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ADOPTION OF WEB-BASED SERVICES FOR TRANSACTION PROCESSING BY ORGANIZATIONS: A MULTILEVEL CONTEXTUAL ANALYSIS

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Abstract

The purpose of this study was to determine the affect that contextual factors such as IS maturity of the organization, organizational factors, and environmental characteristics have on perceived usefulness and adoption of web-based services for transaction processing in organizations. To achieve the purpose of the study a research model and 10 hypotheses were developed based on past literature review. To test the hypotheses, data were collected from senior managers in small business organizations using an instrument that was carefully developed and tested. Structural Equation Modeling was performed to test the goodness of fit of the model as well as the hypotheses. The model suggested moderate fit of the data. This study reveals the importance of perceived usefulness in adoption of technologies by organizations. Other important factors are IS maturity of a company, firm performance, and the budget allocated for IS by the leaders in the organization.

Keywords: Web-based services, innovation adoption, transaction processing

Introduction

Information systems power the operational engines of today's organizations. The impact of informational systems technology on operational practice can be substantial (Grover and Gosler 1993). This impact is even greater when information technology is the backbone of a business such as an Internet-based organization. While web-based services are widely recognized as important, few studies have dealt with factors that affect the decision-making process for adopting web-based services for transaction processing in organizations.

Studies in the field of innovation, which span many disciplines and focus on both the organizational and individual levels have defined an innovation as an idea, practice, or object that is perceived as new by an individual or another unit of adoption (Cooper and Zmud 1990, Hage and Aiken 1967, Rogers and Shoemaker 1978, Zaltman et al. 1973). An innovation provides an individual or an organization with a new alternative, or alternatives, and with means for solving problems (Rogers 1995). The process of organizational innovation was viewed as a stage process with, typically, three stages: initiation, adoption, and implementation (Rogers 1983, Pierce and Delbecq 1977, Thompson 1967). The initiation stage included pressure to change, and gathering and evaluation of information, which culminated in the adoption stage. The adoption stage involved the decision to commit resources to the innovation (Rogers 1995). The final stage, implementation, included development and installation activities to ensure that the expected benefits of the innovation were realized (Thompson 1969). This study related to web-based services for transaction processing as an innovation and examined the factors that facilitate its adoption in organizations.

Adoption of web-based services for transaction processing within the organizational context is the use of the web for day-to-day transactions. The 'Homenet' study (Kraut et. al. 1997) found that electronic mail use was the most popular and stable form of web

use. In the study, participants used email during 49 percent of their Internet sessions. The web was used 38 percent of the time for other purposes. An investigation of Internet usage patterns in Singapore (Teo et. al. 1997) found that messaging and browsing were performed more frequently than downloading and purchasing activities. It appears that web-based services are not commonly used transaction processing. A highlight of this study was to examine the web-based services for transaction processing and study its adoption in organizations.

Much research has investigated the effects of structural organizational factors on innovation adoption (Grover and Goslar 1993). The set of factors that was investigated within the context of organizational adoption of web-based services were the Information Systems (IS) maturity, organizational factors, external environmental factors, and perceived usefulness of web-based services. It was assumed that mature IS departments would be more proactive in adopting web-based services, so they were considered (Grover and Goslar 1993). Centralization, formalization, IS budget, firm performance, communication and organizational slack were the factors that were considered important for evaluating the internal structure of organizations (Rogers 1995). Innovation literature suggested that some of the external factors that facilitate adoption of innovations are environmental uncertainties, including, dynamism, hostility and heterogeneity (Dimaggio and Powell 1983, Pierce and Delbecq 1977, Schroeder and Benbasat 1975). Technology Acceptance Model (TAM) studies showed that perceived usefulness of a technology is one of the determinants in its usage. This factor was considered for the study (Davis 1989).

Research Model

The research model and hypotheses were developed based on literature review. The research model for the adoption of web-based services for transaction processing is as shown in Figure 1. In each of the following sections, variables from the model were evaluated and hypotheses were developed.

IS Maturity

Information Systems (IS) maturity has been discussed in various contexts in the IS literature. Some of the factors are the extent of infusion and diffusion of technology by organizations (Sullivan 1985), the necessity of a formalized planning process that includes strategic, tactical and operational planning to ensure consistency of IS and organizational goals (McFarlan 1971), and top management's role in taking responsibility for fostering information systems with the potential to provide an impact (Benjamin et al. 1984, Ives and Learchmouth 1984, Wiseman and MacMillan 1984, Parsons 1983). In organizational terms, organizations with a mature IS group tend to be proactive in evaluating the advantages of web-based services and implementing them in their organizations. Consequently, these organizations might perceive the web-based services as useful for transaction processing. Thus, it was hypothesized that

H1: IS maturity is *positively related* to the degree of adoption of web-based services for transaction processing.

H2: IS maturity is *positively related* to perceived usefulness of the web-based services for transaction processing.

Environmental Uncertainty

Innovation literature has consistently recognized that environmental uncertainty is a consequence of dynamic and hostile (competitive) environment and heterogeneity. It was observed that the more dynamic and hostile (i.e. competitive) the environment, the greater the need for innovation and the more likely it is that firms will be innovative (Miller and Freisen 1969). When competitors' products change rapidly or when customer needs fluctuate, it is assumed that innovation will be common. In stable environments it is less likely to be true. (Burns and Stalker 1961). Another environmental dimension may also be germane, namely, that of heterogeneity. Firms operating in many different markets are likely to learn from their broad experience with competitors and customers. They tend to borrow ideas from one market and apply in another. Uncertainty stimulates a change in strategy or policy and can ultimately lead to innovation. Based on a review of the literature, Pierce and Delbecq (1977) hypothesized that "environmental uncertainty will be positively related with organizational innovation (initiation, adoption and implementation)". Duscheneau et. al. (1979) found that environmental uncertainty was related to a shoe firm's competitive strategy to the extent that it became more future oriented and promoted consideration of innovation. Daft and Becker (1978) found that adoption of innovation was perceived to further goal attainment. The more uncertain the environment for organizations, the more the organizations might perceive the web-based services useful for transaction processing. Thus, it was hypothesized that

H3: Environmental uncertainty is *positively related* to perceived usefulness of web services for transaction processing.

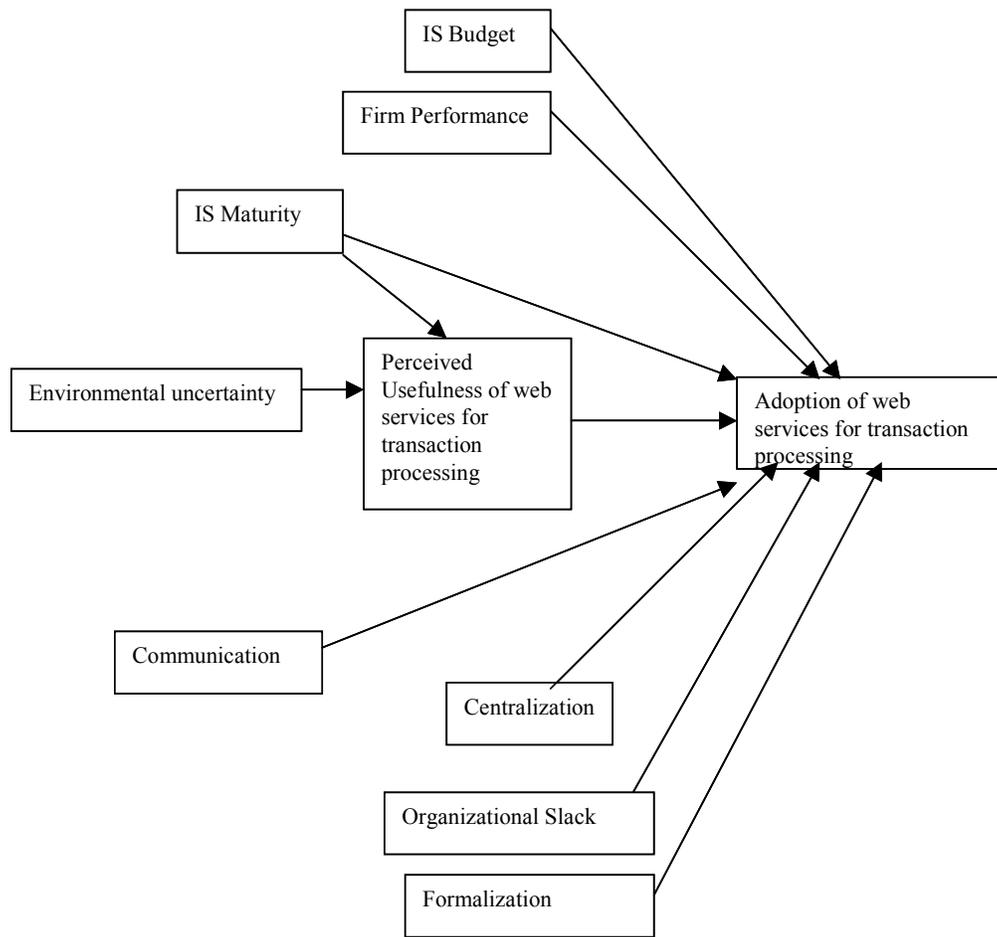


Figure 1. Factors Affecting Adoption of Web-Based Services for Transaction Processing

Organizational Factors

In this context, organizational factors include communication, centralization, formalization, IS budget, organizational slack, and firm performance. As a form of structure, communication serves as a means for control and coordination of both people and resources (Kersten 1986). Through communication, individuals in organizations are able to adjust and react to the dynamic flow of information. As communication increases the interaction among the employees and groups, they are expected to be more knowledgeable about the innovation, thus accepting the innovations more readily. Centralization which refers to concentration of decision-making activity is assumed to increase the predictability of outcomes of decisions (Hage and Aiken 1969). Top level decision makers are less likely to differ in their goals and values than lower level decision makers (Blau 1971) A higher degree of decentralization implies high involvement of lower level decision makers, with their more diverse goals and values in the decision process. This increases unpredictability of the outcomes of decisions. These outcomes have higher variance. Formalization may lead to greater efficiency because the predefined rules and procedures serve to routinize repetitive activities and transactions (Pugh et al. 1968, Ruekert et al. 1985, Rapert and Wren 1998) and thus help adoption of innovations.

Viewing slack as a resource in excess of what is required for the normal operation of an organization, an argument can be made that its presence allows an organization to interact or compete in its environment more boldly (Bourgeois 1981, Singh 1986). Thus, slack resources are expected to be able to facilitate risk taking and innovation. March and Simon (1958) and March and Shapira (1987) argued that if firm performance is above target, managers attempt to avoid actions that may produce below target performance; that is, for high performing managers, the dangers of falling below target performance dominate attention, and the opportunities for gains are less important. Therefore, when a firm is performing well, decision-makers are risk averse and avoid

adopting innovations. Nolan (1979) suggested that organizations encourage innovation and extensive application by maintaining low control and high slack. A higher IS budget allows employees to manage the risk of new innovations. Thus, it was hypothesized that

- H4: Communication is *positively related* to degree of adoption of web-based services for transaction processing.
- H5: Centralization is *positively related* to the degree of adoption of web-based services for transaction processing
- H6: Formalization is *positively related* to degree of adoption of web-based services for transaction processing.
- H7: Organizational slack is *positively related* to degree of adoption of web-based services for transaction processing.
- H8: Firm performance is *negatively related* to degree of adoption of web-based services for transaction processing.
- H9: IS budget is *positively related* to degree of adoption of web-based services for transaction processing

Perceived Usefulness

Within an organizational context, employees are generally reinforced for good performances by raises, promotions, bonuses, and other rewards (Pfeffer 1982, Schein 1980, Vroom 1964). If people within an organization perceive a technology to be useful and consider that it will help improve their job performance, they will adopt an innovation more readily. Thus, it was hypothesized that

- H10: Perceived usefulness is *positively related* to degree of adoption of web-based services for transaction processing.

Research Methodology

The organization was the unit of analysis for this research. The study was conducted by sending the questionnaire to randomly selected organizations from a federal government database of small businesses (Pro-net.sba.gov). The questionnaire items were developed based on the concepts and constructs as discussed in previous sections. The questionnaire was first pretested to refine the wording of the instrument, thereby reinforcing face validity (Churchill 1979). Pretesting was performed by administering the questionnaire to researchers and professionals working in organizations.

A pilot test was carried out before the field survey. The primary purpose of the pilot test was to check the reliability of the instruments. The search engine of this Internet-based database (Pro-net.sba.gov) randomizes the order of the organizations it shows for every search. In order to create a final list of organizations to which the survey was to be sent for the entire study, every 40th organization was selected from the randomly generated list. There were in all 3073 organizations in the final list of organizations. The first 1000 organizations in the final list were sent surveys for the pilot test. The rest of the 2073 organizations were sent questionnaires for the field study. The organizations were distinctly divided into four industrial categories namely construction, manufacturing, services, and research and development. For the pilot test, in approximately two weeks, 113 usable responses were collected. Twelve constructs containing 38 items were tested for reliability. Individual construct reliability was assessed. To improve the instrument, items were eliminated if their corrected item-total correlations were below 0.5 or if their correlation with the two-item criterion scale was below 0.4 (Doll and Torkzadeh 1988). These cutoffs are arbitrary; there are no accepted standards. However, they are comparable to those used by other researchers (Ives et al. 1983). Because as many items as possible were included in each construct, item deletion was justified (Churchill 1979). The results of the pilot study can be seen in the Table 1 below. As a result of the pilot, 8 items were considered for deletion based on reliability assessment. The construct of complexity was removed from the questionnaire, as its Cronbach's alpha was much below the required value of 0.7 (Nunnally 1971). There were 30 questions in the final questionnaire in addition to the demographic items.

Field Study

The final list selected 3073 organizations from the randomly generated list by the Internet-based database. As stated earlier, of the 3073 organizations, one thousand were sent questionnaires for the pilot test. The remaining 2073 organizations were contacted with questionnaires for the field study. At the end of a month, a total of 215 responses were received in all for the entire study including the pilot test. Of the 215 responses, 211 were usable. One hundred and twenty one envelopes were returned unopened due to changes in respondents' addresses. The number of responses from each industry and the profile of the respondents in the management is as shown in Figure 2.

Table 1. Results of Pilot Test—Cronbach’s Reliability Coefficients for the Constructs

Construct	Abbrev. of the Constructs	Number of Items Before Pilot Test	Cronbach’s Alpha Before Pilot Test	Number of Items After Pilot Test	Cronbach’s Alpha After the Pilot Test
IT Maturity	IT	7	0.83	6	0.85
Environmental Uncertainty	EU	9	0.5836	3	0.6791
Centralization	CENT	5	0.6997	4	0.7845
Formalization	FORM	4	0.7707	4	0.7707
Communication	COMM	5	0.7121	5	0.7121
Perceived Usefulness of Web-based services for transaction processing	PEU	3	0.9830	3	0.9830
Adoption of web-based services for transaction processing	AD	2	0.8962	2	0.8962

In addition the Cronbach’s alpha, the variance extracted and the convergent and discriminant validity were calculated for the data to confirm the reliability and validity of the instrument. A value greater than 0.5 for variance-extracted values occurs when the indicators or items truly represent the hypothesized latent constructs (Byrne 1998, Hair et al. 1998). Convergent validity, which is said to be “the extent to which different assessment methods occur in their measurement of the same trait (i.e. construct) is deemed as a complementary measure to variance extracted (Byrne 1998). The analysis of convergent validity and variance extracted shows that all the proposed constructs except environmental uncertainty satisfy the recommended values. The variance extracted and composite reliability of the hypothesized constructs are as shown in Table 3. Discriminant validity is said to be “the extent to which independent assessment method diverge in their measurement of different traits” (Byrne 1998). Fornell and Larcker (1981) proposed a method of evaluating the discriminant validity. It was stated that the square of the correlations between the constructs should be less than the variance explained by construct. It is found that that all the hypothesized constructs show a good level of discriminant validity as shown in Table 4.

Table 2. Number of Responses and Profile of the Respondents in the Management

Position	Overall sample	Manufacturing	R & D	Construction	Services
Top Management	176	50	41	33	52
Middle Management	27	5	10	7	5
First Line Management	9	0	3	1	4
Total	211	55	54	41	61

Table 3. Average Variance Extracted and Convergent Validity

Construct	Abbreviation	Average Variance Extracted	Convergent Validity or Composite Reliability
IS Maturity	IT	0.5	0.85
Environmental Uncertainty	EU	0.38	0.65
Centralization	CENT	0.63	0.83
Formalization	FORM	0.5	0.78
Communication	COMM	0.61	0.82
Adoption of web based services	AD	0.84	0.91
Perceived Usefulness	PEU	0.94	0.98

The discussion concludes that the measurement instrument in this study has passed important criteria for measurement reliability and validity. The following sections shall discuss the measurement and structural model testing.

Table 4. Comparison of Variance Extracted and Square of the Correlation between the Constructs for Discriminant Validity for Model

Constructs	IT	EU	CENT	FORM	COMM	AD	PEU
IT	0.5						
EU	0.0004	0.4					
CENT	0.01	0	0.63				
FORM	0.01	0	0.0016	0.5			
COMM	0.0	0	0.0001	0	0.61		
AD	.1936	0	.0036	.04	.0001	0.84	
PEU	.1369	0.0225	.0025	.0196	.0001	.5041	0.94

Model Testing

As strong theoretical foundations supported the area under study, it was only appropriate to evaluate the associations of the constructs with structural equation modeling (SEM) (Joreskog and Sorbom 1993). The research model was tested using structural equation modeling techniques performed using LISREL 8.51. The syntax was written in the SIMPLIS command language. PRELIS 2.30 was used to produce data subsets and matrices.

The measurement model testing, which specifies how the latent variables or hypothetical constructs are measured in terms of the observed (measured) variables was first performed (Schumaker and Lomax 1996). Also, as it is difficult to fit data to large and complex models, and it is more likely to capitalize on chances when researchers make modifications to such models (MacCallum 1986), the model was divided into two sub-models, each containing a subset of constructs. For simplification, the subset of the model that contained the independent variables directed towards the mediator variable, perceived usefulness (PEU) including the mediator variable were named as SUBSET 1. Similarly, the subset that contained all the variables directed towards the dependent variable, adoption of web-based services (AD) including the dependent variable were named as SUBSET 2. SUBSET1 contained the following constructs and their measurement items: Perceived Usefulness (PEU), Environmental Uncertainty (EU), IS Maturity (IT), and Communication (COMM). SUBSET2 included the following constructs and their measurement items: Perceived Usefulness (PEU), Adoption of web-based technologies (AD), IS maturity (IT), Firm Performance (FIRMPER), Centralization (CENT), Formalization (FORM), Communication (COMM), Organizational Slack (SLACK), IS budget (ISBUDGET). The fit statistics for SUBSET1 were: χ^2 (df=101, N=211)=191.42, p<. 00, RMSEA=0.065, NNFI=0.95, CFI=.95 and GFI=.9. The fit statistics for SUBSET2 were: χ^2 (df=267, N=211)=564.8, p<. 00001, RMSEA=0.064, NNFI=0.89, CFI=.90, and GFI=.82.

Given a satisfactory measurement model fit for the models, the structural equation model was assessed. The structural equation model specifies the direct and indirect relationships among the latent variables and is used to describe the amount of explained and unexplained variance (Schumaker and Lomax 1996). Twelve structural paths exist in the structural models. The model fit statistics were $\chi^2(df=340, N=211)=669.77, p<.00001, RMSEA=0.07, NNFI=0.88, CFI=.9$ and $GFI=.81$. Overall, the statistics demonstrated a moderate fit to the model. Figure 2 shows the estimated standardized path coefficients and their t values in the structural model for adoption of web-based services for communication by organizations. A summary of the estimated standardized path coefficients and hypotheses' testing is presented in Table 5.

Discussion and Implications

The aim of this study was to study the affect that IS maturity, organizational factors, and environmental uncertainty have on perceived usefulness and adoption of web-based services for transaction processing in organizations. Overall, the results of this study confirm many of the prior studies while promising evidence of differences. This study validates the findings of the Technology Acceptance Model (TAM), which suggests that the prominence of perceived usefulness makes sense conceptually as users are driven to use an application primarily because of the functions it performs for them. From the structural model testing, it was found that perceived usefulness (PEU) presents the highest t values ($t= 11.17$) with adoption of web-based services for transaction processing in organizations. Despite the results, it is worth noting that the variable of perceived usefulness in Technology Acceptance Model, which is used to study the individual acceptance of technology, holds good for the organizational acceptance of technology as well.

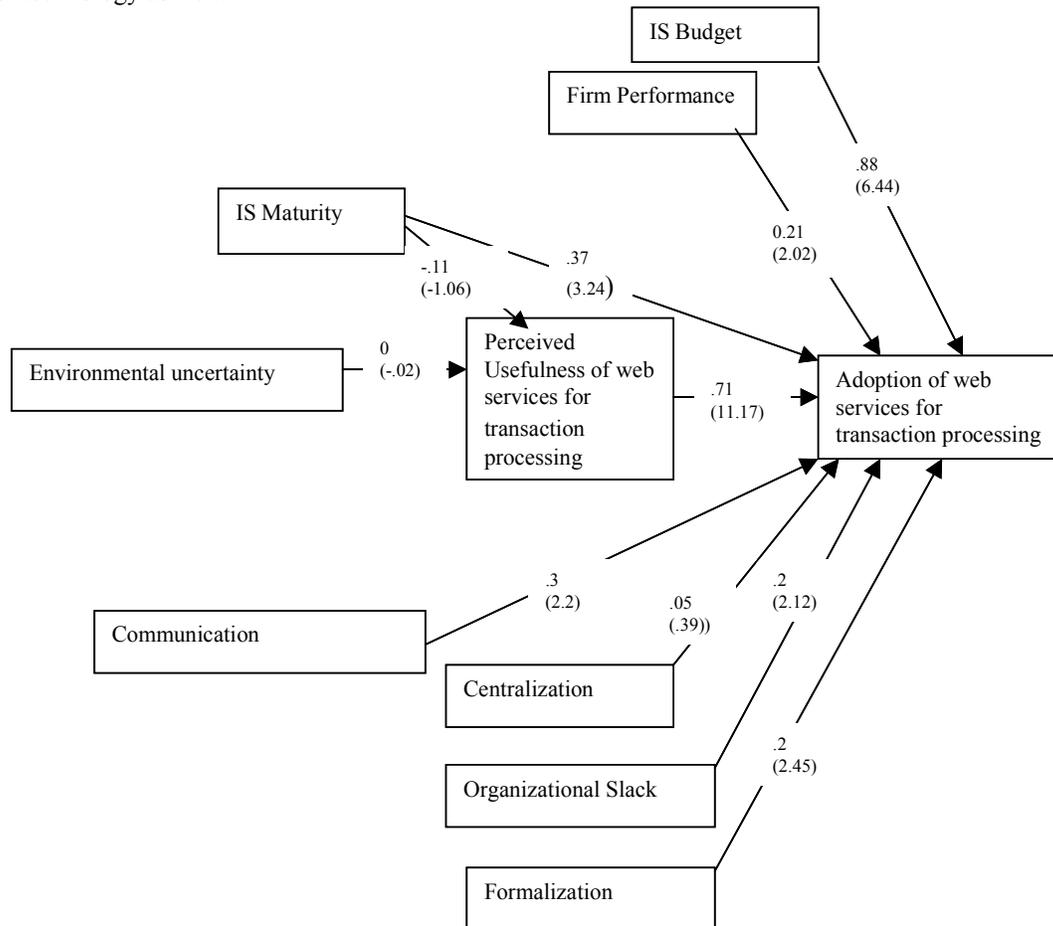


Figure 2. Standardized Path Coefficients for Model -Factors Affecting Adoption of Web-Based Services for Transaction Processing (t Values of Estimated Coefficients are in Parentheses)

Table 5. Summary of Parameter Estimates for Proposed Model -Adoption of Web-Based Services for Transaction Processing

Hypotheses	Structural Path	Standardized Values	t values	Interpretation
H1	IS Maturity (IT)-> Adoption of web-based services(AD)	0.37	3.24	Hypotheses supported
H2	IS Maturity (IT) -> Perceived Usefulness (PEU)	0.11	1.06	Hypotheses not supported
H3	Environmental Uncertainty (EU) -> Perceived Usefulness (PEU)	0	-0.02	Hypotheses not supported
H4	Communication (COMM)-> Adoption of web-based services (AD)	0.05	0.39	Hypotheses not supported
H5	Centralization (CENT)-> Adoption of web-based services (AD)	0.18	2.27	Hypotheses supported
H6	Formalization (FORM)-> Adoption of web-based services (AD)	0.2	2.45	Hypotheses supported
H7	Organizational Slack (SLACK)-> Adoption of web-based services (AD)	0.2	2.12	Hypotheses supported
H8	Firm performance (FIRMPER) -> Adoption of web-based services (AD)	0.21	2.02	Hypotheses not supported
H9	IS Budget (ISBUDGET) -> Adoption of web-based services (AD)	.88	6.44	Hypotheses supported
H10	Perceived Usefulness (PEU)-> Adoption of web-based services (AD)	0.71	11.17	Hypotheses supported

Note $p < 0.05$

This model revealed some interesting findings. It was found that IS Maturity positively influences the adoption of web-based services. This suggests that firms that recognize the business impact of information technology and have IS maturity do not necessarily evaluate and adopt web-based technologies, but do adopt technologies to a greater extent (Grover and Goslar 1993). Adoption of web-based technologies for transaction processing is influenced by Centralization (CENT) and formalization (FORM) positively. It can be assumed that centralized and formalized organizations may benefit in efficiency gains with transaction processing. Organizational Slack (SLACK) was found to be positively related to adoption of web-based services. One can argue that the presence of organizational slack allows an organization to interact or compete in its environment more boldly. That is, as slack is generated, the organization can literally afford to experiment with new strategies by, for example, introducing new products, entering new markets and so on (Hambrick and Snow 1977).

IS budget (ISBUDGET) has a positive influence on adoption of web-based services. This was in accordance to some of the existing studies (Harris and Katz 1988, PIMS Program 1984). Thus, organizations with a higher IS budget can afford to utilize some of the budget for experimenting with new technologies. The data in the results show that firm performance (FIRMPER) is positively related to adoption. This is contradictory to hypotheses of this study and findings in some of the previous studies (Singh 1986, March and Shapira 1987). When organizational performance exceeds some sacrificing levels, "then the decision-making group may take the view that the margin of surplus permits them to adopt arrangements which accord the better with their preferences" than economic considerations (Bourgeois 1981). In other words, when the firm is performing well, the decision makers can afford to take decisions as per their choice rather than be dictated by the environmental conditions. None of the organizational factors such as IS maturity, organizational size, environmental uncertainty, and communications affect the perceived usefulness of web-based technologies. One possible explanation for the above conflicting results could be that research designs that take the organization as a unit of analysis are inappropriate if a researcher wishes to predict or explain the perceived usefulness of a *particular* innovation (Meyer and Goes 1988).

In this study, several relationships have been identified that provide insight to academicians. Many of the findings portend future avenues for research. In this study, many existing measures were used and have been revalidated. Measurement reliability and validity are more assured for future investigation. As one of the first empirically and methodologically consistent studies to

investigate web-based technologies holistically from an organizational perspective, the study can be a basis for in-depth investigation of specific factors. Anchored in theory, this study synthesizes much of the innovation theory research currently published. Moreover, the variable of organizational size needs to be examined carefully. This study took a look at the small businesses perspective of adoption of web-based technologies, thus providing a limited scope of the importance of the various factors that affect adoption of the technologies. This study presents perceived usefulness of a technology as perhaps the single most important reason why organizations would adopt a specific technology. Other important factors are IS maturity of a company as well as the budget allocated for IS by the leaders in the organization. This shows that organizations that have IS maturity as well as the budget to support them, would experiment and adopt new technologies.

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