Information Systems Success in the Context of Different Corporate Cultural Types: An Empirical Investigation

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ABSTRACT: Previous studies surrounding the DeLone and McLean model of information systems (IS) success have called for future research and further examination of its measure in different contexts. We draw from the literature on strategic IS planning and organizational culture to contextualize the DeLone and McLean model. There is some evidence that a high-quality information technology (IT) plan leads to system success; therefore, we empirically examine the inclusion of the IT plan quality construct as an antecedent to IS success. We also empirically examine the relationships among constructs in the model of IS success in the context of different corporate cultural types—entrepreneurial and formal. The results provide strong support for the research

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model and suggest that variations in IS success are explained by the quality of the IT plan and the corporate culture exhibited by a firm. We discuss implications related to our finding that IT plan quality has a greater impact on IS success in organizations that exhibit an entrepreneurial corporate culture than in those that exhibit a formal corporate culture. Furthermore, we discuss how the relationships in the DeLone and McLean model of IS success differ in diverse corporate cultural types and the meaning of these differences.

KEY WORDS AND PHRASES: corporate culture, impact of information systems use, information systems success, information technology plan quality.

THE PRIMARY PURPOSE OF THE DELONE AND MCLEAN (D&M) model of information systems (IS) success was to provide guidance for future research. The D&M model is a multidimensional and interdependent construct that provides a clearer picture as to what constitutes IS success by studying the interactions among the dimensions of the model. Previous studies surrounding the model have called for future research and further examination of the measure [19, 56]. For example, Rai et al. called for researchers to examine the performance of the D&M model in different contexts, and suggested that the model be "critically evaluated, refined and tested" [56, p. 66]. More recently, DeLone and McLean [20] suggested the addition of control variables and contingencies to assess the validity of the model of IS success. In this paper, we consider a possible antecedent, information technology (IT) plan quality; a contingency factor, corporate cultural type; and variations of the dependent variable, IS use, when examining the D&M model of IS success.

An IT plan results from the process of considering and formally asserting the IT development strategies, the overall purpose for IT, the priorities of IT, and, possibly, a coordination of the IT resources with business strategy and structure [61]. The IT plan, of course, is a fundamental guide for the development and acquisition of IS applications, IT infrastructure, data, and networks in an organization. A quality IT plan can help establish standards that will affect the connectivity, compatibility, and modularity of the hardware, software, and data within an organization [8]. Without such an IT plan, organizations are likely to drift into developing and acquiring IT resources characterized by a hodgepodge collection of incompatible hardware, software, and data. Without quality IT plans, organizations typically find themselves with "silos" of technological resources that cannot connect or cooperate easily [59]. Sophisticated IT plans should have a positive effect on the IT resources in the organization and raise the overall quality of the use of these resources. However, we caution that when evaluating the use of IT resources, conclusions about such use might be deemed premature and inappropriate if the type of use is not considered in conjunction with the corporate culture of the organization.

The classification of organizations into identifiable corporate cultural types is important for examining issues surrounding their varying characteristics [52]. Two main classifications of culture are commonly cited in the organizational culture literature.

The first classification, sometimes referred to as entrepreneurial [25, 60], represents organizations with an emphasis on spontaneity, flexibility, and individuality [10, 38, 60]. Entrepreneurial organizations have a tendency of being on the leading edge and of being first to market. Organizations that fit this cultural type are often viewed as "agents through which a creative new product, process, or service is brought into the marketplace" [60, p. 7].

The second classification, sometimes referred to as formal [60], represents organizations with an emphasis on control, stability, order, and bureaucracy [10, 38, 60]. Formal organizations have a predisposition to demonstrate cost-effectiveness continually and to be consistently rigid. They also tend to possess an organizational structure that is more routinized and specialized [60].

The D&M model is especially significant in this study because it provides an opportunity to examine intermediate IS effects [4, 5, 57, 58]. Barua et al. noted that the value or success of IS could best be identified through a "web of intermediate level contributions" [4, p. 6]. With this approach, IS effects are analyzed at lower levels in the firm instead of at an aggregate level as in Brynjolfsson and Hitt [7]. Moreover, the effects analyzed at lower levels in the firm can be explored further to see how they might affect performance at a higher level. In this way, the web of intermediate-level contributions, as introduced by Barua et al. [4], can be determined for a particular domain. The D&M model provides a theoretically derived opportunity to study these intermediate IS effects.

One difficulty in the D&M model, cited by Seddon [65], is the multifaceted meaning of IS use (e.g., benefits from use, future IS use, impact of use). Therefore, while investigating this model or while using it as a foundation for study, researchers must explicitly express their definition of IS use. That is, researchers should state whether IS use means the benefits from use, future IS use, impact of use, or some other characterization of IS use. We have chosen the impact of IS use as our dependent variable. With this designation, it is not the use of IS itself that is the measure of IS success but, rather, the implied impact of that use on the organization that is important [65]. Because our study and measures focus on the organizational level of analysis, this view of IS use is the most appropriate one here.

Moreover, we will separate the impact of IS use into three levels—strategic, tactical, and operational [76]. The impact of IS use at the strategic level focuses on overall organizational goals, strategies, policies, and objectives. At the strategic level, IS is typically used by top management. The impact of IS use at the tactical level focuses on allocating resources and monitoring the performance of subunits, divisions, and departments. Middle managers are typical users of IS at the tactical level. The impact of IS use at the operational level focuses on directing resource use and the performance of tasks to yield labor productivity [76]. Clerical and production workers are typical users of IS at the operational level. Weill [76] states that an IS is not necessarily a homogeneous entity and showed that the type of IS can be important in gaining detailed insight into its value. He attributes this to the fact that different systems exist for different management objectives. The different types most likely consist of very different IS applications with many varying characteristics. There is also some evidence

that separating technology into different types can help in predicting firm effectiveness [79]. Accordingly, studies have considered the effects of IT for operational use [3], tactical use [17], and strategic use [55].

We will also investigate the possibility of IT plan quality as being an antecedent to the front-end variables of the D&M model—namely, system quality and information quality. There is some evidence that a high-quality IT plan leads to system success, but there have been few studies explicitly linking IT plan quality to these two variables [61]. Moreover, we will contrast the IS success model in two different types of organizational cultures—formal organizations and entrepreneurial organizations. Past studies suggest that the relationships between some of the variables in the model may differ by cultural type. A more explicit set of dependent variables may also better enable us to detect any differences in the model across cultural types, hence the reason we will investigate the need to separate the consequence variable, IS use, into three different types. We will discuss and test these possibilities in the paper.

Development of Research Questions

SEVERAL STUDIES SURROUNDING IS SUCCESS have called for modifications and additions to the model [19, 20, 56]. We follow their suggestions in this study by adding an antecedent variable, IT plan quality; a contingency factor, organizational cultural type; and a more refined and explicit dependent variable, impact of IS use at the strategic, tactical, and operational levels. We present our overall model in Figure 1.

There is some evidence that an organization's IT plan is likely a primary determinant of the quality of the systems and data that are ultimately implemented in an organization [53]. An IT plan can act as a blueprint to assemble IT resources that are compatible and that work well together. Moreover, an IT plan can help establish maintenance procedures that can assist in keeping IT resources online and running at maximum capacity and uptime. It may also help integrate IT resources into the organization [53, 59]. This argument demonstrates the potential of an IT plan to influence the success of IS in the organization. This leads to our first research question:

> *Research Question 1: How does the inclusion of IT plan quality as an antecedent to system quality and information quality affect IS success?*

The above arguments also make it plausible that IS success might vary in the context of different corporate cultural types. Corporate culture is regarded as an organization-specific system of broadly shared assumptions and values, and has been shown to be related to the effectiveness of an organization and its attributes. Therefore, it is important to examine the relationships between factors in the D&M model in different corporate cultural types. We believe these differences are more likely to be discovered by refining and making more explicit our dependent variable of IS use. This leads to our second research question:

> *Research Question 2: How do the relationships between factors in our modified D&M model differ in the context of different corporate cultural types?*

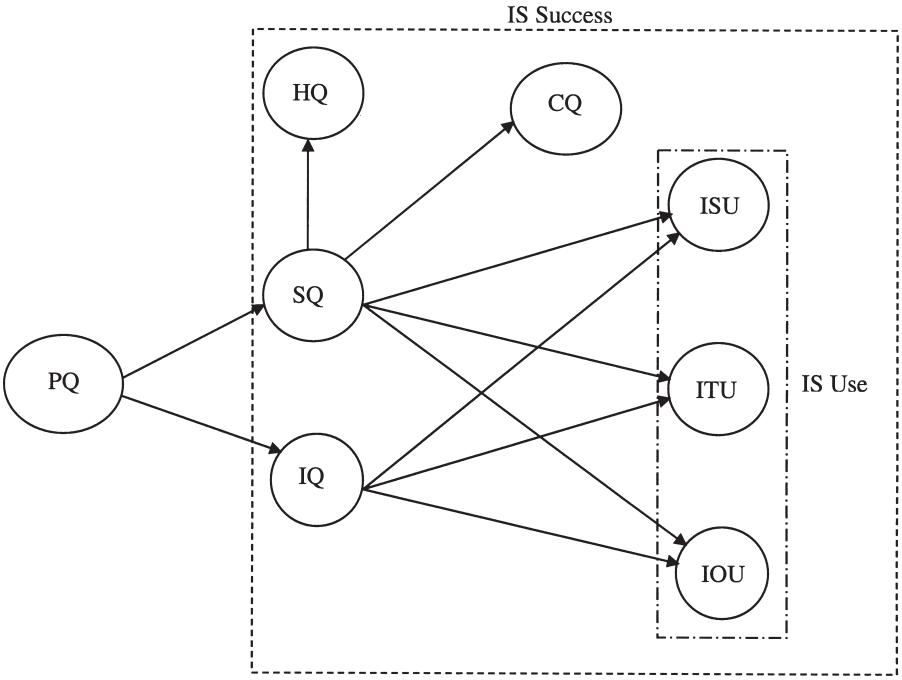

Figure 1. Research Model for Hypotheses 1 and 2 (Plan Quality as an Antecedent to IS Success)
Notes: PQ = plan quality; SQ = system quality; IQ = information quality; ISU = impact of strategic IS use; ITU = impact of tactical IS use; IOU = impact of operational IS use.

Finding the answers to these two questions will make a significant contribution to the IS literature in this very important area of research.

Research Model

In 1992, DeLone and McLean [19] developed a six-factor model of IS success based on empirical and theoretical research of IS success measures used by a number of researchers in the 1970s and 1980s. The six categories of the D&M model of IS success are system quality, information quality, IS use, user satisfaction, individual impact, and organizational impact. Seddon and Kiew [66] partially tested this model of IS success, and their results provided substantial support for the constructs tested. This study was followed by Seddon's [65] respecification and extension of the D&M model. In his attempt to clarify the D&M model of IS success, and through the integration of core theoretical relationships adopted from the IS success literature [56], Seddon [65] reduced the D&M model to five constructs. The five constructs include system quality, information quality, perceived usefulness, user satisfaction, and IS use. Since the development and extension of the D&M model, nearly 300 articles in refereed journals have referred to and made use of this model [20]. Whereas the D&M

model is seen as a major catalyst for and a key enabler in the measurement of IS success, it is imperative to continue to build upon the work of DeLone and McLean [19], Seddon [65], Seddon and Kiew [66], and others. Such an attempt could help establish a more robust model that will also encompass other antecedent variables such as IT plan quality.

IT Plan Quality as an Antecedent to System Quality

In the IS literature, some researchers imply that the quality of an IT plan influences system success [34, 44, 61]. Sabherwal [61] reported on a study of 36 companies, where 16 of 18 successful users of IS had formal IT plans. Raghunathan and Raghunathan [53] found that IT planning success predicted improvement in systems' capabilities. Finally, Doll [23] reported that organizations with successful IS were three times more likely to have and use formal plans for systems development.

This may be a valid assumption because one of the objectives of an IT plan is to lead to the development of more successful IS [53]. First, a sophisticated, high-quality IT plan may increase the ability of IS and business managers to agree on the development priorities of new systems [28, 41, 61]. This unified management approach could possibly lead to IT managers who know and understand business issues and business managers who are knowledgeable about IT and the opportunities it provides. This convergence and knowledge sharing may improve the identification and development of new and high-payoff IT systems [28, 61].

Next, a higher-quality IT plan would likely lead to improved horizontal and vertical communication relative to IT managers, end users, and top management. This can, in turn, lead to increased top management support [28] and therefore will generate greater support and resources for IS development efforts and, consequently, increase productivity in systems development and maintenance [27]. Overall, a higher-quality IT plan could lead to a reduction of problems during IS development [61] and better system performance [6]. From these arguments, we posit:

> *Hypothesis 1: A high level of IT plan quality leads to a high level of system quality.*

Information is arguably the livelihood of a firm. The quality of the information will often determine the performance of the firm. Therefore, the ability to access quality information—meaning information that is timely, accurate, complete, and thorough—about the entire enterprise from various organizational subsystems is often the key to a successful response in a competitive environment. Still, even today, many large and medium-sized organizations cannot access enterprise-wide, relevant information resulting from different entry points across their functional areas. The lack of quality information manifests itself in many obstacles that block successful execution of the firm's business strategy. Goodhue et al. [28] argued that the development of an IT data plan was significant in helping companies realize the promise of enterprise-wide quality data. They noted that the concept of developing enterprise-wide data had its roots in "information engineering" [30, 47]. Goodhue et al. [28] concluded from their analysis of information

engineering that the development of an IT plan addressing the data needs of the organization was the first step in attaining the requisite information integration.

One of the most common outputs from any organizational IT planning process is the data requirements for the enterprise. IT planning methodologies such as information engineering, strategic data planning [47], business systems planning (BSP), and strategic IT planning [24] all express the need to create an information architecture or, at least, an information needs assessment of some type. Simple logic implies that any resultant IT plan from a high-quality process would likely yield high information quality for that organization. This leads to our second hypothesis:

> *Hypothesis 2: A high level of IT plan quality leads to a high level of information quality.*

Organizational Cultural Types

Culture is defined as "a system of knowledge, of learned standards for perceiving, believing, evaluating and acting" [1, p. 198], and as a "system of socially transmitted behavior patterns that serve to relate human communities to their ecological settings" [1, p. 201]. Davis [18] asserts that corporate culture is based on internally oriented beliefs concerned with how to manage, and externally oriented beliefs concerned with how to compete. These individual and collective assumptions, beliefs, and values strongly shape both an organization's competencies and rigidities [39]. Futhermore, corporate culture has been shown to affect the relationships between organizational variables, including those in IT [36, 39, 52].

Prior research has shown that a strong relationship exists between the corporate culture of an organization and the effectiveness of the organization and its attributes [10]. For instance, entrepreneurial organizations desire flexibility and innovation, whereas formal organizations stress cost containment [48, 62, 79]. An organization that is entrepreneurial, by nature, will not employ or utilize technology in the same manner that an organization driven by cost efficiency will [62]. Entrepreneurial firms might utilize certain technology more effectively or efficiently than formal firms, whereas, when considering other technology, formal firms might be more efficient or effective. We explore these possibilities in the next set of hypotheses.

Past research contrasting the effects of strategic plans in formal and entrepreneurial organizations has shown these effects to be different [75]. The next set of hypotheses will consider this possibility as we explore the differences in the strengths of the relationships between factors in our research model for the two types of firms. For each relationship, and thus, each hypothesis, we present evidence and argue that the relationship in one type of firm will be superior to that in the other type of firm.

The first sets of relationships in our model are the effects of IT plan quality on system quality and information quality. In trying to determine if the effects of IT plan quality on system quality and information quality are stronger in formal organizations than entrepreneurial organizations or vice versa, two concerns—uncertainty and adaptability—seem to dominate and lead to somewhat different conclusions.

First, we discuss uncertainty. Formal firms operate under a relatively low level of uncertainty compared with entrepreneurial firms. Because of their simple and stable product market domain, formal firms have operations that are routine, repetitive, and standardized. The IS infrastructure and applications of formal firms, therefore, will likely be characterized by legacy systems. Legacy systems are generally viewed as technology that supports routine, repetitive, and slowly changing operations. From this perspective, it would seem that the quality of an IT plan would have a very large effect on the resulting IS in the firm because of the relative certainty of the systems and the operations that they support. Because the uncertainty in entrepreneurial firms would be much greater, we would expect much more of a change in IS in this type of firm. Even a high-quality IT plan would have little effect on IS in a firm if the need for unpredictable change in IS infrastructure and applications occurred due to some transformations in the internal or external environment, as is likely in entrepreneurial firms. Therefore, when considering uncertainty, IT plan quality would seem to have a greater effect in formal firms.

However, we can also view the effects of IT plan quality by exploring adaptability within formal and entrepreneurial firms. Entrepreneurial firms faced with uncertainty would likely need a guiding mechanism such as a sophisticated IT plan because its organization structure is decentralized. Experimentation in system quality and data management technologies would probably be much greater in entrepreneurial firms because it also is in other areas of operation. A high-quality IT plan with appropriate guidelines, if utilized, is likely to keep this experimentation under control and make it productive, thus creating a large effect. In formal firms, one might argue—as opposed to the thoughts in the previous paragraph—that because technology is likely to be stable and unchanging, a high-quality IT plan would probably not have much effect on system quality and information quality. Centralized management in formal firms can make decisions about their stable set of technologies without the benefits of a plan because of similar decisions they may have made in the past. There is also the possibility that the formal firm would generate essentially the same IT plan year after year, thus having little new effect.

Which view is correct? Empirical evidence seems to favor the entrepreneurial firm over the formal firm in these relationships. Veliyath and Shortell [75] found that strategic plans were more effectively implemented in entrepreneurial firms than in formal firms and had a greater effect. From the argument above and this empirical evidence, our next two hypotheses are:

Hypothesis 3a: The effect of IT plan quality on system quality will be significantly greater in entrepreneurial firms than in formal firms.

Hypothesis 3b: The effect of IT plan quality on information quality will be significantly greater in entrepreneurial firms than in formal firms.

Formal organizations usually employ a rigid, mechanistic organizational structure [62]. By this, we mean that organizations that fit this profile rarely undergo major adjustments. However, formal organizations can be innovative in their own way. Although entrepreneurial organizations are innovative in developing new technologies

and products, many formal organizations can be extremely adept at producing and delivering existing products and services to their customers [48]. Formal organizations invest in a few of what they consider to be cost-effective, core technologies and, because they typically have these technologies deeply rooted in their firms, these organizations are able to succeed by being efficient. When formal organizations perceive something as useful, they are more likely to institutionalize its use. In light of the characteristics exhibited by this culture, we would expect the relationship between system quality and impact of operational use to be greater for formal organizations than for entrepreneurial organizations. Our next hypothesis, therefore, is:

Hypothesis 4: The strength of the relationship between system quality and impact of operational IS use will be significantly greater for formal firms than entrepreneurial firms.

The definition for tactical IS use in our study focuses on administrative efficiency, productivity, improvement in scarce resources, and improvement in internal and external services. In formal firms, the product market mix changes very slowly. Improvements in the tasks in these firms are likely to be due to automating more tasks and advances in automation technology and not necessarily from decisions made by tactical managers. Moreover, tactical managers in formal firms are likely to follow policies and procedures rather than use computer systems to search or scan for critical decision-making information. Therefore, the impact of these managers in using these systems is likely to be low. On the other hand, tactical managers will make many decisions in an entrepreneurial firm. By the very nature of this type of organization, the managers are empowered to make decisions and to implement them. They will utilize computer systems to search, scan, and analyze data and information from all over the organization to make decisions that are far-ranging in effect. The better the quality of these systems, the better able the managers are to carry out the actions needed to make good decisions. These observations lead to:

Hypothesis 5: The strength of the relationship between system quality and impact of tactical IS use will be significantly greater for entrepreneurial firms than formal firms.

With entrepreneurial firms focused more on developing new products and entering new markets, their emphasis in utilizing IS is more likely to take place at the strategic level. At the strategic level in entrepreneurial firms, senior executives will likely use technologies to scan for new markets for existing products and products that are being developed [26, 72]. Because technologies at the strategic level seem to be more important in entrepreneurial firms than in formal firms, it is reasonable to expect that system quality influence on these technologies would be greater in entrepreneurial firms. These arguments lead to the next hypothesis.

Hypothesis 6: The strength of the relationship between system quality and impact of strategic IS use will be significantly greater for entrepreneurial firms than formal firms.

Employees throughout entrepreneurial organizations tend to be more involved in the decision-making processes than employees in formal firms. As mentioned earlier, employees at all levels in entrepreneurial firms are included in making decisions because of the decentralized nature of this type of organization. Moreover, because entrepreneurial firms are constantly adding new products and services, we can conclude that such organizations would have more decisions, many of them new and novel, to make than formal firms. Therefore, most of the workers in entrepreneurial enterprises would certainly gain more experience and expertise in decision making.

Research has shown the effects of information quality on outcomes, such as impact of IS use, is based on the level of that information quality and the quality of the decision maker in assessing problems and making decisions [54]. Raghunathan [54] found that decision quality improved with greater information quality for decision makers who were able to understand problems better. However, he also found that, even with increasing quality of the information, decision quality degraded when decision makers who were not skilled in making decisions and understanding problems made decisions. His conclusion was that simultaneous improvement in information quality and decision-maker quality prevents the degradation of decision quality.

By coupling the above argument with this empirical evidence, it is logical to conclude that because the employees of entrepreneurial enterprises are more experienced in decision making and have greater expertise, higher information quality would have a greater impact in entrepreneurial firms. This would apply to workers using technology to acquire information at the operational, tactical, and strategic levels. Workers at all three levels would simply have more expertise in the decision-making process in entrepreneurial firms than would their counterparts in formal firms. Higher information quality would therefore give entrepreneurial firms a greater impact from the IS delivering this information. Reflecting on this, the last three hypotheses are as follows:

Hypothesis 7: The strength of the relationship between information quality and impact of operational IS use will be significantly greater for entrepreneurial firms than formal firms.

Hypothesis 8: The strength of the relationship between information quality and impact of tactical IS use will be significantly greater for entrepreneurial firms than formal firms.

Hypothesis 9: The strength of the relationship between information quality and impact of strategic IS use will be significantly greater for entrepreneurial firms than formal firms.

Methods

Data Collection

A SURVEY INSTRUMENT CONTAINING MULTIPLE ITEMS for each of the constructs used in this study was developed and used to collect the data for this study. The survey instrument was developed based on a review of the IS literature. Top journals in IS

(e.g., *Decision Sciences, Information Systems Research, Journal of Management Information Systems, Management Science, MIS Quarterly*) were searched for items relating to the IS success variables used in the study. A pretest using IS professors and Ph.D. students helped refine the items. A pilot study using IS executives from area firms was performed to ensure that the questionnaire was understandable and measured the proposed factors.

Probably the most logical person to answer questions about IS success in a firm is the top IS executive officer, typically called the chief information officer (CIO). Therefore, we compiled a mailing list of top computer executives and their companies from the *Directory of Top Computer Executives.* Due to the difference in profit motive for private and public organizations [43], we eliminated all public hospitals, public educational institutions, and governmental agencies from consideration as sample participants. We felt that for-profit organizations were the more appropriate population for our initial examination of the IS success construct because of their strong demand for overall performance. We also restricted our population to firms that had 50 or more IT staff members in their IT departments. The restriction assured that the firms had a substantial number of internal IT staffers. This resulted in a population of 3,000 firms from the *Directory.*

Once we chose the population, we generated random numbers for each organization and sorted the organizations in ascending numerical order. The qualified population of organizations was divided into homogeneous strata based on industry type and was placed within each type in ascending numerical order. The number of entries needed for each industry category to achieve a sample size of 1,000 organizations, and yet maintain the population proportion, was calculated. We selected entries for the mailing list by starting with the first entry per industry category and continuing down the list until we obtained the desired number of entries. Thus, a proportional, stratified random sample of fairly large, for-profit organizations was developed.

We mailed our research instrument to the sample at three different times. Each subsequent mailing took place approximately one month after the previous mailing. We targeted individuals designated at each organization as the top information executive as the questionnaire recipients. Three mailings resulted in a return of 225 completed questionnaires. This resulted in a response rate of 22.5 percent of the original 1,000 organizations targeted. Chi-square analysis of the industry distribution of the respondents showed no difference from the industry distribution of all the organizations in the original population of 3,000 in the *Directory.* In another test of nonresponse bias, we performed an analysis of variance (ANOVA) to compare early respondents (first mailing) with late respondents (third mailing). The result of this analysis indicated that there was no difference between the two groups on the IS success factors. These two tests suggested that nonresponse bias in the returned questionnaires relative to industry association and early versus late respondents was not a problem.

Data Analysis and Results

ALL THE FACTORS IN THE MODEL ARE OPERATIONALIZED as principal factors with reflective indicators. The second-order factor, system quality, was also constructed as

a principal factor with reflective indicators of first-order factors hardware/operating systems quality and communications quality. The major difference between factors made up of reflective indicators and formative indicators is that reflective indicators are expected to be correlated and dropping an indicator does not alter the meaning of the construct [37]. All of the items for first-order factors in the model easily meet these criteria. A statistical test can help in validating second-order factors. Segars and Grover wrote: "the second-order factor of this model is merely explaining the covariation among first-order factors in a more parsimonious way. . . . It has been suggested that the efficacy of second-order factors be assessed through examination of the target T coefficient [T = chi-square(baseline model)/chi-square(alternative model)]" [67, p. 153]. A higher value (with an upper bound of 1.0) indicates that the second-order model can be accepted as a "truer" representation of the model structure. In our analysis, the ratio between the baseline (correlated individual factors) and alternative model (the second-order model) was 0.99 and, therefore, the second-order factor was accepted and used in our analysis.

Reliability and Validity

Alpha reliability (Cronbach's alpha) estimates for the multiple item scale are reported in Table 1. Each alpha exceeds the minimum acceptable level of 0.70 recommended by Nunnally and Bernstein [51].

In assessing construct validity, all item loadings for each factor were above the recommended level of 0.70 except for four of the items used to measure impact of operational IS use [31]. Although the loadings for these items were below the recommended level of 0.70, they were all above 0.60, which is deemed acceptable for most studies [31]. We also used the measure of average variance extracted (AVE) to assess construct validity. All the factors, except impact of operational IS use (0.46), were above the recommended threshold of 0.50.

We measured discriminant validity using pair-wise comparisons for all the factors with the correlations constrained to unity and not being constrained to unity. In each comparison, the correlations were significantly different from each other. In addition to using the traditional approach of assessing discriminant validity as described, we used an iterative process to compare the one-factor model (by loading all the items onto a single factor and running the one-factor model) to the corresponding two-factor model. The results suggested that the two-factor models were better than the one-factor models. This indicates that all the factors were independent from each other, and, therefore, distinct measures. To validate further that all measures were indeed different, we compared the square root of the AVE of each construct to the interconstruct correlations. We present the interconstruct correlations and the AVE for each construct in Table 2. The square root of the AVE for each construct was greater than their interconstruct correlations. This result provides more evidence that the factors in the study were distinct.

Table 1. Indicator Loadings

Sources	Construct (Cronbach's coefficient alpha)	Loadings
Dickson et al. [22]	Plan quality (0.89)	
Lewis et al. [45]	IT department's planning supports your firm's ability to keep up with changing technology.	0.88
Sambamurthy and Zmud [63]	IT department's services evolve to meet your firm's changing needs and capabilities.	0.87
	Long-term data infrastructure plans exist and are followed.	0.83
	Long-term network infrastructure plans exist and are followed.	0.82
Bailey and Pearson [2]	Information quality (0.87)	
Slevin et al. [68]	Users receive reports in a timely manner.	0.87
Zmud [81]	Users receive accurate information output.	0.83
	Users receive current information output.	0.88
	Users receive complete (thorough) information output.	0.75
	Users receive relevant information output.	0.89
	Users receive reliable information output.	0.83
Hamilton and Chervany [32, 33]	Hardware quality (0.78)	
Lewis et al. [45]	Hardware and operating systems are available for use 24 hours per day, seven days a week.	0.70
Miller and Doyle [50]	Hardware and operating systems response times are adequate to keep users satisfied.	0.77
Wilson [77]	Hardware and operating systems exhibit high degrees of reliability.	0.87
	Hardware and operating systems uptime are comparable to available user time.	0.82
Hamilton and Chervany [32, 33]	Communication quality (0.85)	
Lewis et al. [45]	Communication systems are available for use 24 hours per day, seven days per week.	0.70
Miller and Doyle [50]	Communication systems response times are adequate to keep users satisfied.	0.88
Wilson [77]	Communication systems exhibit high degrees of reliability.	0.90
	Communication systems uptimes are comparable to available user time.	0.89

(continues)

Table 1. Continued

Sources	Construct (Cronbach's coefficient alpha)	Loadings
Katz [40]	Impact of strategic IS use (0.92)	
Miller [49]	IT has enabled your firm to gain market share.	0.93
Szewczak [71]	IT has enabled your firm to establish competitive barriers.	0.92
Saunders and Jones [64]	IT has enabled your firm to establish a defensible market.	0.91
Hamilton and Chervany [32, 33]	Impact of tactical IS use (0.89)	
Katz [40]	IT has enabled your firm to improve administrative efficiency.	0.82
Miller [49]	IT has enabled your firm to improve productivity.	0.90
Wilson [77]	IT has enabled your firm to improve allocation of scare resources.	0.81
Szewczak [71]	IT has enabled your firm to improve internal services.	0.87
	IT has enabled your firm to improve external services.	0.76
Hamilton and Chervany [32, 33]	Impact of operational IS use (0.88)	
Katz [40]	Activities associated with purchasing inputs (raw materials) required by your firm	0.75
Wilson [77]	Receiving, storing, and disseminating inputs to the products (e.g., materials handling, warehousing)	0.77
	Transforming inputs into final product (e.g., cutting, assembly)	0.69
	Collecting, storing, and distributing the final product to your firm's customers (e.g., order processing, scheduling)	0.70
	Providing service to maintain or enhance the value of the product (e.g., maintenance notices, upgrades)	0.61
	Improving your firm's products and processes (e.g., R&D)	0.65
	Coordinating different activities described above (e.g., purchasing, order processing, marketing, etc.)	0.68
	Interacting and coordinating activities with customers	0.70

Table 2. Interconstruct Correlations

	PQ	SQ	IQ	ISU	ITU	IOU
PQ	0.71					
SQ	0.50	0.53				
IQ	0.43	0.50	0.81			
ISU	0.40	0.19	0.16	0.84		
ITU	0.63	0.49	0.42	0.51	0.69	
IOU	0.40	0.29	0.23	0.25	0.46	0.46

Notes: Diagonal elements represent the AVE for each construct. PQ = plan quality; SQ = system quality; IQ = information quality; ISU = impact of strategic IS use; ITU = impact of tactical IS use; IOU = impact of operational IS use.

Cluster Analysis Results

We performed a *K*-means cluster analysis to classify the organizations into entrepreneurial and formal organizations. The items used in the cluster analysis to distinguish entrepreneurial and formal firms were derived from Quinn and Spreitzer's [52] model of corporate cultural types, the so-called competing values model. In our cluster analysis using these items, three distinct groups were identified: formal (high values on "formal" items and low on "entrepreneurial" items), entrepreneurial (high values for "entrepreneurial" items and low on "formal" items), and indeterminate (low values on "entrepreneurial" items and low values on "formal" items). As presented in Table 3, the number of organizations in each cluster was as follows: Cluster 1 ($n = 80$) fit the profile of formal; Cluster 2 ($n = 73$) fit the profile of entrepreneurial; Cluster 3 ($n = 72$) was indeterminate. Because the items used in the cluster analysis were geared toward classifying organizations into two primary groups, formal and entrepreneurial, there was little doubt about the interpretation of two of the resulting groups, Clusters 1 and 2. These corporate cultural types are often contrasted in studies [52, 80]. Therefore, in this study, we focused on the two distinguishable corporate cultural types represented by Clusters 1 and 2—formal and entrepreneurial. We performed an ANOVA on the items used in the cluster analysis to test for statistical differences between the two groups. The result of the ANOVA validated the cluster solution since it indicated that the means of the two clusters were significantly different at $p < 0.001$ (see Table 4).

Results of Hypothesis Testing

The research model for the two groups was tested using PLS-Graph (partial least squares), a path-modeling tool that is well cited for highly complex predictive path models [14, 15]. PLS-Graph has several strengths that make it appropriate for this study, including its ability to accommodate smaller sample sizes. We used the bootstrapping technique with two runs of 1,000 samples in each run. H1 and H2 are

Table 3. Cluster Analysis Results

Variable	Mean* Cluster 1 (formal) $N = 80$	Cluster 2 (entrepreneurial) $N = 73$	Cluster 3 (indeterminate) $N = 72$
Your firm is a very dynamic and entrepreneurial place.	3.28	5.41	3.61
Your firm is a very formal and structured place.	5.03	3.73	2.33
The glue that holds your firm together is commitment to innovation and development.	3.56	5.47	3.13
The glue that holds your firm together is formal rules and policies.	4.66	3.37	2.36

* 1 = strongly disagree; 7 = strongly agree.

supported; our results show that IT plan quality has a significant effect on both system quality and information quality when all organizations are considered (see Figure 2).

We employed multigroup analysis[1] to test the remaining hypotheses when the corresponding relationships proved to be significant in both types of firms. The multigroup analysis method of model comparison has been used in other studies that made use of path analysis and structural equation modeling [16, 29, 42]. Because the purpose of this study was to examine structural relationships between the construct of interest and other constructs across corporate cultural types, tests of configural and metric invariance were assessed. Steenkamp and Baumgartner [70] suggest that these two tests of measurement invariance are necessary when the intent of the study is in line with the aforementioned purpose. Furthermore, configural and metric invariance are the most frequently conducted tests when assessing measurement invariance [73, 74]. Therefore, tests of configural and metric invariance were assessed to ensure the instrument used to measure the theoretical constructs exhibited adequate equivalence across both types of firms [9, 70]. Based on the chi-square difference test, the model proved to be invariant across groups because the requirements for the tests of configural and metric invariance were met. Therefore, we can conclude that there was no evidence of differential item functioning (DIF) across corporate cultural types [11], and we can proceed to interpret the results of the multigroup analysis with confidence.

The results of the research model for entrepreneurial and formal firms are illustrated in Figures 3 and 4, respectively. H3a and H3b are both supported at $p < 0.001$ using the multigroup analysis technique. The effects of IT plan quality are significantly greater in entrepreneurial firms than in formal firms. H4 is not supported be-

Table 4. Results of Testing of Cluster Means Across Groups

Source	Degrees of freedom	Sum of squares	Mean square	F	p
One-way ANOVA: For items used to cluster entrepreneurial organizations					
Groups	2	404.54	202.27	157.22	0.000
Error	447	575.07	1.29		
SD = 1.134	R^2 = 41.30 percent		R^2 (adj.) = 41.03 percent		
One-way ANOVA: Items used to cluster formal organizations					
Groups	2	488.66	244.33	239.05	0.000
Error	447	456.87	1.02		
SD = 1.011	R^2 = 51.68 percent		R^2 (adj.) = 51.46 percent		

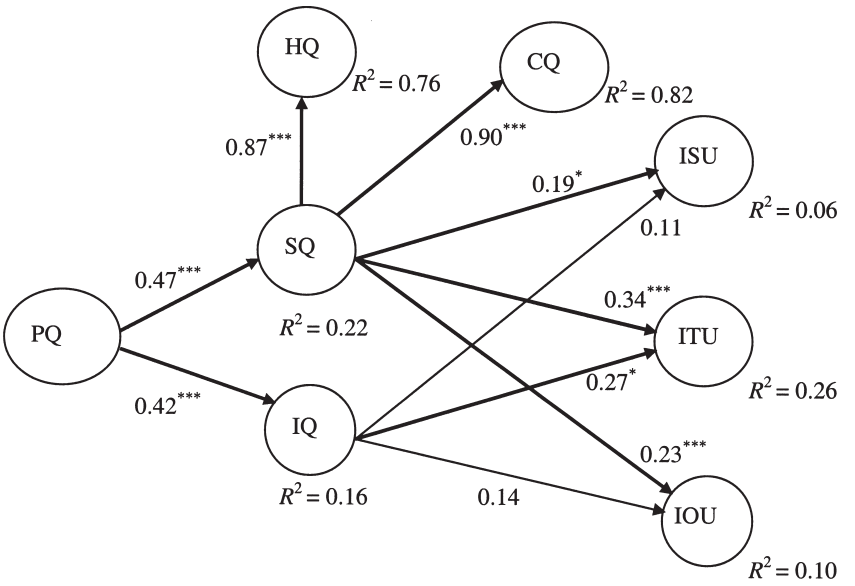

Figure 2. Results of the Research Model with Plan Quality as an Antecedent to IS Success for All Corporate Cultural Types
Notes: PQ = plan quality; SQ = system quality; IQ = information quality; ISU = impact of strategic IS use; ITU = impact of tactical IS use; IOU = impact of operational IS use.
* significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$.

cause the relationship between system quality and impact of operational IS use is not significant for either entrepreneurial firms or for formal firms. H5 is supported because the relationship between system quality and impact of tactical IS use is greater in entrepreneurial firms. H6 is supported because the relationship between system quality and impact of strategic IS use is significantly greater in entrepreneurial firms than in formal firms. H7 is not supported because, again, the evidence showed the opposite case where the relationship between information quality and impact of operational IS use is significantly greater in formal firms and not in entrepreneurial firms as hypothesized. H8 is supported because the relationship between information quality and impact of tactical IS use is significantly greater in entrepreneurial firms than in formal firms. Finally, H9 is not supported because the relationship between information quality and impact of strategic IS use is not significant in either type of firm. A summary of the hypothesis testing results are presented in Table 5.

Discussion

Research Implications

THIS STUDY PROPOSES THAT IT PLAN QUALITY, through its relationship with system quality and information quality, influences IS success. The results of our study indicate

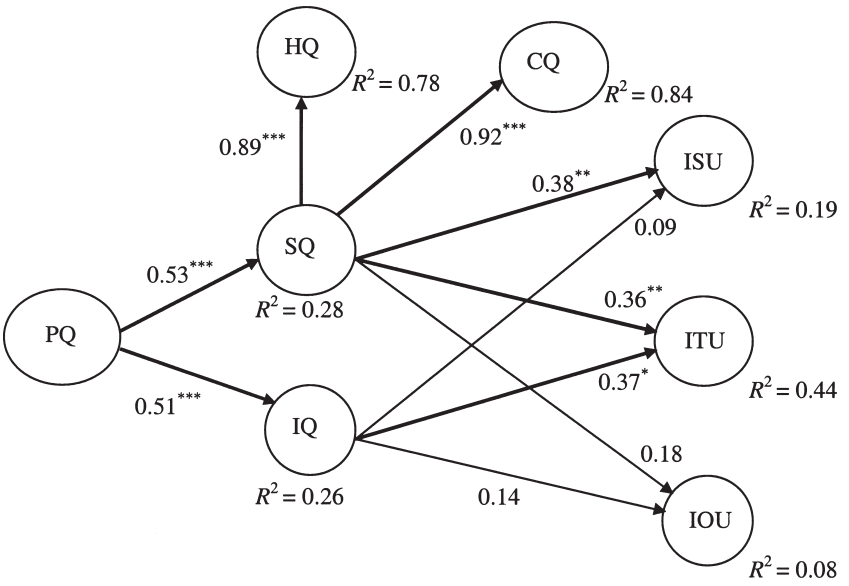

Figure 3. Results of the Research Model with Plan Quality as an Antecedent to IS Success for Entrepreneurial Cultural Type
Notes: PQ = plan quality; SQ = system quality; IQ = information quality; ISU = impact of strategic IS use; ITU = impact of tactical IS use; IOU = impact of operational IS use.
* significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$.

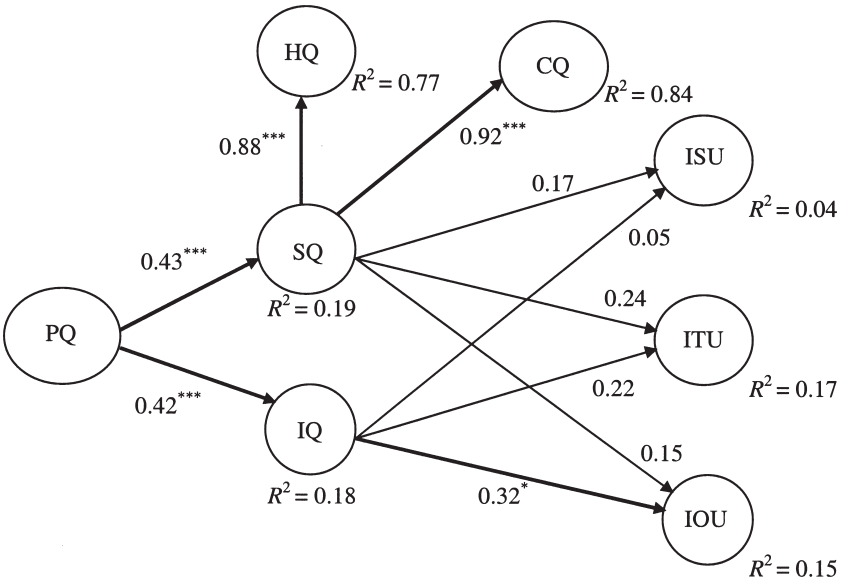

Figure 4. Results of the Research Model with Plan Quality as an Antecedent to IS Success for Formal Cultural Type
Notes: PQ = plan quality; SQ = system quality; IQ = information quality; ISU = impact of strategic IS use; ITU = impact of tactical IS use; IOU = impact of operational IS use.
* significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$.

Table 5. Results of Hypothesis Testing

	Weights		
Hypothesis	Entrepreneurial	Formal	Result
H1	0.53***	0.43***	Supported
H2	0.51***	0.42***	Supported
H3a	0.53***	0.43***	Supported
H3b	0.51***	0.42***	Supported
H4	0.18	0.15	Not Supported
H5	0.36**	0.24	Supported
H6	0.38**	0.17	Supported
H7	0.14	0.32*	Not Supported
H8	0.37*	0.22	Supported
H9	0.09	0.05	Not Supported

* significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$.

that IT plan quality directly influences system quality and information quality in both entrepreneurial and formal firms. These results support those of other researchers, including Sabherwal [61]. Combined with findings on the value of IT plans in other studies (e.g., [53]), these results firmly establish IT plan quality as an antecedent that should be considered when IS success is examined. Researchers investigating the quality of enterprise-wide IT should contemplate including an IT plan quality variable because of the substantial effects we found. Our results indicate that IT plan quality may also help to explain some of the variance in studies investigating related issues such as systems development, IS maintenance, and data management.

Our study also found that the type of cultural environment affects some of the relationships between factors in our modified D&M model. This shows that corporate culture should be included in studies examining the D&M model. Even when we found that the relationships between two factors in the model were significant in both cultural types, there were still differences in the strengths of the relationships for both entrepreneurial firms and formal firms. For example, in the relationships between IT plan quality with system quality and information quality, the strengths of the relationships in entrepreneurial firms were stronger than those in formal firms, even though relationships in both types of firms were significant. This suggests that we should review the research on IT plans and planning a little more critically and evaluate whether corporate culture has been an important missing variable in that literature. It would seem so from our research.

The level of IS use, whether at the strategic, tactical, or operational level, proved to be significant when corporate culture was considered in our study. We found a significant relationship between information quality and impact of IS use in formal firms but not in entrepreneurial firms. Although it was hypothesized that the impact of this relationship would be stronger in entrepreneurial firms than formal firms, it is not very surprising that the opposite result was found. For instance, operational excel-

lence is a critical characteristic of many formal firms, and information quality is evidently very important to operations in this type of firm. Because efficiency through automation is often stressed in formal firms, the operational workers in these firms are often reduced to exception handlers. Even in this role, information quality could be important. In fact, it probably becomes more critical. If problems occur in large automated equipment, the effects can be widespread and devastating. Accurate and timely information in such situations would be especially important to get the equipment back on line and functioning correctly. The CIOs in the formal firms that responded to our survey may have been considering this possibility. On the other hand, in entrepreneurial firms, where even operational workers can be empowered to make decisions, the consequences of those decisions at the operational level may be seen as fairly localized and limited. Moreover, internal changes to products and services are likely to be swift, lessening the effects of such low-level decisions even more. In such situations, the CIOs in the entrepreneurial firms may have found that a high level of information quality is not a necessity for operational use in their firms.

The relationship between information quality and impact of tactical IS use was significant in entrepreneurial firms and not in formal firms as expected. Decisions made in entrepreneurial firms at the tactical level can have major effects, unlike those at the operational level. Key decisions that help drive the companies forward are likely to be made at the tactical level, so high information quality is critical. The relationship between system quality and impact of tactical IS use was also significant in entrepreneurial firms and not in formal firms as predicted by H5. One implication of these two results is that the impact of IS might be greatest in entrepreneurial firms at the tactical level.

There was no relationship between system quality and impact of tactical IS use in formal firms. Apparently, policies, procedures, and edicts from superiors were more important to the tactical decision makers in the formal firms than were any effects from decisions supported by IS, especially considering we found no effect of information quality at the tactical level in formal firms.

The results also suggest that strategic-level managers in entrepreneurial firms evidently do use technologies to scan for new products, services, and markets. One major surprise was that the relationship between information quality and the impact of strategic IS use was not significant in entrepreneurial firms, as implied in one of our hypotheses. Although it is important for strategic-level decision makers in entrepreneurial firms to be able to use technologies to scan for and seek information, the quality of the information does not seem to be an issue. This can be explained in at least two ways. One is that the technologies that support strategic decision making (e.g., executive support systems) typically do not deliver precise information; they focus more on making sense of aggregated data such as trends and industry movements by using graphs and charts [46]. Another explanation is that strategic decision makers depend quite a bit on intuitive and fragmented activities (e.g., rumors, opinions, anecdotes, etc.) to understand their business environments and make decisions [46, 72]. This information does not have to be extremely accurate or timely to be useful.

A general implication of the results of this study is that corporate culture and the type of IS use are important in studying the success of IS. Few studies at the organizational level of analysis have considered either one of these contingencies individually in their models and they have certainly not considered them together. Both corporate culture and type of IS use have been shown to be important contingencies in evaluating the D&M model and would probably be in any model examining IS success.

Managerial Implications

Organizations should not neglect the IT plan but, rather, should devote just as much time and energy to the quality and sophistication of the IT plan as to other corporate endeavors. This support includes the allocation of sufficient human and financial resources. Providing adequate resources is of great importance because the development of a high-quality IT plan can be quite time-consuming and dynamic in nature, requiring frequent changes [28, 35]. Although the effects of the IT plan were greater in entrepreneurial firms, the quality of the IT plan was still important in formal firms. The quality of these plans has a major impact on the quality of the systems and information in organizations.

The effects of technologies were evident more in entrepreneurial firms at the tactical level. As competition in more and more industries necessitates rapid changes within firms, more companies will take on the characteristics of the entrepreneurial firm. This will probably mean that the relationships of IT plan quality with system quality and information quality will become even more important in firms. Moreover, such companies besieged by competition and looking to invest more in their IS may need to look first at the technology at the tactical level because this is where the biggest impact is likely to be felt, according to our findings. Spending indiscriminately across all three levels of management might be counterproductive and wasteful.

Companies may need to pursue ways to increase the value of their systems and information in their companies. We found several relationships that were not significant between these two factors and the use of IS. In formal firms, for example, the only relationship we found that was significant with these two factors and the use of IS was the relationship between information quality and the impact of IS use at the operational level. It is imperative for these companies to better align their basic IS factors such as systems and information with the use of technology in their firms. Past research (e.g. [12, 13]) has demonstrated that it is through this alignment that value flows and ultimately affects overall firm performance.

Limitations

Two limitations exist concerning the use of the organizational culture construct. First, the multidimensionality of this construct creates a conceptual challenge in that a vast array of specific combinations could be developed to describe an organization's cul-

ture. However, the psychometric analysis used was shown to be valid and reliable for organizational analysis [52]. Therefore, we are convinced that the instrument used to measure organizational culture was adequate and provided a good depiction. Second, there exists the debate over whether corporate culture or corporate climate is the more accurate term to use or phenomenon to study [21]. Future researchers should delve further into this matter and clearly delineate between the two concepts.

Another issue of concern has to do with sample size. PLS requires a minimum sample size that equals ten times or greater the number of items comprising the formative factor with the highest number of items or the number of independent factors influencing a single dependent factor. Sample size is not an issue when analyzing the combined groups; however, sample size does become an issue when one wishes to separate the models. For instance, the cluster analysis yielded three groups with sample sizes of 73, 80, and 72. Although the guideline for the sample size was met in our model, a larger sample size is always desirable in an analysis of this type.

The respondent in each organization for our study was a single senior IT manager, typically the CIO. Results may be different if business managers or end users are surveyed. Future studies should survey these and other stakeholders to compare our results with their own findings to see if there is consistency in views.

Last, we should point out that one of the assumptions normally associated with multigroup analysis was violated—data set independence. This violation occurred because the data sets used to compare the two models both came from a larger data set. However, it should be noted that the same violation was evident in other studies that made use of multigroup analysis [29, 69].

Future Research

Future research in the D&M model should continue to examine factors such as corporate culture, types of IS use, and antecedents such as IT plan quality. Different definitions of corporate culture and the strength of the culture should also be considered for use in future studies. We have shown that one conceptualization of culture does affect the relationships in the D&M model. Future research is needed, with other conceptualizations to support or refute our results, to get a clearer picture of the effect of this important concept.

Other studies that analyze the value of IS might also look at the impact of different types of IS use. The impact of IS has mainly been viewed as one overall impact instead of as different effects at different levels in the organization. Future studies need to break down the impact of IS into different types, such as the ones in this study or in any other ways that make sense. Following this suggestion, other researchers might examine if targeting IS investment and implementation according to theory has greater impacts than a strategy of simply spending on IS without following such a plan. It seems from our results that IS has its greatest impact at the tactical level in entrepreneurial firms. This possibility certainly needs to be explored further. If this is indeed the case, researchers might search to find why IS has such a large impact at this level but less at other levels in entrepreneurial firms.

Of course, we have only examined three of the many possible antecedents and contingencies that could be included in future studies. Other researchers should add other factors to the IS success model to help in developing more specific theories in this area. Such theories would help managers invest more wisely in their IS and increase the impact of their technology expenditures.

Different sizes of organizations might also be analyzed in future studies. In this study, we focused on large for-profit companies. Other researchers should study other types of firms including small, foreign, or nonprofit organizations. The results from these studies could also be compared to our results to determine where similarities and differences lie. General theories could then be developed where appropriate, and more specific or limited theories could be developed when differences are discovered.

Conclusion

ONE OF THE PRIMARY PURPOSES OF THIS STUDY was to demonstrate that contingency and antecedent variables may significantly affect the relationships between constructs in the D&M model. We have shown that contingencies and antecedent variables can make a difference in the results of studies and analyses exploring the D&M model. Specifically, the inclusion of IT plan quality as an antecedent variable and corporate culture as a contingency variable significantly affected the nature of the relationships in the D&M model of IS success. Perhaps multiple in-depth case studies with two or three entrepreneurial firms and two or three formal firms would provide a clearer picture of these differences. Such examinations could prove to have valuable implications for both researchers and practitioners. These findings should appeal to the curiosity of IS researchers and lead them to further exploration.

NOTE

1. Because this method is not automated in PLS-Graph, the following was used to approximate the *t*-distribution with $m + n - 2$ degrees of freedom, where m and n are the number of observations in *sample_1* and *sample_2*, respectively:

$$t = \frac{Path_{sample\_1} - Path_{sample\_2}}{\left[\sqrt{\frac{(m-1)^2}{(m+n-2)} * S.E._{sample\_1}^2 + \frac{(n-1)^2}{(m+n-2)} * S.E._{sample\_2}^2}\right] * \left[\sqrt{\frac{1}{m} + \frac{1}{n}}\right]}.$$

For more information, see Chin [16].

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