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Successful IS Innovations: The Contingent Contributions of Innovation Characteristics and Implementation Process

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SUCCESSFUL IS INNOVATION: THE CONTINGENT CONTRIBUTIONS OF INNOVATION CHARACTERISTICS AND IMPLEMENTATION PROCESS

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Abstract

This paper develops a contingent model of IS implementation in which the contributions of innovation characteristics and implementation process are contingent upon the implementation context. Different assumptions regarding the implementation context implicit in the innovation characteristics and implementation process theories are identified and a contingent model within which to integrate them is developed. The model is tested within one particular context using data collected from the end-users of an IS innovation introduced in a state health system in Australia. As hypothesized, it is found that, within a context characterized by high individual level impact and low group level impact, the contribution of innovation characteristics to implementation success is higher than that of implementation process. The contingent model is used to explain the null findings for implementation process reported in some previous studies. Implications for research and managerial action are discussed.

Keywords: IS implementation, IS success, diffusion of innovation, contingency models, task interdependence, regression analysis.

1. INTRODUCTION

Information systems (IS) and information technology (IT) innovations are increasingly being used to drive organizational change programs intended to deliver significant performance improvements (Hammer 1990). At the same time, implementation failures are common and end users frequently reject innovations (Markus and Benjamin 1997; Sauer 1993). A careful inspection of the literature reveals two competing theories—innovation characteristics theory and implementation process theory—that are rarely the subject of comparative analysis within a study. Furthermore, tests of both theories have generated a number of null findings (see, for example, Cooper and Zmud 1990; Fuerst and Cheny 1982; Ginzberg 1981; Lee 1986; Leonard-Barton and Deschamps 1988; Markus and Keil 1994). These observations suggest limitations of the extant theory to guide managers in successfully implementing IS innovations. More importantly, from a theoretical viewpoint, they are consistent with non-contingent models being applied to a phenomenon that is context dependent, in which case the need is to identify the critical contextual factors which explain the apparently inconsistent results. This is the goal of this paper, in which a model integrating the two dominant theories within a contingent framework is proposed.

The two theories are distinguished by the different assumptions regarding the implementation context (hereafter simply referred to as context) implicit in them. Whereas innovation characteristics theory assumes that the context is characterized by independent adoption of technologies used to perform individual tasks (Fichman 1992), implementation process theory assumes that the context is characterized by coordinated adoption of technologies by groups performing interdependent tasks (Ginzberg 1980; Klein and Sorra 1996). Fichman identified the assumptions implicit in the innovations characteristics theory and found that support for the theory is contingent upon a match between the context and the assumptions of the theory. Building upon these insights, this paper proposes a contingent framework of contexts characterized by two dimensions, namely, impact of the IS innovation on individual task performance and impact of the IS innovation on group task performance. Further, the paper proposes that the effect of the two theories is contingent upon the implementation context. Where impact on individual task performance is high, innovation characteristics have a significant effect and where impact on group task performance is high, implementation processes have a significant effect.

In addition to extending and integrating extant theory, the proposed contingent framework has important implications for managers. The two theories focus on different impacts of the IS innovation and, consequently, prescribe different managerial actions for ensuring successful implementation. Whereas innovation characteristics theory requires managers to ensure that the IS innovation has the right characteristics, implementation process theory focuses managerial effort on the process of implementation. From a managerial perspective, the proposed contingent framework helps managers identify the relative criticality of the two courses of action within different contexts. Not only does this enable managers to develop more effective implementation strategies by identifying the critical success factors within specific contexts, it also results in a more efficient allocation of managerial resources. In particular, by identifying the magnitude of impact on group task performance, it identifies the level of managerial effort required to implement a particular IS innovation.

The paper begins by identifying the different assumptions implicit in the two theories. A model is then developed integrating the two theories within a contingent framework. Next, one context in the model is selected and a hypothesis predicting the relative contribution of the two theories to successful implementation developed. Testing the proposed theory within one context serves as a preliminary validation that justifies further investigations. The sample characteristics and measurement instruments are described in the methodology section. The hypothesis is tested using data collected from the end-users of a computerized human resource information system introduced across multiple sites of a state health system in Australia. As predicted, it is found that, within the context studied, innovation characteristics are more important than implementation process for the success of this IS innovation, thus providing support for the contingent framework proposed here. Finally, the implications for theory and managerial action are discussed.

2. THEORY AND HYPOTHESES

The literature on IS innovation has investigated the effects of a wide range of variables, drawn primarily from two theoretical domains: innovation characteristics and the implementation process (Ginzberg 1980). Typically, the two dominant theories have been researched independently and are seen as competing explanations for implementation success. Here, it is proposed that the two theories are not competing, but contingent explanations that hold within particular contexts defined by the different assumptions implicit in the two theories. The paper first identifies these assumptions and considers how they impact differently on end-user performance. A contingent framework of contexts within which to integrate the two theories is then developed.

To provide a general theoretical framework within which to test the contingent framework proposed here, the model of secondary adoption proposed by Leonard-Barton and Deschamps (1988) is extended. This framework, presented in Figure 1, integrates the innovation characteristics and the implementation process theories, and also includes the effects of individual characteristics and informal support. Adaptations of or earlier variations on this general framework have been used in a number of studies (see, for example, Cooper and Zmud 1990; Davis 1989; Fuerst and Cheny 1982; Guimaraes et al. 1992; Howard and Mendelow 1991; Lucas 1978; Maish 1979; Sanders and Courtney 1985; Thompson et al. 1991).

2.1 Innovation Characteristics and Implementation Process Theories

Innovation characteristics theory assumes that end-user adoption of IS innovations is based on an evaluation of the innovation characteristics, such as relative advantage (Rogers 1962) or perceived usefulness (Davis 1989). The implicit context is characterized by the independent adoption of individual use technologies, similar to that underlying classical diffusion theory (Fichman 1992). Within this context, the innovation can be used independently and end-users can accrue benefits through individual use. Further, organizational gains are the pooled sum of individual gains (Thompson 1967). Consequently, innovation characteristics theory is developed at the individual level of analysis and identifies and explains the impacts of the innovation on the end-user's task at the individual level of analysis. Support for the contingent effect of innovation characteristics theory is provided by Fichman, who examined 18 studies on implementation based on diffusion theory and concluded that the theory found strong support only when the context met the assumptions of classical diffusion theory.

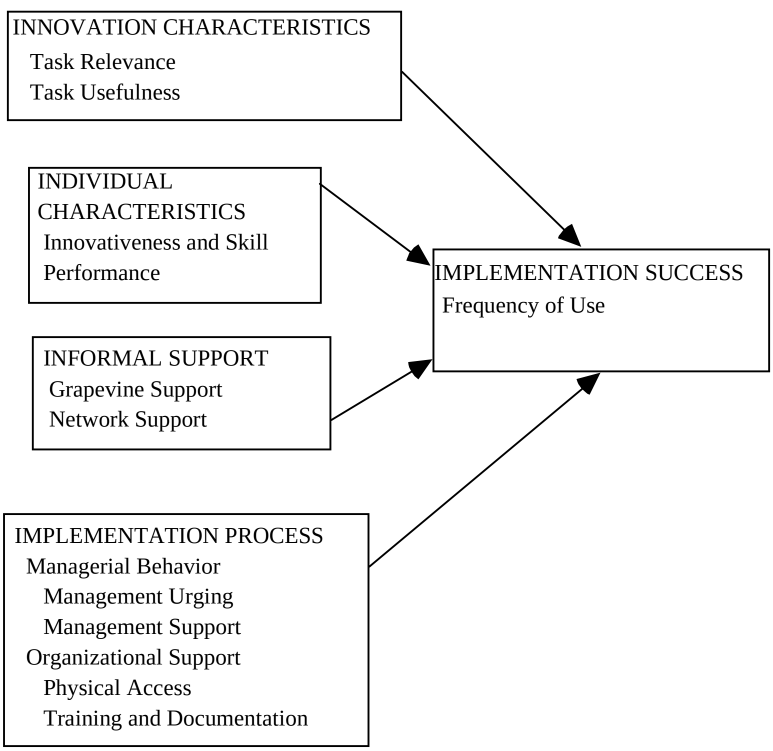

Figure 1. Secondary Adoption Model of IS Implementation
(Adapted from Leonard-Barton and Deschamps 1988)

In contrast, implementation process theory is concerned with the influence of managerial action on the end user's adoption decision. Here, implementation process refers to the organizational effort to diffuse an IS innovation within a user community. The effort covers the organizational and managerial resources expended on activities designed to promote novel behaviors among end-users and to diminish the forces opposing successful implementation (Kwon and Zmud 1987). The implementation process is characterized by the managerial interventions allocating resources to support and supervise the end-users in adopting and using the innovation.

Implementation process theory was developed, in part, in response to the perceived limitations of the innovation characteristics theory which was developed in a non-organizational setting (Bayer and Melone 1989). For instance, Tornatzky and Fleischer (1990) argue that two assumptions central to Rogers' diffusion of innovation theory, namely the invariance of the innovation across the population of potential adopters and the homogeneity of potential adopters, do not hold in the case of innovation implementation. Similarly, Attewell (1992) argues that the processes of information flow, communication and uncertainty reduction, which are central to diffusion theory, have only a limited role to play in organizational adoption. Instead, managerial actions and management support play a key role (Leonard-Barton and Deschamps 1988). Further, Attewell (1992) argues that complex IS innovations are "technologically demanding, fragile and lumpy," unlike the reliable, commodity-like innovations considered in diffusion theory. Implementing such innovations is an uncertain process of knowledge discovery, skill formation and the mutual adaptation of the technology (Attewell 1992; Mankin et al. 1985). Managerial commitment is a critical influence on the uncertain process of adoption by facilitating solutions to the numerous contingencies that arise during the various stages of implementation (Sabherwal and Elam 1995; Sauer 1993).

Implementation process theory, therefore, focuses on the effect of various managerial and organizational influences. It assumes the context to be characterized by coordinated adoption of technologies by groups performing interdependent tasks. The task supported by the IS innovation shares interdependencies among a heterogeneous group of end-users. Within this high task interdependence context, implementation requires coordinated adoption by a critical group of organizational members (Ginzberg 1980). No individual or organizational gains are obtained from sporadic adoption, rather, they are sequential or reciprocal combinations of individual behavior (Thompson 1967). A key impact which needs to be managed within this context is the replacement of existing task interdependencies by a new set of task interdependencies, and the coordination of task changes both within and across task groups. Implementing innovations within this context requires various managerial and organizational interventions to ensure coordinated adoption by heterogeneous task groups (Ginzberg 1980; Klein and Sorra 1996). Consequently, implementation process theory is developed at the group level of analysis and identifies and explains the group-level impacts of the innovation.

2.2 A Contingent Framework

From the above, it follows that the two theories identify and explain impacts of the innovation on the end-user's task at different levels of analysis. Innovation characteristics theory identifies and explains the impact on tasks at the individual level of analysis, whereas implementation process theory identifies and explains the impact on tasks at the group level of analysis. This paper proposes that the levels of impact identified by the two theories, namely, impact on individual task performance and impact on group task performance, represent two distinct dimensions that characterize the context (Figure 2).

The two theories are integrated within the above framework of contexts by proposing that the relative contribution of the two theories is contingent upon the context. Elaborating on the framework of Figure 2, the implementation context of Quadrant 1 is characterized by low individual level impacts as well as low group level impacts, such as in the implementation of a RAM doubler package. Under this context, both innovation characteristics and implemen-

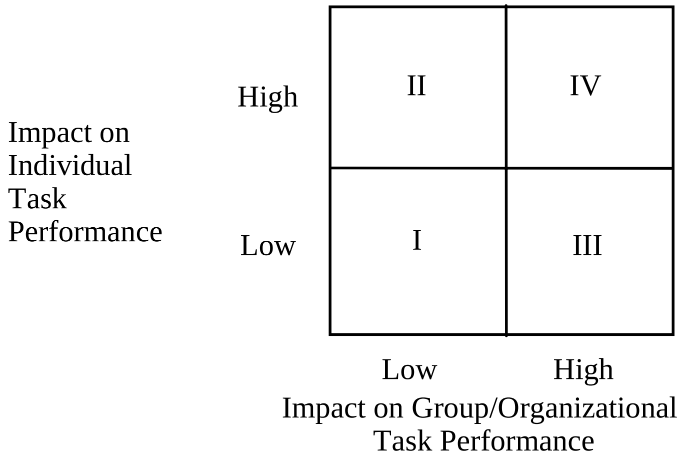

Figure 2. A Framework of Implementation Contexts

tation processes have small effects. Quadrant 2 is characterized by high individual level impacts but low group level impacts, such as in the implementation of a decision support system for portfolio managers. Under this context, innovation characteristics have a large effect but implementation processes have a small effect. Quadrant 3 is characterized by low individual level impacts but high group level impacts, such as in the implementation of a financial MIS package. Under this context innovation characteristics have a small effect but implementation processes have a large effect. Finally, Quadrant 4 is characterized by high individual level impacts as well as high group level impacts, such as in the implementation of a materials requirement planning package. Under this context both innovation characteristics and implementation processes have large effects.

A full test of the contingent framework requires the estimation of the relative contribution of the two theories within each of the four quadrants (Figure 1). Such a large research effort is beyond the scope of an individual study. This paper takes a preliminary step toward validating the contingent framework by testing it within one quadrant. Further validation of the model in other quadrants needs to be carried out in future research, such as that proposed by Sharma and Yetton (1997).

To begin to investigate this model, Quadrant II—high individual level impacts but low group level impacts—is selected and tested to see whether the impacts of the innovation characteristics and implementation process are contingent upon the context. This limited test of the contingent framework serves to establish a preliminary validity of the model, justifying further research to validate the framework in other contexts. Formally, the proposal is:

> H1: In the context of high individual level impact and low group level impact innovations, the effect of innovation characteristics is stronger than that of implementation process.

In order to test Hypothesis 1, the research needs to control for the effects of other factors that have been found to be related to implementation success. Previous research suggests that the analysis should control for the effects of individual characteristics and informal support (Leonard-Barton and Deschamps 1988). Individual characteristics include variables such as personal innovativeness, computer skill, and performance, rather than general personality types or demographic variables (Leonard-Barton and Deschamps 1988). Informal support includes support activated by end-users from their social networks to assist them in adoption (Brancheau and Wetherbe 1990; Zmud 1983) and the evaluation of the innovation carried by the grapevine (Leonard-Barton and Deschamps 1988). Unlike the implementation process and innovation characteristics variables, which are the immediate outcome of managerial action, these sets of variables are generally not subject to short-term manipulation. At a minimum, these variables act as control variables when testing the above hypotheses. More usefully, their effect also can be analyzed, adding to the cumulative research findings in this area.

3. METHODOLOGY

3.1 Research Site

This research studies the implementation of a computerized human resources information system, called Datapower, in an area health service of the publicly funded New South Wales state health system in Australia. The area health service is composed of a large teaching hospital and a number of small hospitals and clinics. Although the human resources (HR) function is centralized in the area administration, a large part of the work associated with the HR function is decentralized. This is because the requirements of the HR function vary across departments, such as finance and nursing, and across locations, such as the teaching hospital and the community clinics. In addition, the HR function is carried out at different hierarchical levels across those departments and locations. Consequently, there is little consistency in the execution or the reporting relationships for the decentralized component of the HR function supported by Datapower, the effective implementation of which is the subject of this research.

Datapower provides routine personnel related information, such as records, leave, and entitlements. Datapower also provides department level information on personnel related costs. This information is useful for departmental managers as the responsibility for managing staff budgets had been decentralized to the departmental level. Prior to Datapower, the extent of computerization in the area health service was very low. For most users, Datapower was their first exposure to an on-line computer-based information system.

Users obtain information regarding their unit by logging onto the central mainframe computer directly from their personal computers. They then use the various functions in the package to obtain the information and reports they require. Use of Datapower is voluntary and individual users use it with varying levels of complexity and sophistication. It follows that Datapower is an individual use technology which can be independently adopted. Its implementation context therefore falls into Quadrant II of Figure 2, which is characterized by high individual level impacts but low group level impacts.

3.2 Sample

To study the implementation of Datapower and to test the hypotheses developed above, a questionnaire was mailed to all 133 users of Datapower in the area health service. A total of 96 responses was returned out of which 29 responses were incomplete and were excluded from the analysis. Hence, the analysis is based on 67 responses which were suitable for analysis.[1] The distribution of respondents is similar to their distribution in the population of 133 Datapower users. Thirty-two responses were from the main hospital and 35 from the smaller hospitals and clinics, while 25 respondents were from administration, 24 from nursing, eight from allied health, seven from support services, and three from other departments.

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[1]A supplementary analysis including all 96 responses was also performed by substituting the missing data with mean values. The results of this analysis are substantially the same as those reported here. These results are available from the authors.

3.2 Operationalization and Measurement of Variables

The research design modifies and extends the model of secondary adoption tested by Leonard-Barton and Deschamps. This research strategy has the merit of contributing toward a cumulative tradition in IS research and generating findings which are comparable across studies. The Leonard-Barton and Deschamps framework, which includes implementation process, individual characteristics, and informal support variables, is extended to include innovation characteristics variables in the model to be tested (Figure 1).

The measures used in this study are adapted from Leonard-Barton and Deschamps, but differ in two respects from their study. First, their measures for use, training, performance, and network support are improved upon to obtain measures with higher internal reliability. Second, two variables used in their study, subjective importance of task and task related skill, were excluded from this study. Subjective importance of task could not be adapted to the particular innovation studied here and, therefore, was excluded. Consequently, task related skill was also excluded as it is derived from the subjective importance of task measure. This is not expected to have a significant impact on the results of this study as Leonard-Barton and Deschamps report non-significant effects for both variables. A comparison of the measures used in the two studies is provided in Table 1.

Table 1. Reliability of Measurement

Variables[a]	Reliability (Cronbach Alpha)	Corresponding Variables (Leonard-Barton and Deschamps 1988)	Reliability (Cronbach Alpha)
Implementation Success (2)	0.85	Use (1)	na[b]
Task Relevance (2)	0.73	Job-determined Importance (Need) (1)	na
Task Usefulness (3)	0.79		
Management Urging (1)	na	Management Urging (1)	na
Management Support (3)	0.86	Management Support (3)	0.56
Physical Access (2)[c]	0.87	Physical Access (3)	0.70
Training and Documentation (4)	0.91	Training (1)	na
Innovativeness and Skill[d] (4)	0.82	Innovativeness (3)	0.66
		Software Use Skill (2)	0.77
Performance (3)	0.82	Performance (1)	na
Grapevine Support (1)	na	Grapevine Support (1)	na
Network Support (2)	0.50	Number of users known (1)	na

[a]Numbers in brackets indicate the number of items in the measure.
[b]na = Not applicable, single-item scale.
[c]Item for system response time, included in the original measure, was dropped as it did not load well with the other items in this construct.
[d]Items for personal innovativeness and computer skill loaded onto a single factor and were combined into a single scale.

3.4 Dependent Variable: Implementation Success

Frequency of use is the most commonly employed measure of implementation success (Davis 1989; Davis, et al. 1989; Hartwick and Barki 1994; Howard and Mendelow 1991; Leonard-Barton and Deschamps 1988). In the case of independent use innovations, such as Datapower, usage is an appropriate measure of implementation success as organizational gains accrue from individual use. This is consistent with Saga and Zmud's (1994) elaboration of the acceptance, routinization, infusion model of implementation success (Cooper and Zmud 1990). Saga and Zmud propose that acceptance is represented by frequency of use, which is then causally related to routinization and infusion. In the early stages of implementation, when the innovation has not yet become routinized, usage is the only available measure of implementation success. Barki and Huff (1985) also propose that use is an appropriate measure of implementation success when use is voluntary, as in the case of Datapower. Consistent with these models, frequency of use was employed as a measure of implementation success, replacing the one-item measure employed by Leonard-Barton and Deschamps by a two-item measure.

3.5 Independent Variables

Innovation characteristics are operationalized using two constructs: task relevance and task usefulness. Task relevance measures the extent to which the innovation is relevant to the performance of the end-user's task (Leonard-Barton and Deschamps 1988), whereas task usefulness measures the extent to which the innovation contributes to improvement in task performance (Davis 1989). The one-item measure, job determined importance, employed by Leonard-Barton and Deschamps to measure task relevance was adapted and strengthened for this study to result in a two-item measure. Task usefulness was measured using Segars and Grover's (1993) adaptation of Davis' perceived usefulness scale.

Scales for the other independent variables, management urging, management support, physical access, training and documentation, computer skill, personal innovativeness, performance, grapevine support, and network support, were adapted from Leonard-Barton and Deschamps and are omitted to meet the space requirements for this paper.

Table 1 reports the reliabilities of the instruments used. Cronbach alpha indices for six of these measures ranges from 0.81 to 0.91 and from 0.73 to 0.80 for another two. These ranges are considered acceptable for basic and preliminary research, respectively (Nunnally 1978). Only one item, network support, has a low reliability level (Cronbach alpha ≤ 0.7). Table 2 reports the results of a factor analysis. This shows that all items load well on their constructs with only one item having a cross-loading greater than 0.40. Table 3 reports the means, standard deviations, and zero-order correlations of the variables.

3.6 Data Analysis

The primary purpose of this paper is to test the contingent model of implementation success proposed here within one quadrant, providing initial partial validation for the model. This is done by testing H1: In the context of high individual level impact and low group level impact innovations, the effect on implementation success of innovation characteristics is stronger than that of implementation process. A two stage procedure is used. In the first stage, the regression coefficients of all the variables in the overall secondary adoption model (see Figure 1) are estimated. In the second stage, the weighted average of the regression coefficients of the innovation characteristics variables is compared against that of the implementation process variables. The larger the departure of the resultant contrast value from zero, the greater the relative effect of innovation characteristics in relation to implementation process. A t-test is employed to formally test the significance of the departure of the resultant contrast value from zero (Cohen and Cohen 1983, pp. 479-480).

Table 2. Rotated Factor Matrix

Questionnaire Item	Factor 1 Training and Documentation	Factor 2 Innovativeness and Skill	Factor 3 Performance	Factor 4 Management Support	Factor 5 Task Usefulness	Factor 6 Task Relevance	Factor 7 Physical Access	Factor 8 Management Urging
Important part of job						.85		
Number of people responsible for						.74		
Impact on work if withdrawn					.71			
Value to work					.74	.49		
Made it easier					.85			
Management urging								.89
Support from supervisor				.88				
Support from Service Director				.79				
Support from Area Administrator				.77				
Access to terminal							.90	
Access to package							.91	
Training in using package	.85							
Documentation on program	.91							
Training in personnel information	.91							
Documentation on personnel information	.88							
First to try new system		.74						
Leave others to work out bugs		.72						
Highly competent with computers		.83						
Used computers extensively		.85						
Energy put into work			.87					
Quality of work			.83					
Amount of work			.85					

1. Informal support items are excluded due to their low reliability.
2. All item loadings less than 0.40 are suppressed.
3. Reverse coded items have been transformed to generate positive loadings.
4. Rotation used is varimax.

Table 3. Table of Means, Standard Deviations and Correlation Matrix

Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10
1. Implementation success	7.1	2.6	1.00									
2. Task relevance	9.0	3.4	.56**	1.00								
3. Task usefulness	15.1	4.6	.60**	.49**	1.00							
4. Management urging	3.8	2.2	-.18	-.15	-.15	1.00						
5. Management support	16.2	3.5	.03	.01	.13	.12	1.00					
6. Physical access	11.8	3.5	.38**	.13	.10	.20	-.14	1.00				
7. Training and documentation	10.3	6.6	.01	.08	-0.0	-.06	.08	.02	1.00			
8. Innovativeness and skill	15.6	6.8	.26*	.10	.26*	-.04	-.03	.28*	-.09	1.00		
9. Performance	18.6	2.2	-.14	.09	-.05	-.10	.03	-.14	.03	.13	1.00	
10. Grapevine support	5.0	1.0	.22	.05	.23	-.09	.07	.20	.01	.13	.08	1.00
11. Network support	7.6	3.4	.19	.29*	.38**	-.06	.27*	-.06	.31*	.18	.17	.09

* $p \leq 0.05$; ** $p \leq 0.01$

The secondary purpose of this paper is to extend the understanding of the contributions to implementation success of innovation characteristics, implementation process, individual characteristics, and informal support within a single integrated model. The contribution of a block of variables, such as innovation characteristics, is tested by estimating its semi-partial R-square in a multiple regression analysis. The semi-partial R-square of a block of variables is the additional variance in implementation success explained by that block of variables, controlling for the effect of the other three blocks in the model (Cohen and Cohen 1983, pp. 145). Separate hierarchical regressions are conducted to estimate the contributions of innovation characteristics, implementation process, individual characteristics and informal support to implementation success.

4. RESULTS

To test Hypothesis 1, the full secondary adoption model presented in Figure 1 is fit into the hypothesis. The results presented in Table 4 provide strong support for the overall model ($R^2 = 0.57$, $p \leq 0.01$).

Second, the weighted average of the regression coefficients for the innovation characteristics variables is compared with that for the implementation process variables. The results presented in Table 5 provide strong support for H1; the effect of innovation characteristics on implementation process is significantly stronger than the effect of implementation process ($t = 2.34$, $p \leq 0.01$). From an inspection of Table 4, both task relevance ($\hat{\beta} = 0.34$, $p \leq 0.01$) and task usefulness ($\hat{\beta} = 0.35$, $p \leq 0.01$) have significant effects on implementation success. In contrast, among the implementation process variables, only physical access has a significant effect ($\hat{\beta} = 0.28$, $p \leq 0.01$).

The secondary purpose of this paper is to add to the cumulative research on implementation success. Table 6 presents the evidence for the contribution of innovation characteristics, implementation process, individual characteristics, and informal support. The effect of innovation characteristics on implementation success, is significant ($\Delta R^2 = 0.27$, $p \leq 0.01$). The effects of implementation process ($\Delta R^2 = 0.06$, ns), individual characteristics ($\Delta R^2 = 0.02$, ns), and informal support ($\Delta R^2 = 0.00$, ns) on implementation success are non-significant. For completeness, the simple zero-order block correlation coefficients are also included in Table 6.

Table 4. Factors influencing Implementation Success
Multiple Regression Model

Block	Variable	Standardized Regression Co-efficient ($\hat{\beta}$)	Regression Co-efficient (B)
Innovation Characteristics	Task Relevance	0.34**	0.26
	Task Usefulness	0.35**	0.19
Implementation Process	*Managerial Behavior*		
	Management Urging	-0.14	-0.17
	Management Support	0.05	0.03
	Organizational Support		
	Physical Access	0.28**	0.20
	Training and documentation	-0.01	0.00
Individual Characteristics	Innovativeness and skill	0.07	0.03
	Performance	-0.14	-0.16
Informal Support	Grapevine support	0.05	0.13
	Network support	-0.03	-0.02

$R^2 = 0.57$ ($p < .01$), df = 10, 56.
*$p \leq 0.05$, ** $p \leq 0.01$.

Table 5. Relative Contribution of Innovation Characteristics and Implementation Process

Variable	Regression Co-efficient (B)	Standard Error of B	Contrast Coefficient[a]	Results
Innovation Characteristics				
1. Task relevance	0.26	0.08	½	$C^b = 0.124$
2. Task usefulness	0.19	0.06	½	
				$SE_c^{\,c} = 0.053$
Implementation Process				
3. Management urging	-0.17	0.11	-1/4	$t^d = C/SE_c$
4. Management support	0.03	0.07	-1/4	= 2.34
5. Physical access	0.20	0.07	-1/4	($p \leq 0.01$)
6. Training and documentation	0.00	0.04	-1/4	

[a]This set of contrast coefficients compares the magnitude of the raw regression coefficients (B coefficients) of the innovation characteristics variables with the implementation process variables. (See Cohen and Cohen [1983, pp. 479-480] for all calculations used in this table.)

[b]The value of the contrast (C) is calculated as $C = \sum a_i b_i$, where i = 1 to 6 for the six variables involved in the contrast. The calculated value of the contrast (C = 0.124) indicates that, on average, the magnitude of the regression coefficients for the innovation characteristics variables is larger than that of the implementation process variables.

[c]See Cohen and Cohen (1983, pp. 479-480) for the formulae to calculate the standard error of the contrast (SE_c).

[d] The departure of the contrast value C from zero is tested by an ordinary t-test (Cohen and Cohen 1983, pp. 479-480); t = 2.34, ($p \leq 0.01$), H1 is supported.

Table 6. Factors Influencing Implementation Success Blocked Regression Model

Block	Zero-order[a] R^2	Semi-partial[b] R^2 (ΔR^2)
Innovation Characteristics	0.37**	0.27**
Implementation Process	0.18**	0.06
Individual Characteristics	0.08*	0.02
Informal Support	0.09*	0.00

[a]R^2 ignoring the effect of all other blocks.
[b]R^2 controlling for the effect of all other blocks. The ΔR^2 value for the four blocks are generated from four separate hierarchical regression models.
*$p \leq 0.05$, **$p \leq 0.01$

5. DISCUSSION

The results of this study show that, within a context characterized by high individual level impact and low group level impact, innovation characteristics make a strong contribution to implementation success while the contribution of implementation process is weak. These findings provide support for the context contingent model of implementation success proposed here. In addition, an inspection of the results in Table 6 shows that the contingent findings can be partitioned into a significant independent influence of innovation characteristics and a non-significant independent influence of implementation process. This pattern maps directly onto the arguments advanced in support of the development of H1. Given that the former is consistent with the extant literature, it is the latter which effectively provides evidence for the contingent model. Therefore, the potential validity threats to the latter finding are examined below. Finally, the implications of the findings for theory and practice are discussed.

5.1 A Context Contingent Model

The results presented in Table 6 show that innovation characteristics have a strong significant independent effect on implementation success. Further, the results of the regression analysis (Table 4) show that both task relevance and task usefulness are significant and, therefore, make unique independent contributions to implementation success. This is consistent both with the fundamental premise of the secondary adoption model, that innovation implementation is a process of internal diffusion arising out of numerous adoption decisions taken by end-users in the context of their tasks and roles (Kwon and Zmud 1987; Leonard-Barton and Deschamps 1988; Ramiller 1994), and the context contingent model developed here. According to this model, end-user adoption of individual use innovations (Quadrant II) is driven primarily by the extent to which the IS innovation is relevant and useful for the end-user's tasks and roles.

In contrast to the findings for innovation characteristics, the non-significant effect of implementation process is inconsistent with the previous literature which hypothesizes a non-contingent effect for implementation process (Bhattacharjee 1996; Howard and Mendelow 1991; Leonard-Barton and Deschamps 1988; Meyer and Goes 1988; Schultz 1984). However, the null finding for implementation process is consistent with the contingent model developed here. Indeed, it is the null finding for implementation process, as much as the significant finding for innovation characteristics, which supports the contingent model.

Since the operationalization of implementation process covers the key components recommended in the literature, the lack of support for the implementation process hypothesis cannot be considered spurious. However, since the null finding is both critical to the contingent model and contrary to extant theory, two possible validity threats were examined. First, following the procedure suggested by Cohen and Cohen (1983, pp. 154-164), it was found that the null finding is unlikely to be a function of the power of the tests.[2] Second, there is no evidence of range restriction on the measurement of management support, management urging, or organizational support variables across the user departments. This limits the validity threat arising from studying a single organization.[3]

5.2 Previous Research

The null findings for implementation process prompted re-examining the previous empirical literature to better locate the findings of this study with reference to earlier findings. An initial examination of the literature found that null findings for an implementation process main effect have been reported in earlier studies (see, for example, Ginzberg 1981; Goodhue and Thompson 1995; Lee 1986; Leonard-Barton and Deschamps 1988[4]). This suggests that the findings of this study are not unique and that non-significant findings for implementation process have been reported in the literature. However, the theoretical significance of these findings remains to be examined.

The context contingent framework proposed here is used to explain these null findings and motivate further support for the contingent framework. It can be speculated that null or weak findings are obtained in studies where the group impacts of the innovation are low and where, according to the context contingent model, the effect of implementation process variables is likely to be weak. An analysis of the implementation context in the above studies supports this proposition. For instance, Ginzberg (1981) studied the adoption of an "on-line portfolio management system supporting portfolio managers in asset management decisions"; Lee studied "various individual applications"; Leonard-Barton and Deschamps studied the adoption of an "expert system supporting computer salespeople in configuring a computer system"; Bajwa (1993) studied personal use systems "providing executives with communication, coordination, controlling, and planning capabilities"; and Howard and Mendelow studied the "discretionary use of computers by business school academics." The implementation context for all these studies matches the context for this study and corresponds to Quadrant II of the model, i.e., high individual level impact and low group level impact, such as in the individual adoption of low task interdependence innovations. Consistent with the prediction of the model developed here, none of the studies found support for the influence of implementation process variables.

In contrast, it is speculated that strong support for implementation process is likely to be found in studies where the group impacts of the innovation are high and where, according to the context contingent model, the effect of implementation process variables is likely to be strong. For instance, Sanders and Courtney studied the implementation of "Decision Support Systems for strategic planning, annual planning and other financial planning applications"; Hogan (1994) studied "Information Engineering using Computer Aided Software Engineering (CASE) tools"; Ruppel (1995) studied "teleworking among Information Systems professionals for application programming and systems

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[2]For space constraints, these results are not reported here. They are available from the authors.

[3]For space constraints, these results are not reported here. They are available from the authors.

[4]Leonard-Barton and Deschamps report weak empirical evidence for an interaction between managerial behavior and individual characteristics.

programming tasks”; and Lee found that interdependent applications are more likely to be developed when management support is high and that independent applications are more likely to be developed when management support is low. The implementation context for all these studies corresponds to Quadrant IV of the model presented here, i.e., high individual level impact and high group level impact, such as in the adoption of high task interdependence innovations. Consistent with the prediction of the model developed here, all four studies found strong support for the influence of implementation process variables. A comparison of the findings of the above studies is presented in Table 7.

The statistical power of this study, the absence of validity threats, the identification of previous null findings, and the association of support for implementation process with the level of group level impact of IS innovations in previous research all enhance confidence in the null findings for implementation process of this study, and, hence, for the contingent model developed here.

Table 7. Comparison of Findings for Implementation Process Variables in Previous Studies

Reference	Description of Innovation, Task Supported	Support for Implementation Process	Quadrant
Ginzberg (1981)	On-line portfolio management system—supports portfolio managers in asset management decisions.	No	2
Leonard-Barton and Deschamps (1988)	Expert system supporting salespersons in configuration of computer system	No	2
Bajwa (1993)	Executive information system. Provides executives with sophisticated technological capabilities to support their communication, coordination, controlling and planning functions.	No	2
Howard (1991)	Discretionary use of computers by business school faculty.	No	2
Lee (1986)	Individual applications. Interdependent applications.	No Yes	2 4
Sanders and Courtney (1985)	Decision support systems for various financial applications, such as strategic planning, annual planning and budgeting and project analysis.	Yes	4
Hogan (1994)	Computer aided software engineering (CASE) tools for information engineering. It provides an integrated set of tasks, techniques and rules that support a team of programmers through the entire process of information system development.	Yes	4
Ruppel (1995)	Telework among information systems professionals. Includes application programming, systems programming and data entry jobs performed remotely with a personal computer.	Yes	4

5.3 Implications for Theory and Research

Current research treats the innovation characteristics theory and the implementation theory as two competing explanations for the successful implementation of IS innovations. Recent research extends innovation characteristics theory and proposes that the effect of innovation characteristics is contingent upon a fit between the implementation context and the context of classical diffusion theory (Fichman 1992). This study extends and complements this stream of research by proposing that the effect of implementation process is also contingent upon the context. Further, it distinguishes the level of analysis addressed by the two theories and integrates them within a contingent framework.

In addition to resolving the theoretical inconsistencies in the current literature, the contingent model also provides an explanation for some of the null findings for implementation process reported in earlier literature. Future research should carefully identify the implementation context being studied and distinguish the individual and group level impacts of the IS innovation. In particular, research is needed in Quadrants 3 and 4 in Figure 2.

5.4 Implications for Managers

The findings of this study have important implication for managers. The results show that, in the context of individual adoption of low task interdependence innovations, the relative contribution of innovation characteristics to implementation success is higher than that of implementation process, in which case managers need to pay more attention to getting the innovation characteristics right, as compared to getting the implementation process right. Managerial influence in implementation of such innovations is higher at the design stage, when the innovation characteristics are determined, rather than at the implementation stage. For such cases, managers need to focus on the process of design. User involvement and expert input are some of the strategies available for ensuring the appropriate innovation characteristics. Subsequent to the design stage, managerial decisions and behaviors have little influence on the implementation success of independent use IS innovations. Investing resources into the implementation process may be counter-productive, as in the case of implementation failure reported by Markus and Keil.

The context contingent model also suggests that implementing IS innovations involving a high group level impact, such as materials requirement planning systems, CASE tools, or group decision support systems, will involve a high commitment of managerial and organizational resources. The successful implementation of such innovations requires, among other things, coordinated adoption to ensure the development of a new set of task interdependencies. The frequent failure and underutilization of MRP systems (Cooper and Zmud 1990) and CASE tools (Gallivan et al. 1994) suggests that this can be a fairly complex task.

6. CONCLUSIONS

This research has developed a model of IS implementation in which the contributions of innovation characteristics and implementation process are contingent upon the implementation context. A contingent framework is proposed which integrates the innovation characteristics and implementation process theories. The model is tested within a particular implementation context characterized by high individual level impacts but low group level impacts. As hypothesized, innovation characteristics were found to make a strong contribution to implementation success. In contrast, the independent contribution of implementation process was small and non-significant.

The results have important implications for theory and practice. They suggest that implementation researchers need to account for the effect of implementation context and, in particular, distinguish between the individual level and group level impacts of IS innovations. For managers, the findings suggest that they need to develop strategies, and allocate resources between the design stage and the implementation stage, contingent upon the implementation context. For low task interdependence innovations, the design of the innovation is critical to implementation success and more attention needs to be paid to the design stage than the implementation stage. Conversely, high task interdependence innovations require a high level of managerial effort during the implementation stage.

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