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# A DIFFUSION OF INNOVATION APPROACH TO MIS INFUSION: CONCEPTUALIZATION, METHODOLOGY, AND MANAGEMENT STRATEGIES

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## ABSTRACT

MIS implementation is viewed from the context of the organizational introduction of a technological innovation. MIS infusion is conceptualized as a construct for a final stage of the MIS implementation process. Relevant methodological issues are operationalized. The findings indicate two critical factors that directly influence the level of MIS infusion: active communication network behaviors and MIS maturity. The findings also indicate that the MIS climate is another important factor that creates a situation where each factor better functions. Based on the findings, implications are drawn for management strategies and future research on MIS infusion.

## 1. INTRODUCTION

Don't automate across the board. Identify one or two, well-defined tasks that are critical to the company's mission, and make sure the objective is measurable. Don't give everyone computers at first. Target the 20% who can assure the success of your initial experiments. The other 80% will follow. (Business Week 1987, p. 73)

Increasingly, organizations are gaining competitive advantages from their innovative use of a variety of information technologies. In some cases, these benefits arise from the effective targeting of information technologies; in other cases they arise from the efficient management of these technologies; and, in still other cases from both (Kwon, working paper).

As a result, today's organizational MIS activities are, as Zmud (1984) proposed, increasingly characterized by the transfer and distribution of appropriate information technologies in addition to the more traditional "manufacturing" (development) activities. These changes in an organization's MIS activities draw our attention to the need to investigate how organizations and their members can become more adaptive and innovative in their use of information technologies.

This research concerns how best to facilitate the organization's learning and use of information technology. It is becoming essential for organizations to facilitate the use of information technology to efficiently and effectively perform organizational tasks directed at achieving organizational objectives. A major aspect of this facilitation

process is incorporating appropriate information technology in an organization's key tasks, defined here as MIS infusion.

In the MIS literature, no empirical research exists which is theoretically based and which addresses how to facilitate organizational learning and use of information technology. However, the taxonomy for an organizational design alternative developed by Zmud (1984) is useful. Zmud identified three possible approaches based on the Galbraith (1973) information processing model: organizational structure change, information channel change, and management style change. This research focuses the second approach.

Specifically, the research focuses on those organizational members who are MIS opinion leaders, i.e., those influential within their departments regarding the use of information technologies. This research parallels previous research in the diffusion of innovation literature which suggests a paradigm that the diffusion of a technological innovation is likely to be facilitated by influential organizational members who are active in organizational information flows regarding technological innovations. These interpersonal communication networks increase intelligence-gathering interactions outside an organization and both intelligence-spreading and influence-spreading interactions inside an organization. Adopting this communication network paradigm, the primary research proposition is:

Work units whose MIS opinion leaders communicate a great deal within the work unit as well as with other work units will infuse information technologies to a greater degree than work units whose MIS opinion leaders have few such communication links.

## 2. THEORY AND RESEARCH MODEL

One means of facilitating change in organizations is to make their members more adaptive (cognitive change) and innovative (behavioral change). Enhanced adaptiveness and innovativeness usually require expanded perspectives and knowledge. The rather robust literature on the diffusion of technological innovations provides an appealing foundation for expanding our currently limited perspective and knowledge of the MIS implementation process and factors (Kwon and Zmud 1987).

### 2.1 Theory

In the diffusion of innovation literature, the communication network paradigm and the two step process model suggest that "opinion leaders" are more likely to possess multiple and diverse sources of relevant information and, then, mediate information from these sources to other organizational members. These multiple and diverse sources of relevant information are available to opinion leaders because such individuals are often boundary spanning, centrally-positioned individuals (Rogers and Kincaid 1981). Information from these sources is important for organizations and their members in evaluating technological innovations because such information can reduce uncertainty surrounding the use of technological innovations for reasons of access, reliability, and legitimation.

This two-step process model of information flow, with its emphasis on the role of opinion leaders and their communication networks, provides a prescription for MIS implementation research and practice. Specifically, this model suggests using MIS-related opinion leaders as intermediaries in linking MIS change agents to organizational members or work units (Rice 1982, Rogers 1983). Both MIS change agents and users are likely to benefit from such a linkage which facilitates communications in both directions and reduces communication gaps. Communication gaps between MIS change agents and users have been a critical failure factor in MIS implementation (Bostrom and Kaiser 1982). MIS opinion leaders, as these intermediaries, may function both vertically (e.g., initiation and persuasion) and horizontally (e.g., knowledge and skill transfer). Given that they exist to serve effective communication roles, MIS opinion leaders may represent an efficient and effective means of "marketing" (i.e., initiating, designing, experimenting, and distributing) (McLeod and Fuerst 1982) new applications and training users.

### 2.2 Research Model

In the MIS literature, however, the communication network paradigm has not attracted much attention and researchers have not fully explored the potential implications of such information networks to MIS implementation. In addition, most researchers view MIS implementation from an

individual perspective, focusing primarily on individual differences and behaviors (Kwon and Zmud 1987). These individual-oriented research findings have been generalized, often inappropriately (Robey and Zeller 1978) and unsatisfactorily (Huber 1983), to the organizational level.

This research views MIS implementation success as an organizational change intended to contribute to organizational performance rather than individual performance. While many information technologies have a wide range of potential applications, an important concern in assessing MIS success should be the extent to which organizations apply information technologies to support key organizational tasks. This research advocates the use of the MIS infusion construct as a preferred way of conceptualizing MIS implementation success.

In the research model presented in Figure 1, interpersonal (both external and internal) network behaviors represent the study's primary independent variables, while MIS infusion represents the dependent variable. Work unit MIS climate, MIS maturity, and size are used as control variables. Prior research indicates a possible significant influence of these variables on the relationship being investigated. Table 2 lists and describes the research variables.

Using these variables, the research will examine the relationship at the work unit level. In particular, sociometric method and network analysis will reveal each work unit's interpersonal information channels as reflected in the behavior of its MIS opinion leaders.

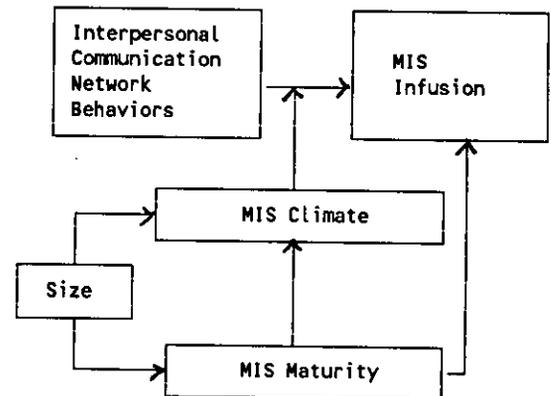


Figure 1. The Research Model

### 2.3 Research Hypothesis

The primary research hypothesis is:

The MIS-related network behaviors of MIS opinion leaders within a department will be positively associated with the extent of MIS infusion, but only when the MIS climate is favorable.

**Table 1. Variable Descriptions**

Variable	Description
Interpersonal Communication Network Behaviors	Both formal and informal patterns of MIS-related interpersonal interaction behaviors of organizational MIS opinion leaders
<ul style="list-style-type: none"> <li>Network Centrality</li> <li>Network Sources</li> <li>Network Intensity</li> <li>Link Sources</li> <li>Link Intensity</li> </ul>	<ul style="list-style-type: none"> <li>• Network status or position</li> <li>• Diversity of external information sources</li> <li>• Value of external information obtained</li> <li>• Multiplicity of internal information sources</li> <li>• Value of internal information</li> </ul>
MIS Infusion	Information technology's embeddedness within an organization to its fullest potential
<ul style="list-style-type: none"> <li>Diffusion Among Key Tasks</li> <li>Extent of Support</li> </ul>	<ul style="list-style-type: none"> <li>• Diffusion across key tasks</li> <li>• Extent of support in key tasks</li> </ul>
MIS Climate	Prevailing organizational norms regarding MIS use
<ul style="list-style-type: none"> <li>Management Support</li> <li>User Involvement</li> <li>Management Attitude</li> </ul>	<ul style="list-style-type: none"> <li>• Top management's commitment to MIS use</li> <li>• General participation level in implementation process</li> <li>• Top management's predisposition regarding MIS use</li> </ul>
MIS Maturity	Organizational structuredness and experience in MIS use
<ul style="list-style-type: none"> <li>MIS Age</li> <li>MIS Range</li> <li>Equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Length of MIS experience</li> <li>• Software experience</li> <li>• Hardware experience</li> </ul>
Size	Organizational context of structural complexity or resource
Work Unit Size	<ul style="list-style-type: none"> <li>• Size of work unit</li> </ul>

### 3. RESEARCH METHODOLOGY

The study used a field survey within administrative offices and departments at a major southeastern university in North America. The survey instruments collected data regarding the characteristics and behaviors of participating departments in using mainframe, mini, and microcomputers. Data were gathered via a multiple-respondent design.

The multiple-respondent data-gathering design was suggested by Rogers (1983) for organizational innovation study. This design was suggested as a remedy for one of the major shortcomings of prior organizational innovation studies, where data were often gathered only from the top executive in each organization or unit, resulting in question about data representativeness. Recognizing this problem provides a caution, if not a remedy, for current and future MIS implementation research.

#### 3.1 Respondents

Seventy-four major administration offices (having their heads at the director level) or departments (having their own administrative offices or personnel) participated in the study. The department's head, "MIS(-related) opinion leaders," and other departmental members familiar with one or more of department's key tasks referred to hereinafter as "coordinators" in each participating administrative department served as respondents. Departmental "MIS opinion leaders" and "coordinators" were identified by the department's head using the informants' rating method (Rogers 1983).

#### 3.2 Measurement

A specially developed form which contained a series of questions was used during the interview with department

heads. The intent of these questions was to help identify "key tasks," "MIS opinion leader," and "coordinators." In phrasing and sequencing the interview questions regarding key departmental tasks, the critical success factors (CSF) interview method (Bullen and Rockart 1981) was applied.

Three survey questionnaires were prepared by the investigator: one for the department's head, one for the department's "MIS opinion leaders," and one for "coordinators." Existing instruments served as points of departure for this survey (Clowes 1982; Van de Ven and Ferry 1980; Young 1980). Table 2 details the contents of these instruments and Table 3 presents brief operational definitions and measures of the variables.

**Table 2. Methodological Issues  
(Variables/Instruments/Respondents)**

Interpersonal Network Behaviors (Independent Variable)	Instrument			
	A	B	C	D
Identification of MIS opinion leaders	X			
1. External Communication				
Network Centrality			X	
Network Sources			X	
Network Intensity			X	
2. Internal Communication				
Link Sources			X	
Link Intensity			X	
MIS Infusion (Dependent Variable)	Instrument			
	A	B	C	D
Identification of key tasks	X			
Identification of coordinators	X			
Diffusion Among Key Tasks				X
Extent of Support in Key Tasks				X
Other (Control Variables)	Instrument			
	A	B	C	D
MIS Climate				
Management Support			X	
User Involvement Level			X	
Management Attitude			X	
MIS Maturity				
MIS Age		X		
MIS Range		X		
Equipment		X		
Size				
Work Unit Size		X		

Instrument A: Interview with department's head  
Instrument B: Questionnaire left with department's head  
Instrument C: Questionnaire sent to MIS opinion leaders  
Instrument D: Questionnaire sent to departmental coordinators

## 4. ANALYSIS AND RESULTS

### 4.1 Data Transformations

Data from individual responses in each department were transformed into departmental data. This study used the average MIS opinion leader's network behavior within a department rather than their collective behavior as the indices of departmental network behavior. Next, a standardization procedure at the mean of 0 and the standard deviation of 1 was applied to all of the study measures. Where multiple items were used in measuring each of the research constructs, a set of factor analyses, first at the item level and then, at the related variable level, derived the construct measures.

The five network-related variables, however, were not aggregated; rather, each was used to represent the construct of interpersonal communication network behavior. The measures of information sources and communication intensity with these sources were not independent of each other. In fact, the measure of information sources was used in determining the average departmental communication intensity. In addition, external and internal communications are separate and distinct processes. The former is more likely to facilitate information transfer, while the latter is more likely to facilitate information distribution. For these reasons, this study uses each of the five network-related variables separately to represent the construct of communication network behavior.

### 4.2 Analysis

The departments were classified into two groups in order to control for any moderating influence of MIS climate. Group 1 consisted of 30 departments with a favorable MIS climate while Group 2 consisted of 27 departments with an unfavorable MIS climate. An examination of group means regarding the research variables showed inequality of the two subgroups in terms of MIS climate and the other research variables except network intensity ( $p$ -value = .39) and size ( $p$ -value = .13).

A path analysis procedure was performed in order to test the weight or importance of the proposed influential path toward MIS infusion. This procedure was based on the partial correlation and regression techniques (Pfaffenberger 1979) and is intended to test out the nature of causal relationships (direct influences) between pairs of research variables. Accordingly, this procedure controlled any indirect influences of other variables between pairs of focal variables.

### 4.3 Results

Both expected and unexpected results were found (see Figures 2 and 3). The paths in Figures 2 and 3 represent the direct influences. The beta coefficients only indicate the magnitude of the direct influence.

**Table 3. Operational Definitions and Measures**

Variable	Description
<b>Network Behaviors</b>	Becker 1970; Ebadi and Utterback 1984
Network Centrality	• Total number of nominations received from other departments
Network Sources	• Total number of nominations directed to different department
Network Intensity	• Average frequency of external interactions weighted by the importance of the information
Link Sources	• Total number of nominations received from and made by the department's MIS opinion leaders
Link Intensity	• Average frequency of internal interactions weighted by the importance of the information
<b>MIS Infusion</b>	Aldrich 1979; Bullen and Rockart 1981
Diffusion	• Portion of key tasks with computer support
Extent of Support	• Average extent of computer support provided for key tasks
<b>MIS Climate</b>	Mumford 1979; Tornatzky and Klein 1982; Yin 1979
Management Support	• Types and number of MIS staffs
User Involvement	• Types and degree of mediated and face-to-face involvement
Management Attitude	• Degree of the individual and departmental advantage perceived regarding computer use
<b>MIS Maturity</b>	Benbasat, Dexter and Mantha 1980; Ein-Dor and Segev 1982
MIS Age	• Length of time since a department's first computer application
MIS Range	• Total number of computer applications across generic administrative tasks
Equipment	• Computer types and number of workstations
<b>Size</b>	DeLone 1981; Ein-Dor and Segev 1982
Work Unit Size	• Total number of administrative and clerical employees

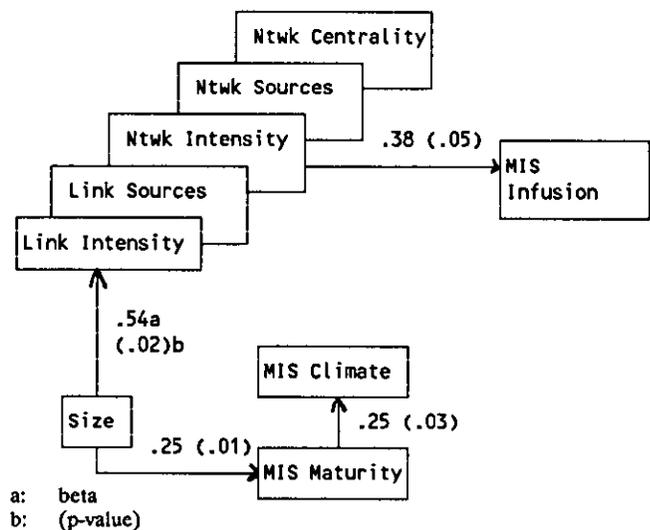
The expected results found from the study was:

1. The presence of a significant, positive association between external communication intensity and MIS infusion, but only when MIS climate was favorable

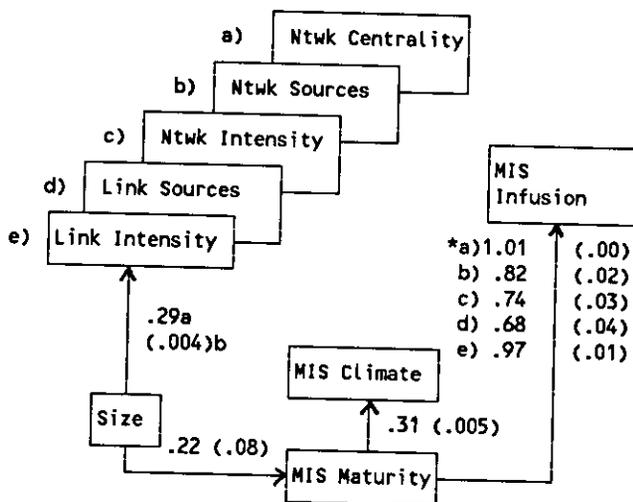
The unexpected, but rather interesting, results were:

1. The absence of a significant association between other network-related variables and MIS infusion, when MIS climate was favorable.
2. The presence of a significant, positive association between MIS maturity and MIS infusion, but only when MIS climate was unfavorable.

Although some unexpected associations have been found from the study, the overall results of the analysis, discussed in the next section, do provide evidence supporting the study's research hypothesis.



**Figure 2. Significant Influential Paths for the Favorable MIS Climate Group**



a: beta  
b: (p-value)

Note \*: Each of these betas and p-values were obtained when each of the five network variables was used as representing the construct of communication networks and, therefore, necessarily controlled.

Figure 3. Significant Influential Paths for the Unfavorable MIS Climate Group

## 5. DISCUSSION

The results of the study suggest that the influence of MIS climate provides differential predictability regarding the influence of the critical factors on MIS infusion.

### 5.1 Hypothesis

The results from the two groups (i.e., significant and not-significant relations for the favorable and unfavorable group, respectively) suggest that both an organization's patterns of interpersonal communication and favorable organizational norms regarding MIS are important factors for facilitating MIS infusion.

#### 5.1.1 Favorable Climate Group

These results suggest both the influence of interpersonal communication networks on MIS infusion and the moderating influence of organizational norms regarding MIS on this relationship. The only direct association found between external communication intensity and MIS infusion is noteworthy.

First, the external nature, rather than internal, of this network variable suggests that external communications may be more important than internal communications for infusing the use of information technologies. It is possible that external communications provide more opportunities to access innovative information through diverse informa-

tion sources (Zmud 1983b) and, further, that the transfer of information from outside must precede its distribution within an organization or work unit.

Second, the quality nature, rather than quantity, of this network variable suggests that the quality or value of information being transferred may be more sensitive or powerful than its quantity. This interpretation is also supported by Ebadi and Utterback (1984) who found, in contrast to previous communication and innovation studies (Allen 1967), a greater effect of communication frequency, i.e., a surrogate for information relevancy or value in their study, than that of communication network centrality and diversity, i.e., information quantity.

Third, an explanation regarding the lack of a significant association between external network centrality and MIS infusion may be attributed to a methodological problem. For example, the relatively small sample size is clearly not desirable when using sociometric methods to identify a department's centeredness within a communication network.

Fourth, the lack of a significant association between external information sources and MIS infusion may be explained by the notion of "channel supply and demand situation" (Swanson 1982a, 1982b). According to Swanson, when information channel authority is coupled with ease-of-access, e.g., reliance of information on such channels, it is likely that a low degree of channel substitutability exists, resulting in a small number of information sources.

Finally, the lack of a significant association between internal communications and MIS infusion may be attributed to the research design and research context. In some situations, the distribution of technological information may be less critical for MIS infusion than the transfer of information (e.g., relatively small work units such as university administrative offices).

#### 5.1.2 Unfavorable Climate Group

When MIS climate was unfavorable, no significant association was found between MIS infusion and network-related variables, including the external communication intensity that was a critical factor for the favorable climate group. The results support previous research in the diffusion of innovation literature that organizational climate is likely to influence the interpersonal communication network behaviors of opinion leaders on the diffusion of technological innovation.

The underlying rationale is that opinion leaders undertake the role of providing information on an innovation as a means to maintain or increase their prestige, but only when the organizational norms support the focal innovation. Likewise, when MIS climate is not favorable, MIS opinion leaders are not likely to seek sources or provide information from such sources regarding the use of information

technologies in key tasks. Consequently, network-related variables are not likely to be significantly associated with MIS infusion.

## 5.2 Other Findings (MIS Maturity – MIS Infusion)

A direct positive association was found between MIS maturity and MIS infusion, only when MIS climate was not favorable. This result suggests an alternative critical factor leading toward MIS infusion for organizations with generally unfavorable organizational norms regarding MIS. The influence of MIS maturity may be explained by self-generated learning and the distribution process of the internal knowledge base.

### 5.2.1 Favorable Climate Group

When the MIS climate is favorable, the organization is likely to set its targets or expectations at a higher level in order to use information technologies (rather proactively) in situations that are different from as well as similar to its prior experience. However, MIS maturity or experience is not likely to contribute to fulfilling these expectations, probably due to its bounded learning process or the limited knowledge base from this learning process.

### 5.2.2 Unfavorable Climate Group

When the MIS climate is unfavorable, the organization is likely to set its expectations at a lower level in order to use information technologies (rather reactively) only in situations similar to its prior experience. On the other hand, it may be relatively easy to persuade such a management into incremental applications. Consequently, the knowledge and skills accumulated based on reality testing may easily contribute to fulfilling these expectations. In summary, when the MIS climate is unfavorable, MIS maturity is likely to directly influence MIS infusion, since the expectation level is not above its capacity.

## 6. MANAGERIAL IMPLICATIONS AND FUTURE RESEARCH

### 6.1 Managerial Implications

The findings regarding the relationships among the research constructs suggest that two paths exist to reach MIS infusion:

1. Communication Networks → MIS Infusion
2. Size → MIS Maturity → MIS Infusion

An MIS climate that is directly influenced by MIS maturity and indirectly influenced by size via MIS maturity seems to create the situation where one of the two paths is more effective for technological information transfer and distribution. These findings provide managers some

guidelines to better facilitate the use of rapidly changing information technologies.

These guidelines should be useful in "marketing" a focal information technology, training organizational members, and structuring role systems in organizations or work units based on identified interpersonal technological information channels. These guidelines deal with appropriate management strategies for promoting organizational uses of information technologies and the related role of MIS opinion leaders for these strategies.

### 6.1.1 Management Strategies

When an organization has little MIS experience, and in general, an unfavorable MIS climate, it is suggested that the organization develop successful cases in an evolutionary fashion in order to create an appropriate organizational MIS climate as well as organizational MIS experience. For example, the management of such an organization may introduce a focal information technology to a fairly simple and structured task, e.g., payroll, ledger accounting, inventory control, or word processing. Even such small successes are likely to begin developing a favorable MIS experience and MIS climate.

When an organization has a considerable amount of MIS experience but has not yet develop a favorable MIS climate, it is suggested that the organization "extend" or broaden MIS use in tasks similar to past and current successful applications. It would be easier to persuade management to accept incremental applications than innovative applications. The management of such an organization, for example, needs to publicize successful organizational cases and available MIS resources.

When an organization has not only a considerable amount of MIS experience but also a favorable MIS climate, it is suggested that the organization "enrich" MIS use in different tasks that require new knowledge and skills (different from those currently being used), i.e., innovative applications. For example, the management of such an organization could demonstrate its willingness to "buy" innovative technological information, e.g., provide more noticeable management support and opportunities for user involvement in MIS activities. In this environment, organizational members are more likely to "sell" their knowledge base, obtained from diverse sources, resulting in a higher level of MIS infusion.

### 6.1.2 The Role of MIS Opinion Leaders

The findings also suggest the utilization of MIS opinion leaders, who carry or transmit information, as intermediaries in linking MIS change agents to organizational members, including top management. They could function both vertically and horizontally. For example, in a rather

direct approach to enhance a favorable MIS climate or to distribute knowledge and skills, MIS change agents should identify MIS opinion leaders as "target customers," monitors, and/or sponsors.

The approach mentioned above may represent an efficient and effective use of human resources. This approach may be essential to an efficient and effective transfer and distribution of information technologies through the interorganizational communication activities of MIS opinion leaders. Such a linkage is likely to serve as a mechanism for managing MIS resources (both people and technology) efficiently and effectively by generating organizational strategies that facilitate strategic planning for MIS.

## 6.2 Future Research

The study shows that the influence of communication networks as a predictor and MIS infusion as an outcome are clearly worth investigating in organizational MIS implementation research. The study confirms, in an MIS context, the differential validity of prior beliefs regarding the influence of communication networks on the diffusion of technological innovations which functions only when the MIS climate is favorable. The results do not preclude other situations, i.e., where the MIS climate is not favorable, by suggesting an alternative critical factor for MIS infusion (MIS maturity). These results clearly indicate that organizational MIS implementation research should control for MIS climate.

Many antecedents of communication network behaviors and many other relevant factors (individual attitudes, organizational interdependence, etc.) and processes (initiation, adoption, etc.) were not included in this study. The findings encourage future research which should aim at developing a more complete model.

Finally, the research was conducted within administrative offices or departments of a large state university and some speculative interpretations are based on the research setting. Future research needs to include a replication in a more business-like research setting with a larger sample size. Findings from future research studies in the suggested areas will increase the prediction of MIS implementation processes, especially in organizational contexts, while providing less questionable theory construction.

## 7. ACKNOWLEDGEMENT

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