most relevant and efficient IS should be provided along with facilitating conditions that encourage acceptance of the new IS.

Often, IS are designed and implemented based only on technical merits. Perhaps this is why many IS are substantially less successful than originally intended. The results of this meta-analysis indicate that, as suggested by Ditsa and Macgregor (1996), it is when all of the factors are considered that a better picture of end-user satisfaction of an IS will be established.

It is therefore imperative that an audit of end-user skills takes place pre-implementation and, indeed, pre-IS design to ensure that the system satisfaction and success measures are incorporated into the total quality systems concept. It may be that where experience levels are extremely variable there needs to be a training program prior to the systems requirements definition since inexperienced users are unlikely to be able to contribute as effectively to a needs analysis as the more experienced user.

This concept also applies to user expectation since it would allow for more realistic systems expectations to be fostered and also for the system design to incorporate these as quality measurements in the testing stages. This strengthens the argument for user involvement throughout the system life cycle and also the need for effective user training programs.

These findings also indicate that the focus of user training programs should be on building the levels of confidence of user experience. Training programs which overemphasize the benefits to be gained from a system without sufficient attention to real live system interaction can create unnecessarily high levels of expectation which, when they fail to materialize, further inhibit end-user satisfaction. Training to provide experience suggests the use of problem-based scenarios which offer a variety of user experiences in a number of different environments. Venkatesh (1999) supports this premise in his recent comparison of end-user training environments where game-based training methods were found to have a stronger effect on behavioral intention to use when compared with

traditional methods. Further this had a stronger effect than the construct of perceived usefulness. Building up a portfolio of scenarios could be particularly useful. Training in basic skills should also not be ignored since this will also lead to more effective (although not necessarily more) use of the system and add to overall user satisfaction.

The study has tried to draw together some of the previous research and to reduce the proliferation of measures and measurement scenarios which have made it so difficult to arrive at consensus on user satisfaction measures. By applying meta-analysis to a group of separate studies we have been able to quantitatively synthesize the findings and come to a definitive conclusion which can now form the base for policy decisions in regard to IS success. It must be noted, however, that this study suffers from the limitations of previous studies. The majority of these studies based their findings on a single data set at one point in time. User satisfaction requires longitudinal studies that reflect changing attitudes over a period of use. Karahanna, Straub and Chervany (1999) found significantly different influencers pre- and post-implementation reflecting temporal evolution of beliefs, attitudes, norms and behaviors across different phases of the innovation process. Further analyses of this type are needed to influence the direction of more focused research in future EUC studies.

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Appendix A: Research studies

TABLE A1
Studies included in research

Study description	Measured factors affecting user satisfaction			
Study name	User expectations and attitudes	User experience	User skills	User involvement in system development
Baroudi *et al.* (1986)				×
Blili *et al.* (1998)		×		
Chan and Storey (1996)		×		
Choe (1998)				×
Davis (1989)	×			
Galleta *et al.* (1995)		×		
Guimaraes *et al.* (1992)		×		×
Guimaraes *et al.* (1996)	×		×	
Hartwick and Barki (1994)				×
Igbaria *et al.* (1995)			×	
Igbaria *et al.* (1989)		×		
Lawrence and Low (1993)	×	×	×	×
Lee *et al.* (1995)			×	
Lehman *et al.* (1986)		×	×	
McKeen and Guimaraes (1997)				×
McKeen *et al.* (1994)				×
Montazemi *et al.* (1996)			×	
Palvia (1996)		×	×	
Park *et al.* (1993–1994)				×
Ryker and Nath (1995)		×		
Saarinen (1996)			×	
Saleem (1996)				×
Szajna and Scamel (1993)		×		
Thompson *et al.* (1994)		×	×	
Venkatesh and Davis (1996)		×	×	
Yoon and Guimaraes (1995)	×	×	×	×

TABLE A2
Studies included in research

Study description	Measured factors affecting user satisfaction				
Name	Organizational support	Perceived attitude of top management towards the project	User attitude towards information system	Perceived usefulness	Ease of usefulness
Blili *et al.* (1998)	×			×	
Davis (1989)				×	×
Davis *et al.* (1989)			×	×	×
Guimaraes *et al.* (1992)	×	×			
Hartwick and Burki, (1994)			×		
Igbaria *et al.* (1995)	×			×	×
Igbaria *et al.* (1995)				×	×
Igbaria *et al.* (1996)	×			×	
Igbaria *et al.* (1989)	×				
King and Teo (1994)		×			
Lawrence and Low (1993)		×			
Lee *et al.* (1995)			×		
Lehman & Murthy (1989)	×				
Mawhinney and Lederer (1990)	×			×	
Nelson and Chney (1987)	×				
Satzinger and Olfman (1995)	×		×		
Thompson *et al.* (1994)	×		×	×	
Vlahos and Ferratt (1995)				×	
Yoon and Guimaraes (1995)		×			