

**THE CONTINGENT EFFECTS OF MANAGEMENT SUPPORT
AND TASK INTERDEPENDENCE ON SUCCESSFUL
IS IMPLEMENTATION: A META-ANALYSIS**

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ABSTRACT

The literature reports inconsistent findings for the effect of management support on the successful implementation of information systems innovations. This study proposes a contingent model that begins to explain this variance in the extant research findings. Conducting a meta-analysis of the IS implementation literature, we show, as hypothesized, that task interdependence moderates the effect of management support on implementation success and that there is no main effect of management support on implementation success. The implications for theory and practice are discussed.

1. INTRODUCTION

The implementation of information systems (IS) innovations remains a theoretical as well as a managerial challenge. Many IS innovations introduced by organizations are either rejected by end-users or under utilized (see, for example, Markus, 1983; Sauer, 1993; Markus, Tanis and van Fenema, 2000). The literature on implementing such innovations has examined the influence of a wide range of factors. A large subset of these belongs to the implementation process framework, which models implementation success as a function of managerial interventions, such as management support (Kwon and Zmud, 1987).

Cumulatively, the findings from this research stream provide inconsistent support for the effect of management support on implementation success. For example, while Robey (1979) and Sanders and Courtney (1985) report that management support has a positive effect on implementation success, Ginzberg (1981) and Guimaraes et al. (1992) report that such support has no effect on the likelihood of success. This pattern of findings is consistent with non-contingent, linear main effects models being applied to a

phenomenon that is context dependent. In which case, the need is to identify a contingency variable (or variables) and extend current theoretical models to explain the inconsistent empirical findings.

The goal of this paper is to begin this task. We review the literature and conclude that the variance in findings is explained in part by the moderating effect of task interdependence on the relationship between management support and implementation success. We then develop a contingent model that begins to explain the variance in the reported findings. A meta-analysis of previous empirical findings reported in the literature is conducted to test the hypotheses developed from the model. The results provide strong support for the hypotheses and begin to explain the inconsistent findings.

We begin by briefly describing implementation process theory, extending it to include the effect of task interdependence and developing hypotheses following from the extended theory. We then describe the meta-analysis methodology used to test the hypotheses. The sample selection procedures, sample characteristics, measurement instruments and analysis techniques are described. As hypothesized, we find that task interdependence moderates the effect of management support on implementation success and that there is only a weak or no main effect of management support on implementation success. Finally, validity threats and the implications for theory and managerial practice are discussed.

2. THEORY AND HYPOTHESES

Implementation process research focuses on barriers to implementation arising from the organizational context and the managerial interventions required to overcome those barriers (Kwon and Zmud, 1987; Leonard-Barton and Deschamps, 1988). For example, end-user resistance, organizational politics, structural change and learning are identified as barriers to successful implementation (Markus, 1983; Tornatzky and Fleischer, 1990; Mankin, Cohen and Bikson, 1996). Managerial support, including training and technical support, rewards and sanctions, incentives, job redesign and sanctioning user involvement, is considered critical for implementation success (Leonard-Barton, 1987b; Bhattacharjee, 1996).

The motivation for developing the implementation process framework was, in part, the perceived limitation of employing Rogers' theory of diffusion of innovations as a theoretical framework for research into the implementation of IS innovations. Diffusion theory (Rogers, 1983) underpins much of the early implementation research but later researchers questioned the validity of employing it in an organizational setting. A key aspect of their critique concerned differences between the context within which diffusion theory was developed and the organizational context within which IS innovations are implemented.

Implementation process theory models success as a function of various managerial interventions to "diffuse an appropriate information technology within a user community" and the expenditure of resources to "promote novel behaviors to diminish opposing forces, and to otherwise insure that expected benefits from investments in new technologies are realized" (Kwon and Zmud, 1987: p. 231-232). Unlike diffusion theory, which assumes that end-users are autonomous decision-makers who make voluntary decisions to adopt or reject innovations, implementation process theory assumes that end-users' decisions are influenced by managerial interventions such as management support (Leonard-Barton and Deschamps, 1988; Bhattacharjee, 1996). In general, two themes underpin the models of IS implementation success belonging to this research stream. First, the organizational context presents various barriers to successful implementation and, second, managerial interventions are required to overcome these barriers and ensure successful implementation (Leonard-Barton, 1987a; Markus and Keil, 1994).

Among the potential barriers, the theory identifies the impact of IS innovations on existing patterns of task interdependence (Thompson, 1967) and coordination as a key barrier to successful implementation (Leonard-Barton, 1987a). Addressing interdependent tasks requires that end-users, performing specific tasks that are components of a broader interdependent business process, develop new patterns of task interdependence and coordination (Fleischer and Roitman, 1990). Frequently, benefits from the adoption of such innovations are dependent on coordinated adoption by a critical group of organizational members (Ginzberg, 1980; Klein and Sorra, 1996). In addition, IS innovations frequently require changes to existing organizational structures and procedures (Orlikowski, 1996; Sharma and Yetton, 1996). In such cases, end-user resistance and

organizational politics often make it difficult to implement the required organizational changes (Markus, 1983; Tornatzky and Fleischer, 1990).

This analysis identifies two important assumptions underpinning implementation research. Recall that diffusion theory was developed to explain the *independent* adoption of *individual* use technologies (Fichman, 1992). In contrast, implicitly and initially explicitly, implementation process theory has been developed to explain the *group or organizational* adoption of *interdependent* use technologies (Eveland and Tornatzky, 1990; Fleischer and Roitman, 1990). This highlights two critical differences between the contexts in which these two theories are applicable. One is the level of analysis and intervention, which is individual in diffusion theory and group or organization in implementation process theory. The other is the nature of the innovation to be adopted, which is independent in the former theory and interdependent in the latter. The analysis also shows that both differences are critically dependent on the level of task interdependence. Contexts in which this is low are consistent with the assumptions of the diffusion framework and, conversely, contexts in which it is high are consistent with the assumptions of the implementation process framework.

The moderating effect of task interdependence on the relationship between management support and implementation success, while implicit in the development of the theory (Tornatzky and Fleischer, 1990; Klein and Sorra, 1996), has not been examined in the research literature. Instead, the empirical analysis of the effects on implementation success of factors such as management support are typically modeled as simple main effects. Cumulatively, this stream of research has reported inconsistent findings. The correlations between management support and implementation success range from as low as -0.15 (Ginzberg, 1981) and 0.01 (Guimaraes et al., 1992) to as high as 0.45 (Sanders and Courtney, 1985). As noted earlier, this variance in findings is consistent with a non-contingent, linear main effects model being fitted to a phenomenon that is context dependent. Contingent models, such as the one developed here, are required to provide a better explanation of the phenomenon.

Summarizing the above discussion, we propose that the effectiveness of managerial interventions to address the actual or potential misfit at the group or organizational level of analysis is context dependent. Specifically, as the level of task interdependence increases, the organizational context presents increased barriers to successful IS implementation. These barriers have to be overcome by effective managerial interventions. Consequently, the influence of management support on successful IS implementation increases as task interdependence increases. Formally,

H1: The effect of management support on implementation success is a positive function of task interdependence.

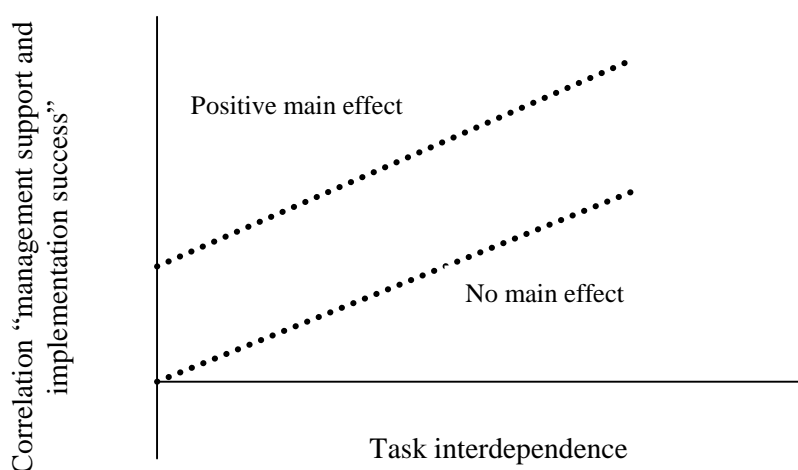


Figure 1: Relationships between management support and implementation success under varying levels of task interdependence

The preceding discussion is silent as to whether there is also a main effect of management support on implementation success, interpreted here as a positive effect of management support in low task interdependence contexts. This potential main effect is shown in Figure 1 as the intercept when task interdependence is low. Two distinct possibilities are identified. One is that the intercept is equal to zero, which implies that there is no main effect of management support. The other is that there is a positive intercept, which implies that there is a main effect. A third possibility, that the intercept is less than zero, is rejected as there is no theoretical support for the proposition that management support has a negative main effect on implementation success.

The two models presented in Figure 1 are hypothetical examples. To examine their validity, we re-examine the above analysis of the literature. We conclude above that high task interdependence generates high barriers to implementation requiring high management support for successful implementation. In contrast, the argument developed here is concerned with low task interdependence contexts in which there are few organizational barriers to adoption by individual end-users. This context approximates the assumptions of the diffusion model. In that context, Fichman (1992) reports that implementation is the result of autonomous individual adoption decisions and Yetton et al. (1999) observe that organizational barriers to adoption are weak and, therefore, that management support is not a critical factor. Similar results are reported by Ginzberg (1981) and Guimaraes et al. (1992). Further, the considerable empirical research on Rogers' diffusion theory and the Technology Acceptance Model (TAM) suggests that, within the context of individual use innovations, motivation to adopt is driven by end-users' perceptions of task usefulness (Davis, 1989). Similarly, Bhattacharjee (1996) reports that the inclusion of incentives, behavioral evaluation and monitoring did not result in increased end-user acceptance over and above that explained by perceived usefulness and ease of use. Considered together, these findings suggest that in low task interdependence contexts managerial interventions do not have a significant effect on end-user adoption. Consequently, in a low task interdependence context, the correlation between management support and implementation success in Figure 1 is expected to be weak. Formally,

H2: There is no main effect of management support on implementation success.

3. METHOD

The above hypotheses are tested using meta-analysis, which is a set of statistical techniques to integrate findings across multiple studies addressing the same research question (Hunter and Schmidt, 1990). It is well accepted that few research questions can be resolved by single studies. In any research field, there typically

exists a number of empirical studies addressing the same or similar research questions. Meta-analysis is a systematic, reliable and rigorous methodology for integrating research findings across studies and developing a cumulative tradition within a research field (Hunter and Schmidt, 1990; Benbasat and Zmud, 1999). While it has been widely used within the psychology and organizational behaviour literatures, meta-analysis has rarely been used in IS research (for an exception, see Alavi and Joachimsthaler, 1992).

Meta-analysis is particularly suited to test the hypotheses developed above for two reasons. First, the individual studies included within the meta-analysis are likely to have varying levels of task interdependence – something that is not easily achieved within a single study. Second, the reliability of the results obtained in a meta-analysis is much higher than obtainable in a single small-sample study – the equivalent sample size is the aggregate sample size of the component studies. Both these conditions, varying levels of task interdependence and large sample size, are difficult to obtain simultaneously, except in a meta-analysis.

3.1. Sample

The sample for this meta-analysis consists of empirical studies reported in journals, books and unpublished dissertations. Following Hunter and Schmidt (1990) and Alavi and Joachimsthaler (1992), studies have been located through several literature searches. These include bibliographic databases, manual searches and bibliographies of existing works. The bibliographic databases searched were ABI/INFORM, Sociological Abstracts and Dissertation Abstracts. The search period for the bibliographies was limited to 1985-95. The bibliographies of the studies identified were searched to locate studies published prior to 1985. Dissertation Abstracts were specifically included in the search in order to overcome the potential bias of higher effect sizes associated with journal articles. This comprehensive search strategy both increases the power of the meta-analysis by maximising the number of studies and reduces source bias. A total of 60 studies and 36 dissertations were identified and examined for possible inclusion in the meta-analysis¹.

Studies were selected for inclusion in the meta-analysis if they satisfied three conditions. First, they operationalized implementation success and management support. Second, the description of the task addressed by the IS innovation provided enough data to code the measure of task interdependence. Third, the study reported the correlations between management support and implementation success. The final sample consisted of 22 studies with an effective sample size of 2820. The most common reason for excluding studies was that they did not report the correlation between implementation success and management support.

3.2. Measurement of Variables

3.2.1 *Implementation success*: Following Alavi and Joachimsthaler's (1992) meta-analysis, use and user satisfaction were employed as measures of implementation success. These are the measures for implementation success most commonly employed in the empirical literature (DeLone and McLean, 1992). The key managerial challenges faced in the implementation stage are overcoming various forms of end-user resistance, motivating end-users to adopt and developing new behaviors among end-users (Kwon and Zmud, 1987). Given these challenges, use and user satisfaction represent the success of various managerial interventions designed to promote end-user adoption. Hence, these variables are also accepted here as the most appropriate proxies for implementation success.

3.2.2 *Implementation process*: Management support is the variable most frequently hypothesized in the implementation process literature as contributing to implementation success (Jarvenpaa and Ives, 1991). The labels most commonly used for this construct are management support and top management support.

3.2.3 *Task interdependence*: Task interdependence is estimated for each study included in the meta-analysis. Based on the information given in each study a brief description of the task addressed by the IS innovation

¹ A complete list of studies examined and a list of studies included in the meta-analysis is available on request from authors. It is not included here on account of space limitations.

was generated. The description includes all information provided in the original study regarding the IS innovation, the task supported by the IS innovation, the organizations participating in the study, and the end-users sampled. Portions of text were taken verbatim from the studies to generate the descriptions and only minor changes were made to link text that came from different parts of the original study.

Two independent judges rated the description of each innovation on a six-item scale of task interdependence developed and validated by Pearce, Sommer, Morris and Fridegar (1992). In addition, the first author also rated each study. The inter-rater correlations were $r = 0.84, 0.81$ and 0.78 and the coefficient of inter-rater concordance was 0.88 , indicating a high level of inter-rater agreement. The task interdependence score for each study was operationalized as the mean value of its three ratings. The Cronbach alpha for this scale is 0.90 .

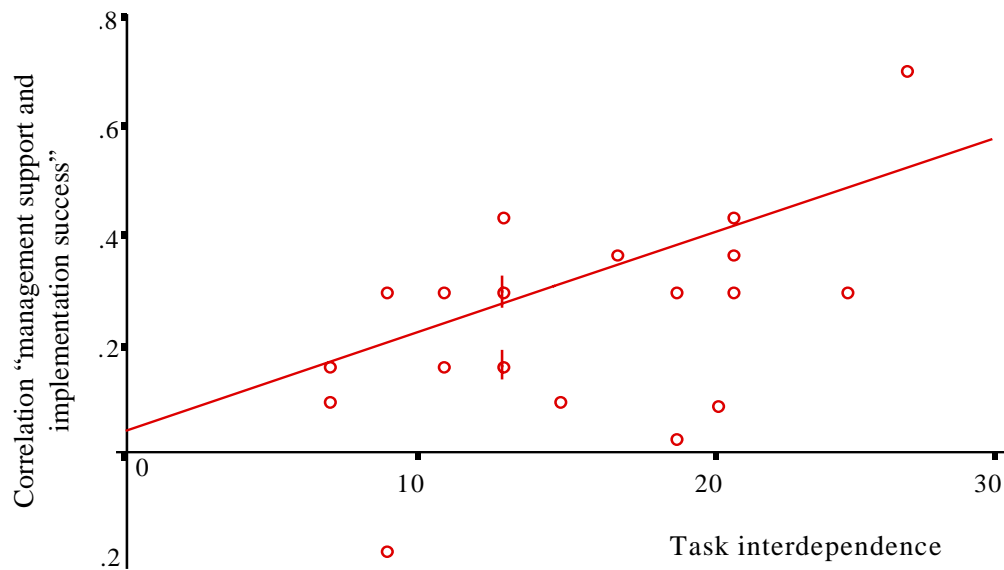
3.3. Analysis

Hypotheses 1 and 2 are tested using a weighted least squares regression procedure proposed by Hedges and Olkin (1985: p. 224-246) and Hunter and Schmidt (1990). This procedure involves testing the slope and intercept in a regression model with task interdependence as the predictor variable, the study correlation as the criterion variable and with each study being weighted by its sample size. H1 predicts that the slope of the function, when the correlation between implementation success and management support is regressed on task interdependence, is positive and significantly different from zero. In contrast, H2 predicts that the intercept of the function, when task interdependence is low, is not significantly different from zero.

4. RESULTS

The effect of management support on implementation success is a positive function of task interdependence. Figure 2 presents the weighted least squares regression² of the correlation between management support and implementation success on task interdependence ($R^2 = 0.36, F = 10.5, p \leq 0.05$). The slope for task interdependence is significantly greater than zero ($\hat{\beta}_{\text{task interdependence}} = 0.60, t = 3.2, p \leq 0.05$) and the intercept is non-significantly different from zero ($\hat{b}_0 = 0.06, t = 0.97, ns$). Hypothesis 1, the effect of management support on implementation success is a positive function of task interdependence, is supported. The 90% confidence interval for the slope is 0.37 to 0.82 . Hypothesis 2 is also supported. When task interdependence is low, management support has a trivial or small effect on implementation success ($\hat{b}_0 = 0.06$). The 90% confidence interval for the intercept is -0.02 to 0.15 . Even at the upper boundary of the confidence interval, the variance explained is only about 2%. This suggests that, at best, the main effect of management support on implementation process is weak.

² This result excludes one observation that was identified as an outlier.



$R^2 = 0.36$ ($p \leq 0.05$): Aggregate sample size = 2702.

Figure 2: Graph of correlation between management support and implementation success versus task interdependence

5. DISCUSSION AND CONCLUSIONS

The results of this study show that, as hypothesized, the effect of management support on implementation success is a positive function of task interdependence, and when task interdependence is low, management support has a weak or low effect on implementation success. An inspection of Figure 2 finds that, in low task interdependence situations, corresponding to a score of 10 on the horizontal axis, the predicted average correlation between management support and implementation success is approximately 0.20 and explains about four percent of the variance in implementation success. In contrast, in high task interdependence situations, corresponding to a score of 25, the predicted average correlation is approximately 0.45 and explains 19% of the variance, or nearly five times as much. We interpret these findings to show that management support has a small effect on implementation when task interdependence is low but a medium to large effect when task interdependence is high. This interpretation of effect sizes is consistent with Cohen and Cohen's (1983) rough guidelines for small ($r = 0.10$), medium ($r = 0.30$) and large ($r = 0.50$) effect sizes. We conclude that the findings support a contingent model in which high management support is a necessary and critical, if not sufficient, component of a successful implementation strategy when task interdependence is high, but a relatively weak and probably not critical component when task interdependence is low.

5.1. Implications for Theory³

As argued in the literature review above, it is difficult, in a non-contingent framework, to explain the variance in reported correlations between implementation success and management support. In contrast, the

³ These findings are not subject to validity threats arising from source bias (dissertations versus journals), the different operationalizations of management support or implementation success (behavioral versus perceptual measures) employed in the primary studies, construct validity or the presence of outliers. A complete analysis of these threats and internal and external threats is not being reported here on account of limitations of space but is available on request from the authors.

contingent model proposed here, which hypothesizes that the effect of management support is moderated by the level of task interdependence, begins to explain this diverse set of findings. The results of the meta-analysis validate this hypothesis: a significant proportion of the variance in reported correlations ($R^2 = 0.36$) is accounted for by the moderating effect of task interdependence.

The findings of this study help to explain previously unexplained findings for the effect of task interdependence on IS implementation. IS innovations involving higher levels of task interdependence are expected to be more difficult to implement (Ginzberg, 1980; Klein and Sorra, 1996). Following from this, a number of researchers hypothesized a negative main effect of task interdependence on implementation success but reported non-significant findings (see, for example, Sanders and Courtney, 1985; Guimaraes et al., 1992; Goodhue and Thompson, 1995). Considered together, these findings and this meta-analysis suggest a revision of Ginzberg's (1980) argument. It is not simply the case that IS applications involving higher levels of task interdependence are more difficult to implement, rather that success on such projects is sensitive to the level of management support.

The findings of this study confirm our speculation that implementation processes, such as management support, contribute to successful implementation by addressing the group level impacts of IS innovations, such as changes to organizational structures and processes. Similarly, reviews of diffusion theory find that it contributes to successful implementation by addressing individual level effects of IS innovations, such as extrinsic motivation (DeSanctis, 1983; Fichman, 1992; Yetton et al., 1999). Taken together, the two observations lead to the key but still speculative conclusion that diffusion theory contributes to fit at the individual level of analysis, and implementation processes, and management support in particular, contribute to fit at the group level of analysis. In which case, the two theories are contingent explanations that hold within different contexts (Yetton et al., 1999). Within contexts characterized by high individual-level impacts, diffusion theory explains successful implementation, and within contexts characterized by high group-level impacts, implementation processes make a high contribution. As Markus and Robey (1983) argued a long time ago, successful implementation requires that the individual as well as the group level impacts of IS innovations be addressed *as needed* (our italics for emphasis) to create an organization-innovation fit.

5.2. Implications for practice

The findings of this study are a first step towards providing a basis for selecting an efficient and effective portfolio of managerial interventions to fit the needs of the situation. The framework of implementation contexts adapted from Yetton et al. (1999) highlights the choices to be made. Here, it is assumed that task interdependence is a predictor of the potential impacts on group task performance.

Impact on Individual Task Performance	High	II Self-Motivate	IV Manage
	Low	I Mandate	III Support
		Low	High
		Impact on Group Task Performance	

Figure 3: Implementation strategies for different contexts

Quadrants I and II are low on task interdependence and the contingent model proposed here predicts that within these two contexts the effect of management support on implementation success is low. Consequently, investing in management support does not result in increased end-user adoption. In Quadrant I, managers should simply mandate use and not invest in management support to influence end-user adoption. Some technical upgrades fall into this category. In Quadrant II, the key managerial intervention is to influence the process of systems analysis and design to ensure that user friendliness and performance gains for end-users are designed into the system. End-users are self-motivated to trial the innovation and to manage their own learning needs. Individual productivity tools, such as the on-line portfolio management system described by Ginzberg (1981), belong in this Quadrant.

Quadrants III and IV identify contexts with high task interdependence in which management support has a significant impact on implementation success. In Quadrant III, end-users are not likely to adopt such an innovation on their own as it is not expected to result in significant individual performance gains. However, if the innovation is to improve the performance of a task group or the organization as a whole, then the appropriate implementation strategy is to proactively support the use of the system. In Quadrant IV, end-users would like to adopt such innovations for the performance gains they offer. However, as they address interdependent tasks, performance gains to one group of users are available only when the system is simultaneously adopted by another group of users. Frequently, these end-users are located in different departments. Simultaneous and coordinated adoption of a system by users located across organizational boundaries requires a high level of management support. Examples include MRP II, ERP and CASE.

6. SUMMARY

This research develops and tests a contingent model of IS implementation in which implementation processes are hypothesized to have a large effect on implementation success in contexts characterized by high group level impacts. As hypothesized, the effect of management support on implementation success is found to be moderated by task interdependence and that, when task interdependence is low, management support has a weak or small influence on implementation success. The hypotheses are tested using meta-analysis.

The results have important implications for theory and practice. They both explain a significant proportion of the variance in empirical findings reported for the effects of management support on implementation success and can also account for recent research findings which explores more complex models to explain implementation success. For managers, the findings both suggest the need and show how to tailor implementation strategies to the task context.

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