



A system implementation study: management commitment to project management

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Abstract

Recent literature has shown a renewed interest in systems implementation research. Current trends in the organizational deployment of IT have motivated new studies of implementation efforts. This paper reports on one phase of a pluralistic investigation of systems implementation projects. A survey instrument, based on previously validated measurement items, is described; it was tested and validated. In the process, a method for appraising the significance of interaction effects was determined. The results of the analysis show that, for the data of this study, the organizational priority given to implementation projects by top management is only associated indirectly with improved user information satisfaction (UIS). Only when this priority occurs in the management of continuing development and enhancement, does top management support seem to be significant to users. It was also found that the efficiency and flexibility of the development process was significant in its own right, even without any effects of top management support.

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1. Introduction

The implementation of automated support systems for information processing has long been a central issue. Much work has appeared addressing the disparity between high technical quality of systems and low success in their effective deployment. This paper reports on the first stage of case study investigation into implementation projects in two medium sized companies. Its objectives included the discovery of success factors in the context of large-scale systems, integrated across multiple corporate functional areas. The company sizes allowed the use of statistical survey sampling.

Early papers on systems implementation assumed that their quality could be evaluated in an absolute sense. Ein-Dor and Segev [19] noted the emphasis on physical installation; this was later characterized as ‘system delivery’ [11]. In reaction to this view, Lucas [52] defined it as including all phases of systems development. Cooper and Zmud [12] then expressed the need for a more specific “directing and organizing framework” for IS implementation research.

The working definition adopted for this research came from Swanson [72]. He used the phrase “system realization” and restricted the implementation process to the systems life cycle stages between design and use. Swanson defined implementation as “a decision-making activity that converts a design concept into an operating reality so as to provide value to

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the client.” Numerous researchers have used definitions with equal scope. In 1994, Iivari and Ervasti used the term “institutionalizing” [34]. They noted the trend toward software acquisition and the relative scarcity of large-scale production systems developed in-house. Guimaraes and Igarria [30] also commented on ‘dramatic’ changes to implementation efforts due to changed system characteristics. They suggested the need to reevaluate prior discoveries in the context of current trends. Lucas and Spitler [54], for instance, noted a lack of implementation field studies involving networked, multifunction workstations that are common in organizations today. In a recent survey exposition of this whole scenario [56], an operationalization of Swanson’s model has been proposed as a unifying vehicle for new implementation research.

2. Implementation issues

2.1. *Prior research*

Numerous writings have assessed research in the implementation of information systems (IS). Many have attempted to synthesize the discoveries and suggest directions for continued research (see [27,65,73], for instance). The quantitative directions have been highlighted in the literature by different formulations for the concept of implementation success. Reviews have appeared of numerous studies whose success formulations use objective assessments [15,58,71]. Others discuss the heavily pursued use of perceptual, surrogate measures of intangible implementation effects [24,32]. The research has furnished a wide spectrum of issues that are important to effective IS implementation [46].

Qualitative work has also contributed insights to the literature in this area [21,57,62,75]. Numerous studies of failed implementation projects have appeared and the lessons they provide have been discussed [1,10,40,61]. Much of this “intensive” empirical research has allowed a deeper understanding of individual implementation issues. All of these contributions have supported a growing body of research, which now combines methods in pluralistic approaches to the study of IS implementation [23,48,59,74].

2.2. *The research model*

Swanson’s model was adopted to serve as a conceptual framework for my project. It is a collection of nine factors critical to implementation success. Table 1 gives lists of the literature sources that support and help operationalize each of the nine factors in the research design.

2.2.1. *User involvement*

User involvement underlines the need for user participation in the implementation project. This factor also involves personal relevance of the system to the user.

2.2.2. *Management commitment*

This represents the apparent top level support for an implementation project.

2.2.3. *Value basis*

This expresses the general appreciation, on the part of its stakeholders, of the value that an implemented system brings to its organization.

2.2.4. *Mutual understanding*

This factor measures the user-to-designer bond and has been a topic of many papers, such as those discussing various uses of group and communication systems.

2.2.5. *Design quality*

The design quality refers to the general characteristics of modeling, presentation, and flexibility exhibited by a system. The ease with which the system can be adapted to accommodate change and preferences will affect the users’ score for this.

2.2.6. *Performance level*

This represents the way users view the products and services provided by the system. It directly reflects the degree to which user expectations are met by the system on a day to day basis.

2.2.7. *Project management*

This factor refers to the way in which the implementation project is conducted, including its organization, scheduling, and responsiveness to stakeholders. User views of project management (PM) are important indicators of issues that impact implementation planning.

Table 1
Instrument items with hypothesized factor groupings and supporting literature—adapted from [56]

Swanson	Item (item number)	Literature support
User involvement	User control (1)	[5,6,26,30,35,36,51,58,60]
	Degree of IS training (2)	
	User understanding of systems (3)	
	Users' feeling of participation (4)	
Management commitment	Top management involvement (5)	[3,12,19,26,30,43,47,52,67]
	Organizational position of IS (6)	
Value basis	Value of IS to the firm (7)	[15,26,28,45,68,73]
Mutual understanding	Users' relationship with IS staff (8)	[12,16,35,51,58]
	Users' communication with IS (9)	
	Attitude of IS staff (10)	
Design quality	Users' confidence in systems (11)	[12,14,15,32,59]
	Flexibility of systems (15)	
	Convenience of access (16)	
Performance level	Relevancy of output (12)	[7,15,16,35,39,51,59]
	Volume of output (13)	
	Completeness of output (14)	
	Timeliness of output (17)	
	Currency of output (18)	
	Reliability of output (19)	
	Accuracy of output (20)	
Project management	Change request response (21)	[3,12,16,37,52,59,67,68]
	Time required for new IS (22)	
Resource adequacy	Technical competence of IS staff (24)	[30,31,39,68]
	IS resource allocation policy (25)	
Situational stability	Change in job freedom (26)	[30,31,39,52,63]
UIS	IS service to organizational unit	
	IS service to organization	
	IS efficiency	
	IS effectiveness	

2.2.8. Resource adequacy

This factor is intended to reflect the degree to which the implementation team has successfully secured the appropriate personnel, equipment, and data to satisfy the demands of the project.

2.2.9. Situational stability

This factor seeks to capture the degree to which the implementation effort is sensitive to its impacts on the lives of its stakeholders.

2.3. The research design

The first part of the study involved formulating measures for the model's components. It was decided

that the model should use existing measures, if possible, so that the process of testing and deployment could proceed with minimal validation effort.

Two existing measurement instruments have been generally accepted: the technology acceptance model (TAM) [14] and the user information satisfaction (UIS) instrument [4]. Each employs a surrogate variable (system use and user satisfaction, respectively) to represent successful implementation. Since the implementation projects that motivated this study are mandatory use systems, it was decided that the TAM instrument would not be appropriate. As observed by Iivari [33], use of a mandatory system is not necessarily indicative of implementation success. This has been underscored by the failure of TAM in similar situations

[13,25,53]. Although Ives et al.'s 'short form' UIS instrument with 13 items [35], has achieved considerable acceptance in the literature, the original 39-item UIS instrument was used as a starting point here.

It should be noted that surrogate measures for IS effectiveness have not been universally accepted. In fact, some have even cast doubts on the use of *user evaluations* at all [29].

The 26 items that were utilized from the UIS instrument are shown in Table 1, which shows hypothesized factor groupings representing the higher order structure of the model. Six of the original 39 items were deleted from all subsequent analysis in the literature because of undesirable psychometric properties; these were not used here either. Of the seven other original items omitted from the current instrument, three were considered to be obsolete (means of input/output, batch turnaround time, and integration of database). The remaining four were judged to be potentially confusing. A panel of three academic experts endorsed the face validity of the 26 chosen items at the outset of the project. With the unit of analysis to be at the individual user level, the nine hypotheses implicit in this study were:

H_i : Higher valuations of the model's i th factor will be associated with higher degrees of user information satisfaction.

3. The field study

3.1. Sampling conduct and evaluation

The two companies under study were both used for the initial test of the postulated constructs of this instrument. Each had recently implemented an organizational IS, which integrated sales and customer service functions with accounting, finance, and purchasing. Each system also included support for operational aspects of its company. Company A is a provider of services and a reseller of integrated computer and communications products. Company B is a manufacturing company. Questionnaires were distributed to 250 users and developers selected at random from both companies. The instrument, together with an initial section for demographic information, was intended for users. As noted by Saarinen [68], few developers are involved in providing later services to

maintain and improve an implemented system. Hence, a separate set of questions was established for developers. Both questionnaires asked for responses about the companies' recent implementation projects and systems.

Of the 250 survey instruments distributed, 112 were returned. A total of 62 respondents returned user instruments; 11 of these had missing values and were not used. This resulted in a return rate with a lower bound of 25% for the UIS instrument. (If any of the 138 non-respondents had been developers, the UIS return rate would be higher.) While this is considered adequate for exploratory research studies [43,76], the relatively small sample size places stricter requirements on the strengths of any discovered relationships among the constructs. Sample size concerns in this study were further ameliorated using Stein's formula for estimating the squared population multiple correlation subsequent to the actual data analysis. (As Stevens would prescribe [69], the value is 0.71 for this study. Thus the sample size is sufficient because the difference between the squared multiple correlation and the squared cross-validated correlation is less than 0.05 with a probability of 0.9.)

The question of pooling responses from two different firms was also addressed as a consideration for judging the viability of the sampling methodology. This was based on the difference between the IS characters of the service and manufacturing industries. The mix was intended to support the generalizability of the study's findings in an analogous approach to that of many other studies [17,66]. With 57% of the usable responses from Company A, analysis of variance indicated no significant differences in responses across the two companies. The demographic data were also examined for any significant bias [38]. The uniformity of respondent profiles across firms also allowed the conclusion that non-response bias was not a problem. As reported in Table 2, the questionnaire was returned by a wide range of experienced users who interact regularly with IS in their organizations. More than 65% of the respondents were highly dependent on IS for carrying out their jobs. Additionally, 68% have been using computer based information systems for more than 10 years and only 3.9% are accessing information exclusively through subordinates.

Table 2
Respondent demographics

Characteristic	Percent of responses
Organizational level	
Senior management	21.6
Supervisory or staff	17.6
Middle management	52.9
Other	7.8
Type of system use	
Exclusively indirect	3.9
Mainly indirect	7.8
Partly indirect	35.3
Mainly direct	41.2
Exclusively direct	11.8
Dependence on system	
Highly dependent	66.7
Quite dependent	29.4
Quite independent	3.9
Not dependent	0.0
Years of experience with systems	
0	2.0
1–6	17.6
7–9	11.7
10–12	37.3
13–15	11.7
16–20	13.7
>20	6.0
Percent of time using system	
0–5	3.9
5–15	7.8
15–25	17.6
25–40	19.6
40–60	29.4
60–80	17.6
80–100	3.9

3.2. Instrument validity

The use of existing, validated instruments provided a strong foundation for internal consistency at the item level [18,31,55]. The instrument's reliability was nevertheless appraised. The individual item reliabilities were evaluated using Cronbach's alpha coefficient. The 26 dual-scale items produced values between 0.77 and 0.99, with only three values below 0.86. Indicating the degree to which their individual scales measure the same thing, this shows a sufficient internal consistency for basic research [64]. Furthermore, with the overall UIS measure used as a control

value, all but two of the 26 item-to-control correlations were significant at the 0.01 level.

3.3. Construct validity

The predictive validity of this study's nine constructs refers to their propensity to predict the study's measure of UIS [5]. This was assessed and satisfied by a correlation analysis. The nine correlations of the constructs with UIS showed values between 0.467 and 0.738, all of which are significant at or below the 0.01 level. The reliability of these nine higher order constructs was also assessed to determine the degree to which their groups of measurement items measure the same phenomena. The Cronbach's alpha values for seven of the nine constructs are between 0.806 and 0.936, while an eighth value is 0.710. These measures of internal consistency are certainly encouraging. The resource adequacy construct, however, evinced an alpha value of 0.585 through the data of this sample. This was the first indication of this sample's deviation from the expected results [9]. It represented weakness in the certainty of any claim.

It was next necessary to determine the strengths and mutual exclusivity of the model's constructs by evaluating their convergent and discriminant validity [49]. As suggested in heavily cited literature [70], a principal component factor analysis with varimax rotation was performed. Fairly standard factor cutoffs were used, requiring eigenvalues of at least 1 and factor loadings of 0.5 or greater. All 26 items loaded on six different factors that lend themselves to reasonable interpretation within the context of the hypothesized structure. Table 3 shows the factor loadings, eigenvalues, explained variance, and reliability coefficients for each of the factors. It should be noted that items 14, 17, and 18 were included in the second component after it was discovered that its reliability improved with their inclusion. Since the varimax rotation took 11 iterations to converge, presumably due to the low sample-to-item ratio, it was decided that the intuitive motivations for inclusion would suffice.

The hypothesized groupings, matching previously validated constructs, should be reinforced to some extent by the new factor model. As Ang and Soh [2] pointed out, however, "extension of a well-established instrument may result in slightly different factor loading." Kettinger and Lee [42] pointed out some

Table 3
Factor loadings for determinants of user information satisfaction

Determinant and component items	IOB/DRLM component [35,16]	Factor loading	Eigenvalue	Variance explained (%)	Cronbach's alpha
Mutual understanding and situational stability			11.835	45.5	0.880
Users' communication with IS (9)	ESS ₂	0.90			
Users' relationship with IS staff (8)	ESS ₂	0.81			
Attitude of IS staff (10)	ESS ₂	0.72			
Change in job freedom (26)		0.67			
Technical competence of IS staff (24)		0.67			
Performance level ₁ : IS product quality			2.435	9.4	0.904
Reliability of output (19)	QIP	0.90			
Accuracy of output (20)	QIP	0.89			
Users' confidence in systems (11)	QIP	0.65			
Relevancy of output (12)	QIP	0.60			
Currency of output (18)	QIP	0.50			
Timeliness of output (17)	QIP	0.48			
Completeness of output (14)	QIP	0.48			
Management commitment and value basis			1.696	6.5	0.861
Organizational position of IS (6)		0.78			
Value of IS to the firm (7)		0.73			
Convenience of access (16)	ESS	0.59			
Top management involvement (5)		0.58			
User involvement			1.430	5.5	0.854
Volume of output (13)	QIP	0.71			
Degree of IS training (2)	KIL	0.69			
User control (1)	ESS	0.68			
Users' feeling of participation (4)	KIL	0.65			
User understanding of systems (3)	KIL	0.60			
Performance level ₂ : project management			1.275	4.9	0.845
Change request response (21)	ESS ₁	0.69			
Time required for new IS (22)	ESS ₁	0.66			
Flexibility of systems (15)	ESS	0.63			
Resource adequacy			1.040	4.0	0.776
Schedule of IS services (23)	QIP	0.89			
IS resource allocation policy (25)		0.77			

reasons for this, citing the modified user interpretations that survey items may enjoy as technology evolves. Frohlich and Dixon [22] also discussed reasons for which some item loadings may differ from hypothesized structures. For comparison with previously validated constructs, another column of Table 3 shows the Ives, Olson and Baroudi higher order factors (ESS, QIP, and KIL), to which items from their study were assigned by their factor analysis. For the ESS (EDP staff and services) items that were also included in the short form analysis of Doll et al. [16], a subscript indicates the “subfactor” member-

ship that resulted from their factor analysis. (ESS₁ corresponds to EDP services and ESS₂ to EDP staff.)

The six-factor structure consolidated items into instrument components for mutual understanding between users and IS staff, IS product quality, top management and organizational aspects of IS, user involvement, IS development services, and IS resources. These do correspond to six of the Swanson categories. Evidently, the user view of IS performance breaks down into two areas: IS product and IS services. This reinforces the distinction captured by data from Doll et al. Abstract design qualities that are

Table 4
Descriptive statistics for the model's factors

Factor	Mean	S.D.	Cronbach's alpha
Mutual understanding and situational stability	3.10	1.066	0.881
Performance level ₁ : IS product quality	3.43	1.283	0.904
Management commitment and value basis	3.40	1.437	0.861
User involvement	3.98	1.167	0.854
Performance level ₂ : project management	4.97	1.433	0.845
Resource adequacy	3.79	1.281	0.776
UIS	3.65	1.406	0.896

separate from the product of those qualities do not seem to occupy a distinct status in the user views captured by this instrument. The value basis and situational stability categories also do not appear to enjoy distinct consideration of users.

Table 4 shows descriptive statistics for the six final constructs as well as the UIS construct. The different numbers of items in the different constructs warranted the averaging of responses to assure that there is equal weighting of each construct in their eventual application. It is noteworthy that the reliability coefficients are all greater than 0.77. This indicates the internal consistency of the six factors of the revised model structure and removes some concerns. With smaller item values indicating more positive views on the 1–7

Likert scales, the averages show a slightly favorable user view of all factors except “project management.” The most positive user views appear to have been received by “Mutual understanding and situational stability.”

To assess the predictive validity of the six-factor model, a new correlation matrix was computed. As shown in Table 5, the correlations between the six implementation success factors and the general UIS measure are high. While this reinforces the likelihood of a higher order structure among the variables, the pairwise correlations are also high enough to indicate the possibility of multicollinearity.

3.4. Multicollinearity check

As a common symptom of multicollinearity, pairwise correlation among predictors is often dismissed if the correlations are significantly different from 1. von Eye and Schuster [20] state that perceptual data in the social sciences rarely produce an absolute lack of correlation among predictors. A cutoff value of 0.8 can be misleading, however, since this reflects only bivariate correlations and fails to consider correlations with sets of other predictors [50]. To investigate those eventualities, each predictor is regressed over the set of other predictors and the resulting coefficients of multiple determination (R^2) are assessed. Computing the variance inflation factor (VIF) for each variable, based on the R^2 value, provides a means of assessment. von Eye and Schuster note that as long

Table 5
Pearson correlation coefficients

Factor	Mutual understanding	Performance level ₁ : IS product quality	Management commitment	User involvement	Performance level ₂ : project management	Resource adequacy	UIS
Mutual understanding	1.000						
Performance level ₁ : design quality	0.509***	1.000					
Management commitment	0.643***	0.655***	1.000				
User involvement	0.512***	0.681***	0.608***	1.000			
Performance level ₂ : project management	0.545***	0.662***	0.684***	0.672***	1.000		
Resource adequacy	0.505***	0.445**	0.456**	0.403*	0.566***	1.000	
UIS	0.650***	0.616**	0.830***	0.670***	0.801***	0.551***	1.000

* Significant at the 0.003 level.

** Significant at the 0.001 level.

*** Significant below the 0.001 level.

Table 6
First-level regression results—dependent variable: UIS

Source	SS	MS	F-value	PR > F	Adjusted R ²	
Model	80.21	13.37	31.50	0.000	0.785	
Error	18.67	0.42				
Total	98.89					
Variable	B	S.E.	Beta	T-value	PR > T	VIF
Constant	-0.625	0.386		-1.69	0.113	
Mutual understanding	0.125	0.120	0.095	1.04	0.303	1.93
Performance level ₁ : IS product quality	-0.117	0.111	-0.106	-1.05	0.299	2.39
Management commitment	0.467	0.103	0.477	4.52	0.000	2.59
User involvement	0.153	0.120	0.127	1.28	0.207	2.30
Performance level ₂ : project management	0.359	0.107	0.366	3.36	0.002	2.76
Resource adequacy	0.081	0.091	0.074	0.89	0.377	1.61

as the VIF is not close to the critical value of 10, its predictor can be dismissed as a potential cause of multicollinearity problems in the analysis. Table 6, which reports the results of multiple linear regression of the hypothesized dependent variable, UIS, over the six factors of the revised factor model, also gives the VIF for each of those factor construct variables. These values do indeed allow the conclusion that none of these variables presents a multicollinearity problem here.

3.5. Predictor interactions

The *t*-statistics in Table 6 show that two of the study hypotheses are supported by the revised factors of the model. Evidently, better user evaluations of the organizational significance of the implemented systems are associated with better overall user information satisfaction. Similarly, better user evaluations of the

continuing systems development services are associated with better overall UIS. Indeed, these two factors appear to explain 0.785 of all variation in the UIS dependent variable.

However, individual factors are highly correlated. This can lead to problems in interpreting the estimated parameters of the regression model. In particular, parameter values can strongly depend on what other variables, however insignificant, happen to be in the equation. Table 7 shows the results of a stepwise regression, which only retains the significant variables of management commitment (MC) and project management (PM). Although it is not extreme, the regression coefficients do show 11% and 20% changes in value, respectively, from the values of Table 6. Regression was therefore repeated for the model, this time with all 15 bivariate interactions included as possible predictors. A stepwise approach retained two bivariate interactions as the only significant explanatory variables, while

Table 7
Stepwise regression results—dependent variable: UIS

Source	SS	MS	F-value	PR > F	Adjusted R ²	
Model	78.22	39.11	90.85	0.000	0.782	
Error	20.66	0.43				
Total	98.89					
Variable	B	S.E.	Beta	T-value	PR > T	VIF
Constant	-0.248	0.335		-0.74	0.463	
Management commitment	0.518	0.088	0.530	5.86	0.000	1.88
Performance level ₂ : project management	0.431	0.089	0.439	4.85	0.000	1.88

Table 8
Stepwise regression results, with interactions—dependent variable: UIS

Source	SS	MS	F-value	PR > F	Adjusted R ²	
Model	76.83	38.42	83.62	0.000	0.768	
Error	20.05	0.46				
Total	98.89					
Variable	B	S.E.	Beta	T-value	PR > T	VIF
Constant	1.376	0.216		6.37	0.000	
Management commitment × performance level ₂ : project management	0.093	0.012	0.729	8.01	0.000	1.78
User involvement × resource adequacy	0.037	0.016	0.209	2.30	0.000	1.78

discounting the effects of the six main factors of the model. These results are shown in Table 8.

3.6. Asymmetric mediation

It is tempting to conclude that this regression model endorses the primacy of interaction terms by virtue of the variables retained. Of course that would be misleading, because of the relatively arbitrary way in which the mathematical optimization process selects predictors in stepwise regression. Stevens refers to this as relying on “chance.” von Eye and Schuster call this a “cheap” method of one-at-a-time variable selection. They note that it is not uncommon to find multiple regression models with different sets of predictor variables, but nearly identical fits of those variable sets. As indicated by the statistics, that is the case here. If prediction is the primary focus of the model, base variable choice can be relegated to statistical reasoning. For explanatory modeling, however, relying on statistical algorithms can lead to overlooking good subsets of predictors. Variable selection should rather be based on theoretical arguments.

Mathematical and theoretical reasoning together offer guidance here. For any variable that shows significance, forcing it to be the first variable in a regression model leads to that variable’s suppressing or “partialling out” the common variation it shares with other predictors. The semi-partial correlation statistic is then used to compute the significance of the second variable entered into the model. This makes sure that participation of the second variable in the regression equation is independent of variations that are shared with the first variable. In case an interaction

between two predictors is significant, its variation will, of course, include any variation it shares with each of its components. However, there will be some variation that does not coincide with variation in the interaction term.

We consider the management commitment and the project management factors, as well as their interaction term (MC × PM) to be the study predictors, since all have shown significance in regression tests. Suppose MC is first allowed into the regression equation. Its parameter estimates will suppress the variation that it shares with the interaction term and will also account for any variation of the MC factor that is separate from the interaction effects. Its representation in the regression equation will therefore fail to allow any distinction between the two different circumstances. The model would lose any information it could convey about that portion of MC’s effect, which is separate from the common effect shared by MC × PM. Indeed, the cross-product construct for the interaction of the factors does seem to vary directly with variation of either or both component factors together. However, if one factor happens to witness zero effect, the other factor cannot affect the prediction through the multiplicative interaction term. It is therefore necessary to force the interaction term into the regression model at the beginning, if its distinct effect is to be captured.

Further, as von Eye and Schuster have noted, “... it is usually not meaningful to include ... an interaction term without at least one of the variables contained in the interaction.” This is because we presume there is reason to represent

Table 9
Forward regression results with interaction entered first—dependent variable: UIS

Source	SS	MS	F-value	PR > F	Adjusted R ²	
Part (a)						
Model	74.42	37.21	73.00	0.000	0.742	
Error	24.47	0.51				
Total	98.89					
Part (b)						
Model	76.33	38.17	81.22	0.000	0.762	
Error	22.55	0.47				
Total	98.89					
Variable	B	S.E.	Beta	T-value	PR > T	VIF
Part (a)						
Constant	1.594	0.326		4.90	0.000	
Management commitment × project management	0.106	0.030	0.834	3.53	0.001	10.86
Management commitment	0.034	0.232	0.035	0.20	0.882	10.86
Part (b)						
Constant	0.889	0.412		2.16	0.036	
Management commitment × project management	0.084	0.016	0.656	5.24	0.000	3.30
Project management	0.249	0.123	0.253	2.02	0.049	3.30

the cross-product as an interaction, rather than simply as a separate calculated predictor variable in its own right. Consequently, after $MC \times PM$ was entered as the first variable in the regression model, each of its components, MC and PM, was entered as a second variable in a separate regression test. As shown in Table 9, MC failed to provide a significant increase to the variation explained by $MC \times PM$. PM, on the other hand, did improve the regression model in a significant way ($P < 0.05$). This indicates that project management perceptions witness significant variations in the data of this study, which are distinct from variation they share with user views of management commitment. All the significant variation in the MC variable, however, is subsumed by the effects of $MC \times PM$. Since no further predictors showed significance when added to the model of Table 9, the variable selection process resulted in the regression equation

$$UIS = 0.889 + 0.249 PM + 0.084(MC \times PM) \quad (1)$$

The VIF values also indicate that this way of separating individual from joint effects appears to have found relatively independent predictor variables.

In predictive models, interaction terms can confound interpretation, because the units of value for such terms might not lend themselves to direct explanation. A verbal interpretation of the above interaction term's effects might state, "Better perceptions of management commitment are associated with a greater positive effect on user information satisfaction when user views of project management are better, as compared with when they are worse."

Since the model can be expressed as

$$UIS = 0.889 + (0.249 + 0.084 MC)PM \quad (2)$$

MC is referred to as mediating the effects of PM on UIS. The effect of PM on UIS is not constant across the values of MC. Clearly, only PM acts directly on UIS. MC's only effects on UIS are through PM. Further, since PM does not also mediate the effects of MC on UIS, the model is called an asymmetric mediation model. The direct effect of one of its two main constructs is absent from the equation. (It should be noted here that some authors use the term 'mediate' in the opposite sense. As such, PM would be viewed as an intermediate, or 'mediating,' variable for MC's effect on UIS [44].)

4. Conclusions

Apparently, active support of management may not be effective if the project is not perceived as well administered. Indeed, the primary emphasis of management's commitment to the project must be shown in the efficiency and flexibility of its response to user needs.

In practical terms, top management in many firms can regard this study as an important guide, in their efforts to obtain support for high-priority implementation projects. The challenges of management have always included the opportunities and risks associated with employee perception. Change management in particular must include a great sensitivity to the potential such perceptions have for helping to carry an implementation project forward, or for stopping it. High-level managers are usually quite accustomed to showing their support to users. Unless priority is given to insuring the efficiency and effectiveness of the implementation process itself, other top management attempts to display high-level support may be viewed as disingenuous.

Methodological aspects surrounding the study of factor interactions in general can also be seen as a contribution of this study. Interaction effects have been discussed in recent literature (e.g. see [8]). There is, however, some inconsistency in the way such interactions are treated. No paper has been found that handles cross-product variable inclusion in quite the same way as I have. As the "interactionist framework" of Kaplan and Duchon [41] becomes more and more relevant to today's research models, a convergent approach to the interrelationships among research variables becomes critical.

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