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A REVIEW OF THE INFLUENCE OF USER INVOLVEMENT ON SYSTEM SUCCESS

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ABSTRACT

User involvement in the system design process and the final success of a system has been the subject of many studies. Conflicting results reported in those studies have not helped to resolve the issue. This study employs meta-analysis to systematically combine the results of many user involvement studies to see if the overall results are significant. In addition, the strength of the relationship between user involvement and system success is also developed. The dependent variables in the underlying studies were combined to form two global variables: *attitude* and *reported behavior.* All of the relationships between various types of involvement and different measures of success yielded significant results.

1. INTRODUCTION

The relationship of user involvement to the ultimate success or failure of a computer based information system has been the subject of many research studies. These studies typically address the hypothesis that user involvement in the design of an information system will result in a more "successful" system (Baroudi, Olson and Ives 1986). There is no agreement, among researchers performing these studies, that this relationship is significant. A more comprehensive research methodology is needed in an effort to rectify these disagreements.

The objective of this research is to develop a clearly delineated model to better illustrate this relationship and its significance. The research tool to be utilized is meta-analysis. As a quantitative research method of analysis, meta-analysis allows the researcher to combine several independent studies into one statistical construct. A clearer definition of the user involvement/system success relationship is provided by this analytical procedure.

The paper includes a review of prior research. Issues involving the definitions of the dependent and independent variables, user involvement and system success are presented, including definitions of user involvement and system success. An in-depth explanation of meta-analysis is presented, followed by a meta-analytic evaluation of the previous studies. In conclusion, the implications of these findings are discussed.

2. PRIOR RESEARCH

The foundation of the meta-analysis is the large base of research which addresses "user involvement" in system design. In a cursory review of the current literature, over 250 articles were identified that addressed this relationship between user involvement and system success. Only a portion of these articles involved research studies suitable for meta-analysis. In close analysis of this research base, it becomes evident that these studies present a fragmented view of the research issue. The fact that these independent studies often fail to conclude with a resolution and offer calls for more research is one manifestation of this fragmentation (Hunter, Schmidt and Jackson 1982). The theoretical foundation of many of these studies is, however, similar.

The findings of prior research often yielded differing conclusions regarding user involvement and system success. Some research projects did report a recognizable linkage between user involvement and system success. Other works identified only a weak, or mixed relationship. While the intent of these independent studies was similar, the research methodology for identifying and measuring user involvement and system success frequently varied.

3. THEORETICAL FRAMEWORK

The role of user involvement in organizational activity can be viewed from the perspective of two different behavioral theories (Ives and Olson 1984). These theories are planned organizational change and participative decision making. The implementation of a new information system often implies a planned change in the way that an organizational unit pursues its objectives. A number of theoretical approaches to change can be found in the behavioral sciences. These theories generally view change as a complex social process (Zand and Sorenson 1975). Participative decision making emphasizes the role of individuals in working groups. Face to face consensus of linked working groups is an essential component of Likert's (1967) System 4. Decision making, by Likert's theory, is the process of establishing a consensus of opinion within the working group. User involvement in the system design implies continuous decision making by the individual and the group. Generally, the productivity improvements derived from this organizational approach are thought to stem from two sources. First, the increased involvement between and within groups is expected to provide improved information flows and thus better decisions. Second, the increased involvement in the decision-making process increases the likelihood that the consensus decision will be supported by the individuals. These theories, like all theories, have to be tested and proved.

Studies of user involvement in system design yielding more successful systems strive to do this. The organizational environment requires the use of surrogates as measures of the dependent and independent variables of interest. User involvement in the system design can be categorized by the type and degree of participation in systems development (Ives and Olson 1981, 1984).

The surrogate measures for user involvement were extremely consistent between studies. System success measures, on the other hand, were somewhat more diffuse. This diffusion may be explained by the fact that system success is often evaluated from many differing perspectives. Upper management, MIS management, and the primary system user may have different criteria for system success. Alter (1978) provides a managerial perspective into this situation by stating that one goal of a system implementation is improved decision making effectiveness. Disregarding the actual surrogates employed in a study, empirically measuring these items is at best extremely difficult. Objective measures of surrogates, such as "improved decision making effectiveness," are frequently not available to the researcher. The surrogate items actually employed in the research base were often subjective perceptions by the respondents.

Through an analysis of the individual studies a compilation of surrogates was assembled. Figure 1 presents these surrogates categorized by user involvement and system success. It is important to note that while individual studies may have presented drastic variances between the names of surrogates utilized, in substance there exists a compatibility of content underlying these names. This statement of compatibility is based upon a close scrutiny of the individual items contained in the instruments of the studies. It is critical for the application of meta-analysis that this compatibility exist (Hunter, Schmidt and Jackson 1983). The eight dependent variables in this framework represent an amalgamation of the variables defined by the authors who performed the research studies being combined here. The content of these eight variables rests, in part, on the research instruments employed in the individual studies. Most of these studies used either the Schultz and Slevin (1975) or the Bailey and Pearson (1983) user satisfaction instrument, or some modification or adaptation thereof. The first four variables (worth, ownership, responsibility and usage) are measures of success manifested by some action on the part of the user. These were combined into a global variable called *reported behavior* (see Figure 2). The last four variables (perceived success, accuracy, reliability and IS quality) are measures of the user's perceptions or attitudes. These will be combined into a global variable, *attitude* (see also Figure 2).

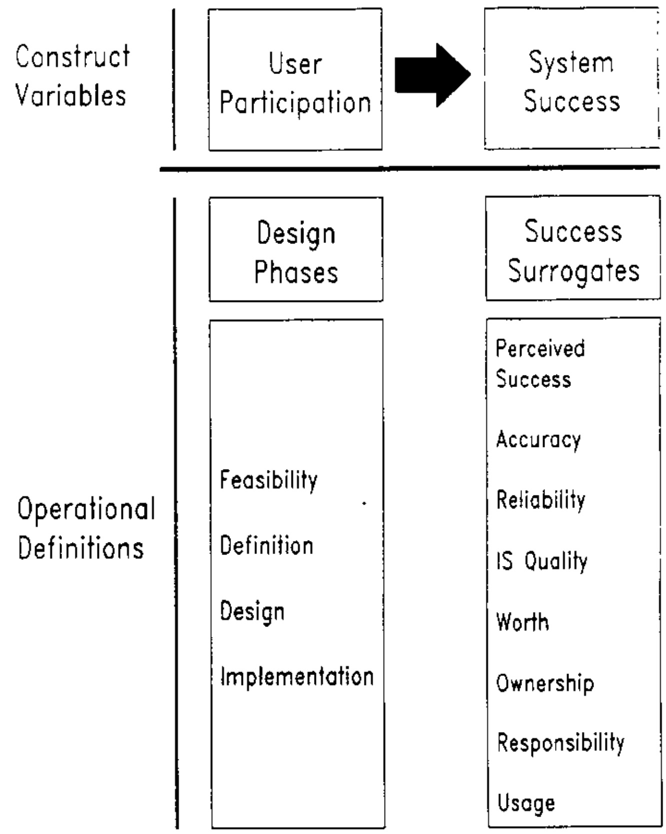

Figure 1. System Development Environment

The independent variable is user participation. In many of these studies, this can be viewed from the perspective of the point in the system development life cycle when the involvement took place: feasibility, definition, design or implementation.

4. META-ANALYSIS

The purpose of meta-analysis is to answer the original research question based on many studies rather than just one study (Glass 1981). Often a researcher concludes that his findings may or may not be significant. By combining studies the focus of the research becomes, "What is the strength of the relationship between the independent variables and the dependent variable?" This question is answered in two parts. The first part of this answer is an estimate of the magnitude of the relationship given as the effect size. The second part is an estimate of the accuracy or reliability of effect size (Rosenthal 1984).

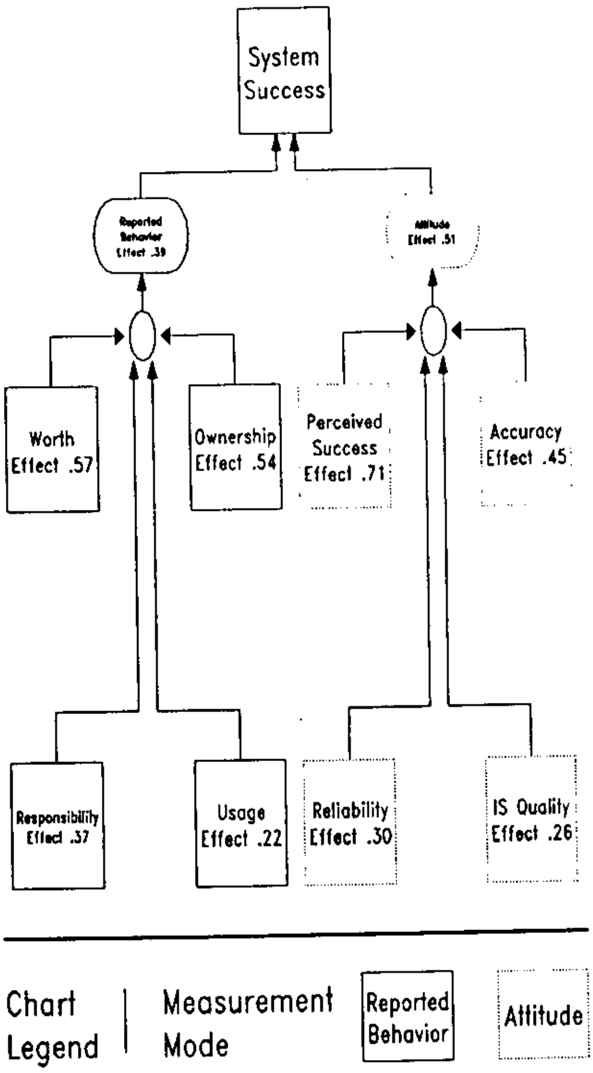

Figure 2. User Involvement Impact by Global Variables

In meta-analysis, no attempt is made to state the cause and effect relationship between the dependent and independent variables. The effect size measures the strength of the apparent relationship between the variables (Wolf 1986). In this study, user involvement or noninvolvement in the system design serves as the independent variable. Some studies refined the independent variable based upon the phase of the system development life cycle. *Use*, *worth*, *ownership*, *responsibility*, *accuracy*, *success*, *reliability*, and *information system quality* were the dependent variables.

Many authors have criticized certain aspects of meta-analysis (Rosenthal 1984; Hunter, Schmidt and Jackson 1982; Wolf 1986). One criticism is the "file drawer" problem. Often studies that do not indicate significant results are not published. The fail safe number, N_{fs}, is the number of studies of non-significant results that would be needed to reverse the conclusion of significant results (Wolf 1986). N_{fs} was calculated for each dependent variable to assess the "file drawer" problem.

Other criticisms of meta-analysis concern the calculation of the effect size (Wolf 1986). The first issue is combining effect sizes based on a variety of statistical techniques. Most studies used in this meta-analysis used rank correlations to compare the groups of users involved in the system design process to the group of users not involved. Because of this similarity in statistical techniques used in the underlying studies, meta-analysis is suitable.

A second area of concern with effect size is consistent variable definition. The research done by Bailey and Pearson (1983) and Schultz and Slevin (1975) provided the foundation for much of the research that we analyzed. Consequently, many of the variables encountered were defined by the same, or very similar, sets of questions.

Finally, the third concern in combining different studies into one effect size is the issue of the "poor" study (Wolf 1986). Researchers question combining "quality" research and "poor" research. Other authors (Hunter, Schmidt and Jackson 1982) suggest that judgment of the quality of research be reserved until viewing the results. These authors recommend the exclusion of questionable studies in final analysis.

These criticisms of meta-analysis are not to be minimized but the strengths of meta-analysis should be acknowledged. Meta-analysis has value because it combines research studies. All of the studies combined provide stronger evidence of the strength of the relationship. Specifically, a measure of the association between user involvement in system design and the ultimate "success" of the system is developed through meta-analysis.

5. METHODOLOGY

Articles, papers, and books were collected relating to the effects of involving users in the design process. Individual studies were examined and those appropriate for the study were selected (Conover 1980). Studies included are listed by variable in Appendix C. Many studies did not lend themselves to inclusion in this meta-analysis. Listed in Appendix D are the studies which were excluded along with an explanation of the exclusion. Selected studies were examined for their variables, data collection methods and statistical techniques. Fortunately most studies used Schultz and Slevin (1975) or Bailey and Pearson (1983) questions. A significant result of this fact is that by using these two sets of questions, the variables studied were more uniform. Most of the studies utilized rank correlation techniques which provided compatible statistics for meta-analysis.

5.1 Effect Sizes and Means

For each study selected, both Pearson's r and Cohen's d effect size were calculated (Conover 1980; Conover and Iman 1981). Fisher's Z was then calculated (see Appendix A). The Fisher's Z test was selected based upon the fact that as r increases the distribution of the r's becomes more skewed. Fisher's Z provides a more useful, nearly normal distribution (Rosenthal 1984). The authors above acknowledge that in using Z_r there is the possibility of an overstatement of the population r, but this overstatement is insignificant unless the sample size is small and the population r is large (Wolf 1986).

The mean values of r, d, and Z_r were calculated for each variable. A weighted mean value of r was calculated using the sample sizes as the weights. A weighted Z_r value was also calculated using the sample size minus three (degrees of freedom) as the weights (Rosenthal 1984).

5.2 Homogeneity

The first test performed on each variable was to determine if the study statistics indicated homogeneous populations (see Appendix B). The purpose of this test is to ensure that the statistics being combined come from a homogeneous population (Rosenthal 1984). The Z test was performed for variables found in only two studies. The Chi square test was used for variables having more than two studies. Appendix B reports the detailed results of these procedures. One variable, *definition*, was found to have a heterogeneous population with a Chi square of 6.6191 and a $p < .05$. The studies were examined and one study had a very different r value of .2013 (Kim and Lee 1986) while the other two had r's of .5071 and .58 (Ginzberg 1981; Edstrom 1977). The fact that the Kim-Lee study was done in Korea while the other two were done in the United States provides insight into the disparity. The Kim-Lee study was excluded from the variable *definition* but was included with the variables *feasibility* and *implementation*. After exclusion the p value of *definition* is .38.

5.3 Fail-Safe N

Once the studies within the variables were found to be homogeneous, Fail-Safe N was calculated (Wolf 1986). Fail-Safe N represents the number of studies needed to change the mean effect size d of the variable. In the calculations of Fail-Safe N (N_{fs} in Appendix B), a conservative effect size, $d = .2$, was used. The most sensitive variables were *use*, *implementation*, *accuracy* and *feasibility*. The Fail-Safe N is interpreted by concluding that one more study could possibly influence the effect size of the variables *use* and *implementation* if conflicting results were found. Two more studies could possibly influence the effect sizes of the variables *accuracy* and *feasibility* if the results conflicted with the current studies.

5.4 Variance

Variance of the effect sizes was then examined. The variance of the effect size, r, is composed of the variance in each of the study effect sizes and the variance due to sampling error (Hunter, Schmidt and Jackson 1982). The variance across the studies was calculated using the weighted mean r's. When one of the sample sizes dominated, variance was calculated using the mean value of r. In all cases where S_E^2 was calculated both ways, the difference in the sample variance was negligible.

Next the variance due to sampling error was calculated. It is necessary to calculate sampling error variation because variation due to moderating variables needs to be found. In all cases except for the variables *feasibility*, and *design*, the sampling error variance (S_E^2) was greater than the effect size variance (S_R^2). This is explained by the fact that the sampling error variance does not cancel out variance of opposite signs by squaring. A constant is thus included in the sampling error variance that is not included in the between studies variance (Hunter, Schmidt and Jackson 1982).

All the variables had insignificant variance in each of the study effect sizes (S_R^2 -S_E^2). Because of the very small study effect size variances, the effects of moderating variables were not considered significant.

5.5 Equal Population Correlation Test

Statistics of variables being combined have to be tested to be sure that there are no moderating variables confounding the findings. To resolve this, a test of the hypothesis of equal population correlations was performed. Hunter, Schmidt and Jackson (1982) suggest using the Chi square test because of its statistical strength. All of the studies were found to be significant so no moderating variables were considered after the test.

Many researchers recommend the use of the confidence interval of the effect size to see if it includes zero. If the confidence interval included zero, then the conclusion would be that the effect size was not significantly different from zero. The formula used was: $r_w + 2.58 (S_E/N^{.5})$ for a $p < .01$ one-tail test. This formula was used because it is consistent with traditional confidence interval testing. S_E was used because in most cases it was the larger variance and therefore would give a more conservative interval. Other formulas are provided in the above references for the interested reader. The Winer Combined Test (Hunter, Schmidt and Jackson 1982) was calculated for the global variables of *attitude* and *reported behavior*. The combined test indicated a significant effect common in each of these variables.

6. ANALYSIS

The dependent variable *success* has been represented by a variety of surrogate measurements. These surrogate measures have been combined into two global variables termed *attitude* and *reported behavior* (Figure 2). *Attitude* includes that set of measures that represents the attitudinal perceptions reported by the subjects. *Reported be-*

havior measures are those in which the actions of the subjects were either measured directly or reported upon. Both of these variables are considered significant since neither's confidence interval includes zero at $p < .01$ (Conover 1980).

	d	r	confidence interval
behavior	.3858	.1872	.0991 ← r ← .2753
attitude	.5139	.2399	.2198 ← r ← .2600

All of the surrogates were found to be significant (see Appendix A). Higher values of d or r indicate stronger relationships between the surrogates and system success. *Perceived success*, *worth* and *ownership* variables show a strong relationship between system success and involving users in the system design process.

These relationships can be thought of in terms of shifting the mean of the distribution of possible project outcomes. Figures 3 and 4 show the comparison of project outcomes with and without user involvement. The average user not involved in the system development would be in the fiftieth percentile. In those studies where *reported behavior* measures were employed, outcomes improved from the fiftieth percentile to the seventieth percentile. Where users' *attitude* was measured, outcomes improved from the average to the sixty-fifth percentile. Figure 3 illustrates the improved perception of the value of the system by involving the user in the design process.

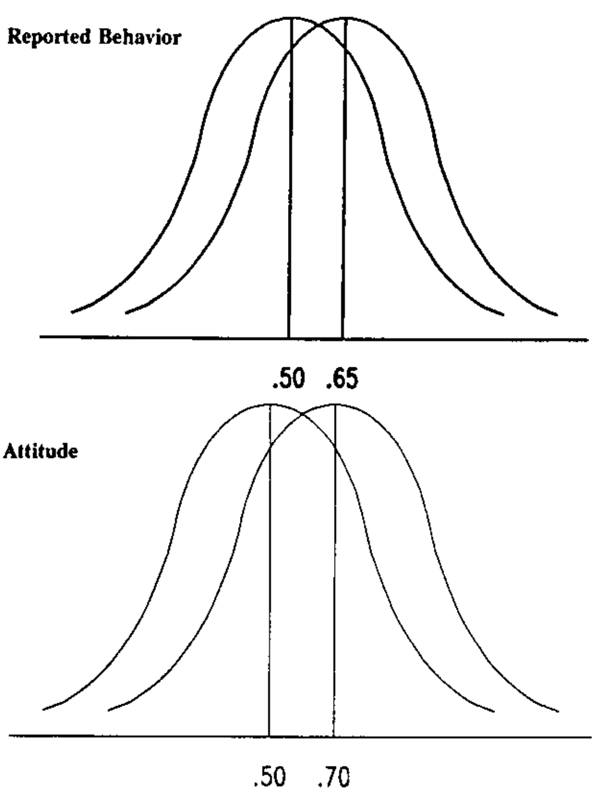

Figure 3. Comparison of Effect Size by Global Variable

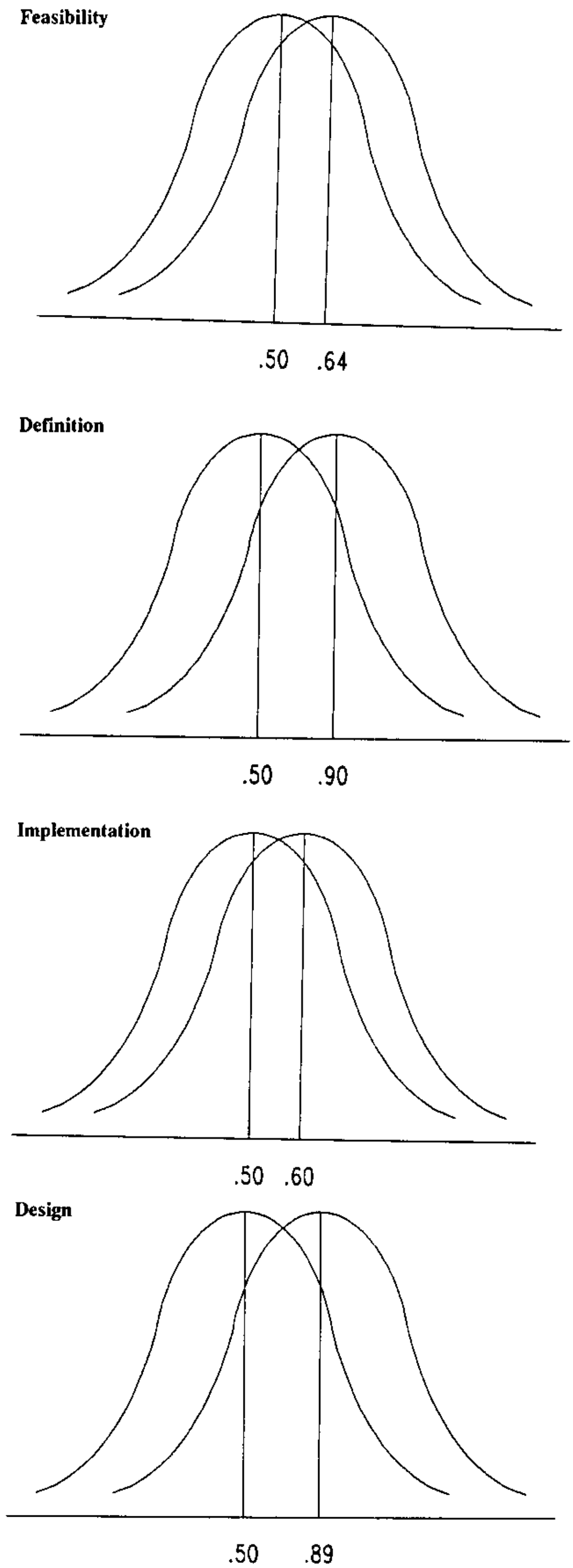

Figure 4. Comparison of Effect Size by Life Cycle Phase

The shift of outcomes can also be considered on the basis of when in the project the involvement occurs. Figure 4 illustrates the improvement in success realized by including users in the system design phases. By including users in the *definition* and *design* phases, the average outcome improved from the fiftieth to the ninetieth and eighty-ninth percentile, respectively, in perceived system success. Figure 4 points out the value of including users in the different design phases. Including users in the definition and design phases increases their perception of the value of the system the most.

Guidelines for the interpretation of relative effect sizes are provided in Cohen (1977). The range of effect sizes (small = 0 - .2, medium = .2 - .5, large = .5 and up) for the variables in this study are shown in Figure 5. Questions measuring *perceived success*, *worth*, and *ownership* reflect the strongest relationship with user involvement.

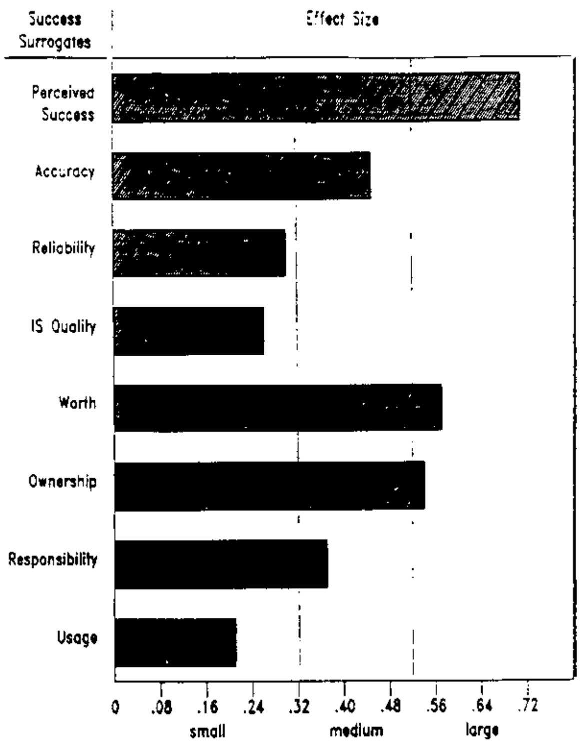

Figure 5. The Range Effect of Sizes

7. CONCLUSION

The cumulative analysis of the research on user involvement has provided a clarity that the individual studies did not reveal. Strong relationships between user involvement and system success emerged from a number of different perspectives. Meta-analysis has proved to be a useful tool in analyzing the relationship between user involvement in system development and a successful system. Individual studies hypothesized that systems developed involving users in the system design were more successful. Meta-analysis took these studies one step further and addressed the strength of this relationship. The relationship found in the meta-analysis is positive and significant for all the surrogate variables used.

An added dimension of meta-analysis is the combination of variables for an overall global effect size. By abstracting to the level of the global variables (*attitude* and *reported behavior* in this study), an integrated perspective can be achieved. Both of the global variables in this study yielded significant results. At the same time, it is necessary to note that these conclusions are not irreversible. By examining N_{fs} (see Appendix B) one can see that the inclusion of a few additional studies with nonsignificant results could reverse the findings for some variables (e.g., *accuracy, use, feasibility, implementation*).

Meta-analysis is a young statistical tool but is beneficial. Combining existing studies of user involvement has brought together divergent conclusions to show a significant relationship between user involvement and a successful system.

8. ACKNOWLEDGMENTS

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APPENDIX A

CALCULATED EFFECT SIZES[a]

	NUMBER OF DIFFERENT STUDIES	MEAN r	MEAN d	MEAN z_r	WEIGHTED MEAN r	WEIGHTED MEAN z_r	TOTAL N
ATTITUDE	5	.24	.51	.25	.23	.24	320
accuracy	2	.22	.45	.22	.26	.27	72
success	3	.32	.71	.34	.34	.37	108
reliability	1	.15	.30				57
IS quality	1	.13	.26				83
REPORTED BEHAVIOR	9	.19	.39	.19	.19	.19	1021
use	5	.11	.22	.11	.12	.12	509
worth	3	.27	.57	.28	.24	.25	108
ownership	3	.26	.54	.27	.25	.26	369
responsibility	1	.18	.37				35
DESIGN PHASES							
feasibility	3	.18	.36	.18	.18	.18	230
definition	2	.54	1.30	.61	.53	.58	48
design	6	.45	1.26	.41	.36	.35	215
implementation	4	.12	.24	.12	.16	.16	348

[a]Weighted means use the sample sizes as the weights Total N is the sum of the sample sizes of the included studies.

APPENDIX B

DEPENDENT VARIABLES STATISTICS ON THE EFFECT SIZES[a]

VARIABLES	N_{fs}	HOMOGENEOUS TEST (p-VALUE)	S_R^2 ($S_R^2 - S_E^2$)	S_E^2	CONFIDENCE INTERVAL
ATTITUDE	10	4.94 (p>.20)	.0137 (.0058)	.0195	.21 < r < .25 .06 < r < .41[d]
accuracy	2	.50[b] (p>.30)	.0039 (.0202)	.0241	.24 < r < .28 .21 < r < .31[d]
success	7	.02 (p>.20)	.0133 (.0083)	.0216	.32 < r < .37 .24 < r < .45[d]
reliability[c]					
IS quality[c]					
REPORTED BEHAVIOR	12	7.72 (p>.20)	.0075 (.0044)	.0119	.18 < r < .20 .05 < r < .32[d]
use	1	2.83 (p>.20)	.0056 (.0034)	.0090	.11 < r < .13 .03 < r < .20[d]
worth	8	.33 (p>.20)	.0030 (.0216)	.0246	.23 < r < .26 .20 < r < .29[d]
ownership	5	.10 (p>.20)	.0023 (.0048)	.0071	.25 < r < .26 .23 < r < .28[d]
responsibility[c]					
DESIGN PHASES					
feasibility	2	3.22 (p>.20)	.0137 (.0017)	.0122	.16 < r < .20 .08 < r < .27[d]
definition	11	.29[b] (p>.38)	.0011 (.0107)	.0217	.52 < r < .54 .50 < r < .55[d]
design	26	1.72 (p>.20)	.0192 (.0017)	.0175	.34 < r < .38 .19 < r < .53[d]
implementation	1	1.55 (p>.20)	.0045 (.1045)	.0109	.15 < r < .16 .10 < r < .21[d]

[a] S_R2 is the variance of the effect size. S_E^2 is the variance due to sampling error.

[b] Z test was used.

[c] Only one study.

[d] Interval computed using the square root of the sum of 1/N.

APPENDIX C

POST IMPLEMENTATION VARIABLES

VARIABLES	REFERENCES
accuracy	King and Rodriguez 1981 Mahmood and Becker 1985
use	King and Rodriguez 1981 Baroudi, Olson and Ives 1986 Olson and Ives 1981 Kim and Lee 1986 Spence 1978
worth	King and Rodriguez 1981 Vanlommel and DeBrabander 1975 Ein-Dor and Segev 1981
ownership	Ginzberg 1981 Baroudi, Olson and Ives 1986 Igersheim 1976
success	King and Rodriguez 1981 Edstrom 1977 Kaiser and Srinivasan 1980
reliability	Mahmood and Becker 1985
IS quality	Olson and Ives 1981
responsibility	Ginzberg 1981

GLOBAL VARIABLES

VARIABLE	REFERENCE
attitude	King and Rodriguez 1981 Baroudi, Olson and Ives 1986 Olson and Ives 1981 Kim and Lee 1986 Spence 1978 Vanlommel and DeBrabander 1975 Ein-Dor and Segev 1981 Ginzberg 1981 Igersheim 1976
reported behavior	King and Rodriguez 1981 Edstrom 1977 Kaiser and Srinivasan 1980 Mahmood and Becker 1985 Olson and Ives 1981

SYSTEM DESIGN PHASES INVOLVEMENT

VARIABLES	REFERENCES
feasibility	Olson and Ives 1981 Edstrom 1977 Kim and Lee 1986
definition	Ginzberg 1981 Edstrom 1977 Kim and Lee 1986
design	Ginzberg 1981 Swanson 1974 Edstrom 1977 Boland 1978 Franz and Robey 1986 Kim and Lee 1986
implementation	Olson and Ives 1981 Edstrom 1977 Franz and Robey 1986 Kim and Lee 1986