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EMPIRICAL RESEARCH

Adopting IS process innovations in organizations: the role of IS leaders' individual factors and technology perceptions in decision making

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Abstract
While there is a rich body of literature on information system (IS) innovations, there is a limited understanding of the role IS leaders' individual factors and their appraisals of technological factors play in organizations' adoption of IS innovations. We address these gaps in the IS literature by focusing on an IS process innovation – namely, computer-aided software engineering (CASE) – which is targeted at the core activities of systems development/maintenance in IS departments. We specifically examine how organizations' CASE adoption decision is impacted by (1) two individual factors of IS leaders (i.e., leaders' hierarchical position and job tenure) and (2) their perceptions of technological factors (i.e., relative advantage and technological complexity of CASE). Data were gathered from IS leaders at 350 organizations in the United States using a national cross-sectional survey. The findings suggest that IS leaders' hierarchical position and their job tenure significantly differentiate CASE adopters from non-adopters. IS leaders at lower levels of the organizational hierarchy and with shorter job tenure made the adoption decisions in adopter organizations, while IS leaders at higher levels of the organizational hierarchy and with longer job tenure made the adoption decisions in non-adopter organizations. The findings also reveal that relative advantage has two dimensions – namely, perceived efficacy advantage and perceived efficiency advantage – and IS leaders' evaluation of the perceived efficacy advantage of CASE differentiates adopters from non-adopters. The study has important implications for our theoretical and practical understanding of the factors related to IS leaders that are influential in the organizational adoption of IS innovations.
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Introduction

Information systems (IS) innovation may be broadly defined as the innovation in the organizational application of digital computer and communications technologies, commonly known as information technology (IT) (Swanson, 1994). Over the years, there have been numerous studies in the IS literature examining the adoption of various IS innovations in organizations (e.g., Chau & Tam, 1997; Chwelos *et al*, 2001; Otondo *et al*, 2009). These studies have identified many variables that affect the organizational adoption

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of an IS innovation. In a widely cited work, 'Unifying the Fragmented Models of Information Systems Implementation', Kwon & Zmud (1987) classified these variables into five categories: *individual*, *structural*, *technological*, *task-related*, and *environmental* factors. While many past studies have developed empirical evidence and have elaborated the theoretical rationale for the influence of structural, technological, task-related, and environmental factors, our review of the literature revealed that very limited attention has been paid to *individual factors*. Following Kimberly & Evanisko (1981), we define individual factors as the characteristics of individuals in positions of authority in a subject organization and are concerned with the individual factors of IS leaders that influence organizational adoption decisions of IS innovations.

We identified two studies examining the impact of IS leaders' individual factors on organizational adoption decisions of IS innovations. First, Thong (1999) examined the influence of chief executive officers' (CEOs) characteristics on the adoption of IS innovations in small organizations. However, research shows that organizational theories and practices that are applicable to small business may not generalize to large business (Blau *et al*, 1966; Cohn & Lindberg, 1972). Second, Sharma & Rai (2003) examined the influence of IS leaders' individual factors on the organizational adoption of IS innovations. However, they did not develop the theoretical rationale for the selection or influence of specific individual factors of IS leaders, nor did they evaluate the influence of these individual factors on organizational adoption decisions while considering IS leaders' appraisals of the technological characteristics of the innovation. As such, while IS departments (ISDs) are likely to assume significant responsibility for IS innovations and IS leaders are responsible for the work of the ISD, there is an important gap in our understanding of IS leaders' individual factors that influence adoption decisions.

Motivated by the above gap in our understanding, our first research objective is to develop the theoretical rationale for the influence of two individual factors of IS leaders – hierarchical position and job tenure – on an organization's adoption decision of IS process innovations, specifically computer-aided software engineering (CASE). We refer to CASE as an IS process innovation based on Swanson's typology, which differentiates among the following types of IS innovations: (1) those targeted at IS processes and tasks, including core IS activities, such as systems development (Type 1); (2) those targeted at the administration of the business (also referred to as the host organization of the IS unit) (Type 2); and (3) those embedded in core business technology (Type 3).

Our second research objective is to examine how IS leaders' appraisals of technological characteristics affect the adoption of IS process innovations. We are motivated to examine IS leaders' appraisals of technological characteristics because research has suggested that two technological factors – relative advantage and complexity – of an IS innovation affect its organizational adoption (Teng *et al*, 2002; Lee & Shim, 2007). While we have developed a general understanding that these factors are likely to influence the adoption of IS innovations, this understanding needs contextual elaboration because the types of IS innovations have different objectives and stakeholders whose evaluations are likely to affect adoption decisions. Specifically, it is unclear how IS leaders' evaluations of technological characteristics influence organizational adoption of IS process innovations. Accordingly, we investigate the influence of both IS leaders' appraisals of CASE's technological characteristics and IS leaders' individual factors on CASE adoption decisions.

By addressing the above two research objectives based on theory development and a large-scale empirical study, we make six contributions. First, we develop a theoretical rationale for the influence of IS leaders' individual factors on the organizational adoption of IS innovations. Second, we extend the works of Thong (1999) and Sharma & Rai (2003) by expanding the set of explanatory variables involving IS leaders to encompass IS leaders' individual factors, as well as their appraisals of IS innovations' technological characteristics. Specifically, in contrast to Thong (1999), who studied the influence of CEO characteristics on organizational adoption decisions of IS innovations in small business organizations, we extend the focus to IS leaders and the organizational adoption of IS innovations in the context of both small and large organizations. We extend Sharma & Rai (2003) by considering IS leaders' individual factors along with their perceptions of technological characteristics and a range of control variables. Third, we extend the general line of inquiry on management support for IS innovations by revealing that insights can be gained by focusing on leadership characteristics at a granular level in the functional unit where the innovation is targeted. Fourth, our study suggests that IS leaders' appraisal of relative advantage is more nuanced in that IS leaders distinguish between efficacy advantage and efficiency advantage, thereby suggesting that the relative advantage construct requires elaboration. Fifth, by identifying the individual characteristics of IS leaders and their appraisals of technological characteristics that affect IS adoption at the organizational level, our study bridges the dominant macro-level focus of previous organizational-level studies and the dominant micro-level focus of individual-level studies on IS innovations. Finally, our study provides guidelines for both vendors and potential adopters by identifying the profile of an adopter organization. For vendors, this profile provides a basis for targeted marketing and promotion. For potential adopters, deviations from the profile reveal the elements that are in opposition to adoption and thus require managerial intervention to achieve alignment and increase the odds of adoption.

Theoretical development

The focal IS innovation: CASE

We focus on CASE as an instance of an IS innovation that can be adopted by organizations. It is targeted at the systems development and maintenance processes that are among the core activities of an ISD. Drawing on García-Magariño *et al* (2010), we define CASE as 'tools and methods to support an engineering approach to software development'. CASE aims to improve different activities of software engineering – namely, definition, design, production, and maintenance – through the use and integration of automated software tools (Tate *et al*, 1992; Schmidt, 2006). A wide variety of CASE tools exist that support one, many, or all phases of the software development lifecycle (Whitten & Bentley, 2007). Front-end CASE tools help streamline the requirement development process, thereby resulting in fewer problems at later stages (Schach, 2004). Back-end CASE tools facilitate later stages of development, such as logical design, physical design, and construction (Whitten & Bentley, 2007). Integrated CASE tools support all stages of systems development activities, ranging from logical and physical design to code construction to testing (Whitten & Bentley, 2007).

Dependent variable: the CASE adoption decision in an organization

Adoption of an innovation usually 'refers to the point in the innovation process where the user moves from not having the innovation to having it' (Tornatzky & Fleischer, 1990, p. 179). In the case of organization innovation, the innovation is targeted at users associated with an organizational unit (Tornatzky & Fleischer, 1990; Rogers, 2003). The adoption decision in an organization occurs when the decision-making unit in the organization makes a choice to adopt or reject the innovation (Rogers, 2003). It is important to note that it is the choice to adopt or reject the innovation that reflects the adoption decision; the actual use of technology is not the focus of this construct (Tornatzky & Fleischer, 1990). On the basis of this consideration, we define the CASE adoption decision in an organization to occur when an organization's ISD has *decided* to use CASE tools in its IS projects. Having defined the CASE adoption decision, we provide theoretical rationale for why IS leaders' individual factors should influence organizations' CASE adoption decisions.

Influence of IS leaders' individual factors on the organizational CASE adoption decision

According to Simon (1997), organizational decision-making processes are characterized by a 'vertical division of labor', or vertical specialization. A hierarchy of authority or leadership positions is established, and decision-making functions are specified among members of this hierarchy to achieve coordination among the operative personnel, to develop greater expertise in decision making, and to hold operative personnel accountable for their decisions (Simon, 1997). Mintzberg's (1980) work on managerial roles, which has been validated by numerous studies across countries, cultures, and contexts (e.g., Kurke & Aldrich, 1983; Pinsonneault & Rivard, 1998; Worrall & Cooper, 2004), also suggests that managers, while viewed as generalists within organizations, are specialists who are required to perform a set of specialized roles (i.e., interpersonal, informational, and/or decisional) depending on their level in the hierarchy.

As an organizational decision-making process, the organizational innovation adoption decision is not an act of individuals in isolation but is a group activity consisting of many stakeholders, such as boundary spanners, idea generators, technological gatekeepers, process/product champions, top management, and so on (Tornatzky & Klein, 1982). Because of 'vertical' specialization, however, different individuals at different levels of the organizational hierarchy must make the 'final call' after receiving inputs from these stakeholders. As the successful implementation of an innovation depends on decisions made by these individuals at different levels of the organizational hierarchy (or in leadership positions), it is important to study *their characteristics* or *individual factors* in the context of organizational adoption decisions of IS innovations.

In the organizational innovation context, leaders' individual factors have been studied under many guises. Kimberly & Evanisko (1981) studied them under the guise of individual variables and specifically examined the influence of organizational leaders' characteristics (i.e., tenure, cosmopolitanism, educational level, educational substance, committee participation, role involvement) on the adoption of technological innovation in hospitals, finding them to be insignificant. Hage & Dewar (1973) studied them under the guise of leadership values (i.e., leader values, elite values) and found that these characteristics do not significantly influence the organizational adoption of rehabilitation services. On the basis of a review of the organizational innovation literature, Baldridge & Burnham (1975) concluded that 'individual characteristics, such as sex, age, and personal attitudes, do not seem to be important determinants of innovation behavior among people in complex organizations. However, administrative positions and roles do seem to have an impact on the involvement of an individual in the innovation process' (p. 165). They contended that 'when individuals are the innovation adopters, then individual characteristics are important. However, when organizations are innovation adopters, then organizational characteristics probably account for differences in innovative behavior' (p. 166). Indeed, Kwon & Zmud (1987) identified job tenure, cosmopolitanism, education, and role involvement as individual factors of those in positions of power and authority that can influence the organizational adoption of IS innovations. However, since their work on unifying the fragmented models of IS implementation, the research on organizational-level IS innovation using individual factors has been sparse with some notable exceptions. Gatignon & Robertson (1989) found that decision makers' preferences for negative information and exposure to personal information sources predict firms' adoption of laptops, while Thong (1999) found CEO knowledge and innovativeness to be positively related to small businesses' adoption of IT. More recently, Sharma & Rai (2003) found ISD leadership characteristics – namely, the ISD leader's positional power and job tenure – to be negatively related to the organizational adoption of IS innovations. In contrast to Thong's (1999) general focus on CEOs and IT innovations in small organizations, we concentrate on ISD leadership and IS process innovation (i.e., CASE, which is targeted at ISDs' core activities) for small and large organizations. While Sharma & Rai (2003) examined the influence of ISD leadership characteristics on CASE adoption, they did not evaluate the contribution of these IS leadership variables along with the IS leaders' evaluations of the innovation's technological characteristics. As technological factors have been identified as important determinants of innovation adoption decisions, we evaluate how IS leaders' perceptions of technological characteristics influence the adoption of CASE innovations. As such, we evaluate both the influence of IS leaders' individual factors and their perceptions of the technological characteristics of the IS innovation in an organizational context to develop a holistic picture of how they together influence organizational adoption decisions of IS innovations.

Past research also shows that resource availability and allocation have been the driving forces behind the adoption and use of innovations in organizations (Tornatzky & Fleischer, 1990; Rogers, 2003). Baldridge & Burnham (1975) contended that the leadership characteristics of those heading up organizational units engaged in innovative activity play an important role in determining what resources are allocated toward adopting and using innovations. As IS innovations, especially those targeted at systems development and maintenance, are often adopted by ISDs in organizations, people in leadership positions in these organizational units are deemed to play major roles in the organizational adoption of IS innovations.

In general, executives in high-level positions have more authority in the allocation of resources necessary to promote innovations (Baldridge & Burnham, 1975; Paolillo & Brown, 1979). Indeed, past studies have found executives who are placed higher in the organizational hierarchy implement more business innovations (Hage & Dewar, 1973; Hall, 1982; Larsen, 1993). Accordingly, *we expect IS leaders of adopting organizations of CASE to be at a higher level in the organizational hierarchy than those of non-adopting organizations.*

Organizational innovation leaders' ability to allocate resources also requires strong knowledge of how to navigate political waters in order to obtain desired outcomes. Longevity in the job is seen as providing contextual knowledge and institutional legitimacy to achieve this goal (Kimberly & Evanisko, 1981; Kwon & Zmud, 1987). An organizational member who has been with the organization for a longer period of time has increased functional and political knowledge to seek and allocate desired resources for the innovation. As resource allocation is central to organizational innovation adoption processes, we also examine *IS leaders' job tenure*, another individual factor. *We expect that the IS leaders of adopting organizations of CASE to have longer job tenure than those of non-adopting organizations.*

Influence of IS leaders' perceptions of technological characteristics on the CASE adoption decision

We include IS leaders' evaluations of CASE's relative advantage and complexity as technological factors that should differentiate CASE adopters from non-adopters. These are two key technological factors that influence the adoption of IS innovations in organizations (Rai & Patnayakuni, 1996; Teng *et al*, 2002), and both of these factors should also affect the adoption of CASE innovations in organizations. Because of our focus on IS leadership and also because of 'vertical specialization' in carrying out decision-making activities, we argue that it is IS leaders' perceptions of these technological characteristics that will influence CASE adoption decisions in organizations. *We expect IS leaders in adopter organizations to perceive CASE as having relative advantage over old systems/techniques* as CASE helps to (1) streamline the front-end requirement development and (2) facilitate the back-end activities of the systems development process involving logical design, physical design, and construction (Whitten & Bentley, 2007). *Also, we expect IS leaders in adopting organizations to perceive CASE as being less complex than non-adopting organizations* as adopting organizations may have already developed the competencies and skills necessary to use CASE as part of their readiness assessment (Chau & Tam, 1997), thereby reducing the perceived complexity of these innovations for their IS leaders.

Control variables

We use the proportion of active development projects to maintenance/enhancement projects in the ISD as a control variable as it characterizes the task environment for which CASE adoption is considered (Albizuri-Romero, 2000). We also include *ISD size* as a control variable as larger organizational size has traditionally been related to more resource availability for innovation (Grover *et al*, 1997; Ravichandran, 2000). We specify *industry type* as another control variable because industry differences exist in the adoption of IS innovations (Bretschneider & Wittmer, 1993). In addition, because front-end CASE tools differ in functionality from back-end and integrated CASE tools, we include *type of CASE tools the organization evaluated* as a control variable. Finally, we control for the *time elapsed since the CASE tools were first evaluated by the organization* because adopting organizations are likely to experiment with CASE for a longer period of time (Chau & Tam, 1997).

Table 1 summarizes the definitions of the theorized and control variables on which we examine differences between CASE adopter and non-adopter organizations. Table 2 summarizes the expected direction of the effect of these variables on an organization's CASE adoption decision.

Table 1 Definitions of the variables

Variable name	*Definition*
Dependent variable	
CASE adoption decision	● Decision of an ISD to adopt CASE technology for its core development and maintenance processes ● ISDs are classified into two groups, namely 'adopters' and 'non-adopters'
Individual factors	
Hierarchical position of the IS leader	● Position of the IS leader in the organizational IS hierarchy at the time of the CASE adoption decision
Job tenure of the IS leader	● Duration of time that the IS leader has been in his/her position in the current organization at the time of the CASE adoption decision
Technological factors	
Perceived relative advantage	● Degree to which CASE is perceived by the ISD leader as having superior capabilities in comparison to other alternatives or *status quo*
Perceived complexity	● Degree to which CASE is perceived by the ISD leader as difficult to understand and use
Control variables	
Proportion of active development to maintenance/enhancement projects	● Ratio of all active development projects in the ISD to all active maintenance/enhancement projects at the time of the adoption decision
ISD size	● Number of full-time employees in the ISD at the time of the adoption decision
Industry type	● Industry sector in which the organization conducts its core business activities. Sectors considered are manufacturing, government, and service
Type of CASE tools evaluated	● Type of CASE tools evaluated before making adoption decision. On the basis of their functionality, CASE tools were categorized as full life cycle, front-end, and back-end
Time elapsed since CASE evaluation	● Number of years elapsed since CASE tools were first evaluated or experimented with at the time of adoption decision

Table 2 Expected direction of mean differences between adopter and non-adopter organizations

Variables	*Adopter mean*	*Non-adopter mean*
Hierarchical position of the IS leader (1–4)	Higher	Lower
Job tenure of the IS leader (years)	Longer	Shorter
IS leaders' perceived relative advantage	Higher	Lower
IS leaders' perceived complexity	Lower	Higher
Proportion of active development to maintenance/enhancement projects in the ISD	Higher	Lower
ISD size (number of employees)	Larger	Smaller
Time elapsed since CASE evaluation (years)	Longer	Shorter

Methodology

Consistent with the majority of past work on innovation diffusion, a random mail survey research design was used to collect data. The procedures for sample selection, instrument development, and data collection, as well as our analysis and results, are discussed below.

Sample

The population of the interest was executives in the ISDs of organizations located in the United States. An appropriate source for this sample is the Directory of Top Computer Executives maintained by Applied Computer Research, Inc., Phoenix, Arizona. This database was selected because it is one of the most diversified databases in the country for IS organizations and their IS executives and represents a variety of firms ranging from the very small to the very large. From a list of approximately 34,000 executives in about 15,000 firms, 1582 top IS executives (one from each organization) were randomly selected and used as the targeted sample.

Instrument development

We developed a survey instrument to collect the data. The survey was evaluated by IS executives and faculty peers with expertise in CASE, systems development, and the organizational adoption of IS innovations to ensure adequate content coverage of the constructs and question clarity. These individuals' suggestions were incorporated to refine the survey instrument, which was further pilot tested with IS executives from four different organizations located in four cities in the midwestern United States.

The position of the IS leader in the organizational hierarchy who made the CASE adoption decision was operationalized by classifying the IS executives' job titles into managerial decision-making categories indicative of a common organizational hierarchy in the IT industry. That is, while the roles and responsibilities of IS leaders may vary from one organization to another, there is a commonly perceived hierarchy in the IT industry of chief information officer (CIO), IS director, IS manager, and so on (please see Copeland, 2001; Melymuka, 2002a, b). Different levels of this organizational hierarchy were labeled with descriptive names in accordance with the following well-established levels of decision making in organizations (Anthony, 1965; Gorry & Scott Morton, 1989): strategic management (Level 4), tactical management (Level 3), operations management (Level 2), and lower management (Level 1). We classified the collected data on the position of the IS leader into these four managerial categories using the following approach: *strategic management* consists of the CIO/vice president of IT, chief technology officer, and chief security officer; *tactical management* consists of the director of systems development, director of IT/IS operations, and internet technology strategist; *operations management* includes the computer operations manager, database manager, help desk/technical support manager, information security manager, IT/IS manager, network manager, product manager, application development manager, and project manager; and *lower management* includes the project leader, database analyst/administrator, network administrator, system administrator, and so on. We had eight responses that did not fit in any of these categories of IS leader and were thus removed from the analysis: four CEOs, one chief financial officer, one president, one dean, and one administrative assistant.

Following Damanpour (1991) and Taylor *et al* (1996), IS leaders' job tenure was operationalized by the number of years they were in their position with the current organization at the time of the CASE adoption decision.

Moore & Benbasat's (1991) scales on the technological characteristics of an IS innovation have been widely used in IS innovation studies to operationalize relative advantage and complexity constructs. However, these scales were developed in the context of personal workstations and may not capture the assumptions and limitations of a complex innovation technology like CASE (Iivari, 1996). Moreover, Compeau & Meister (1997) showed that many of the innovation characteristics operationalized by Moore & Benbasat (1991) may not be reliable across different IS innovations. Accordingly, Moore and Benbasat's perceived relative advantage scale was supplemented with other items using well-established benefits of using CASE technology (Wynekoop, 1991; Premkumar *et al*, 1994; Premkumar & Potter, 1995). As such, our relative advantage instrument consisted of 12 items. Along similar lines, IS leaders' perceived complexity was measured by five items.

Respondents were requested to provide the percentage breakdown of their ISD's projects into development projects and maintenance/enhancement projects at the time of the CASE adoption decision. An active project was defined as a project with which the ISD was involved at the time of the CASE adoption decision. A measure of the proportion of active development projects to active maintenance/enhancement projects was obtained by dividing the former by the latter.

ISD size was measured by the number of personnel in the ISD (Grover *et al*, 1997; Ravichandran, 2000). Although the questionnaires were coded for industry sectors, the respondents were asked to provide their organization's industry sector for matching and verification purposes.

The respondents were also asked to provide the time elapsed in years since CASE tools were first evaluated by their ISD at the time of the CASE adoption decision. To measure the type of CASE tools organizations had evaluated, the respondents were asked to indicate which (one or more) of the following categories of CASE tools their ISDs had evaluated before making the CASE adoption decision: (1) full lifecycle, (2) front end, and (3) back end.

The dependent variable – CASE adoption decision – was operationalized as a dichotomous variable (0 = reject, 1 = accept).

Data collection and sample profile

The head of the ISD was considered to be the most suitable person to contact for this study. He or she was requested to forward the questionnaire to the IS executive responsible for making the final CASE adoption decision. A follow-up mailing was conducted 3 weeks after the first mailing. Of the 1582 questionnaires, 22 survey packets were returned back to the sender because the respondents were no longer employed at the organization. Of the remaining 1560 questionnaires, 360 were returned, resulting in a response rate of 23.1%. Of these, 10 were not usable because of missing data. Thus, the final sample for this study was 350. Of these, 46 were from adopter organizations and the remainder 304 were from non-adopter organizations. The sample characteristics are shown in Tables 3 and 4.

The median annual sales revenue of the organizations in the sample was US$160 million. The ISDs of these organizations employed a median of 14 employees and had 10 active projects at the time of CASE adoption that included 35% development and 60% maintenance/enhancement projects.

To assess non-response bias, the proportion of respondents in each industry category was compared with the proportion in the overall sample using a χ^2 test. The χ^2

Table 3 Sample characteristics

Aspect	*Mean*	*SD*	*Median*	*Minimum*	*Maximum*
Annual sales ($ million)	800.12	2169.71	160.00	1.50	20,000
Number of full-time ISD employees	61.47	130.94	14.00	1.00	1200
Number of active software projects	29.05	56.55	10.00	0.00	450
Percentage of development projects	38.91	25.88	35.00	0.00	100
Percentage of maintenance projects	60.22	26.36	60.00	0.00	100
Job tenure of IS leader (years)	7.53	6.27	6.00	0.25	36
Time elapsed since CASE evaluation (years)	4.75	2.26	5.00	0.50	13

Table 4 Distribution of organizational adoption decision by IS leader's hierarchical position, job tenure, number of active projects, and ISD size

Hierarchical level	*Adopter*	*Non-adopter*	*Total*	*Percentage of adopter*
Strategic management	6	49	55	10.91
Tactical management	15	115	130	11.54
Operations management	15	102	117	12.82
Lower-level management	10	21	31	32.26
Missing	0	17	17	
Total	46	304	350	13.14
Job tenure (in years)				
0–3	17	56	73	23.29
3–6	14	76	90	15.56
6–10	8	53	61	13.11
>10	6	102	108	5.56
Missing	1	17	18	
Total	46	304	350	13.14
Number of active projects				
0–5	10	57	67	14.93
5–12	11	78	89	12.35
12–15	7	66	73	9.59
>25	13	66	79	16.45
Missing	5	37	42	
Total	46	304	350	13.14
ISD size (in number of employees)				
0–6	1	61	62	1.61
6–15	6	97	103	5.83
15–50	17	60	77	22.08
>50	19	63	82	23.17
Missing	3	23	26	
Total	46	304	350	13.14

statistic ($\chi^2 = 1.57$, DF = 2) was not significant at $\alpha = 0.05$, indicating no response bias among respondents from different industries based on their membership in the sample. The correlation matrix for all the variables is shown in Table 5.

Reliability and validity of measures

The data were analyzed following well-established procedures to determine the reliability and validity of the multi-item scales for IS leaders' appraisals of relative advantage and complexity (Mackenzie *et al*, 2011). Contrary to the results obtained by Iivari (1996) and Premkumar & Potter (1995), exploratory factor analysis revealed that IS leaders' appraisals of the relative advantage of CASE resulted in two factors probably because additional benefits of CASE were included (Table 6).

One factor – perceived efficacy advantage – captures the capability of CASE tools to impact the efficacy of the systems development process. This factor relates to the ability of CASE to improve IS quality, standardize systems development procedures, and improve the control of and coordination among different systems development activities. The other factor – perceived efficiency advantage – captures the process efficiency benefits of CASE. This factor relates to the ability of CASE to reduce systems development costs and time, as well as decrease systems backlog in the ISD. These two factors have Cronbach's α coefficients of 0.81 and 0.84, respectively. Perceived complexity has a Cronbach's α coefficient of 0.91. We conducted a supplementary confirmatory factor analysis using covariance-based structural equation modeling to evaluate the three-factor structure for IS leaders' appraisals of technological characteristics (i.e., efficacy, efficiency, and complexity). Our results suggest the three-factor structure achieves good model fit ($\chi^2/41 = 1.37$; NNFI = 0.96; CFI = 0.97; RMSEA = 0.03). The square root of the average variance extracted for each construct was greater than all the pairwise correlations of the construct, with other study constructs providing additional evidence of discriminant validity.

Results and implications

We used hierarchical logistical regression to test the differences between adopter and non-adopter organizations on the study variables. The model was first checked for collinearity and influential cases. Then, the variables were entered in the model in the following order: (1) control variables, (2) IS leaders' perceptions of technological factors, and (3) IS leaders' individual factors. This hierarchical approach for model testing enabled us to assess the contribution of later factors after controlling for the contribution of earlier factors. The overall model was

Table 5 Correlations and square root of average variance extracted

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Adoption decision											
2. industry sector	0.010										
3. Ln(ISD size)	0.243**	0.310**									
4. Ln(Time since CASE tools evaluated)_	0.287**	−0.036	0.136								
5. Type of CASE tools	−0.007	−0.098	−0.185	0.021							
6. Hierarchical position of the IS leader	−0.119*	0.237**	0.258**	−0.070	0.032						
7. Ln(job tenure)	−0.173**	0.084	−0.141*	0.183	0.073	0.026					
8. IS leaders' perceived efficacy of CASE tools	0.284**	−0.220**	−0.033	0.079	0.115	−0.148	0.029	0.76			
9. IS leaders' perceived efficiency of CASE tools	0.125	−0.290**	−0.118	0.039	0.050	−0.133	−0.044	0.508**	0.75		
10. Perceived complexity of CASE tools	−0.135	0.216*	0.014	−0.155	−0.143	0.225*	0.036	−0.418**	−0.339**	0.85	
11. Proportion of active development to maintenance/enhancement projects	−0.072	0.091	−0.084	−0.066	−0.124	−0.065	0.014	0.080	0.055	0.023	

Note: * significant at the 0.05 level (2-tailed); ** significant at the 0.01 level (2-tailed).
The diagonal shows the square root of the average variance extracted for the three reflectively measured constructs; AVE calculated based on the CFA loadings for the three-factor structure of the perceptions of technology characteristics.

Table 6 Factor loadings and discriminant validity assessment

Measurement item	*Perceived efficacy advantage*	*Perceived efficiency advantage*	*Perceived complexity*
Improve the quality of information systems	0.76	0.18	−0.27
Increase standardization of systems development procedures	0.87	0.08	−0.10
Improve control and coordination of different systems development activities	0.83	0.16	−0.10
Reduce systems development cost	0.36	0.71	−0.09
Decrease systems development time	0.18	0.83	−0.22
Decrease systems backlog in the ISD	−0.09	0.85	−0.08
Decrease systems delivery time	−0.11	0.77	−0.12
Be very complex to use	−0.04	−0.10	0.83
Be cumbersome to use	−0.18	−0.06	0.90
Be much harder to use	−0.18	−0.14	0.90
Be often frustrating to use	−0.16	−0.25	0.80
Cronbach's α	0.81	0.84	0.91

The shaded areas individually constitute one factor. There are three separate factors; hence three shaded areas.

significant at $P=0.0001$ (see Table 7). Hosmer–Lemeshow goodness-of-fit statistic ($\chi^2/8=8.16$, $P>0.4183$) shows that the model fits well to the data.

Control variables and the CASE adoption decision

ISD size was found to significantly differentiate adopters from non-adopters ($P=0.0236$), which is consistent with past research. Adopters had a significantly larger ISD (mean = 121.07 employees) on average than non-adopters (mean = 52.35 employees (Table 8) as larger ISDs are likely to have more resources and a better infrastructure to facilitate the adoption of CASE in comparison to smaller ISDs. A one-unit increase in the Ln(ISD Size), or an increase of 2.718 employees in ISD size, increases the odds of CASE adoption by 76.88% (see Table 7).

Industry type was not found to be significantly related to CASE adoption. This finding is contrary to past results (Bretschneider & Wittmer, 1993) and may result from our consolidation of industry sectors into only three groups. Future studies may want to examine the role of industry sector in IS innovation adoption decisions by including industry variables at a lower level of granularity.

Time elapsed since an organization's first evaluation of CASE tools also significantly differentiated adopters from non-adopters ($P=0.0021$). Significantly more time elapsed for adopter organizations than for non-adopter organizations before they adopted CASE tools (Table 8). A one-unit

Table 7 Results of the hierarchical logistic regression

Hosmer–Lemeshow goodness-of-fit $\chi^2/8 = 8.16$, $P > 0.4183$

Statistic		*Value*	*DF.*	*Significance*		*Statistic*		*Value*
-2 Log likelihood		*63.48*	*14*	*<0.0001*		*Efron R^2*		*0.52*
Variable groups	*Variables*	*Unstandard β*	*Standard error of β*	*Standard β*	*Wald statistic*	*DF*	*1-tailed significance*	*Exp(B)/ Odds Ratio)*
Control variables	Ln(ISD Size)	0.5703	0.2874	1.9842	3.9371	1	0.0236	1.7688
	Industry Sector				0.2634	2	0.4383	
	Manufacturing		Reference sector					1.0000
	Government	−0.0185	0.8929	−0.3991	0.0004	1	0.4918	1.0187
	Service	−0.3649	0.7804	−0.4676	0.2187	1	0.3200	0.6942
	Ln(time elapsed since CASE evaluation)	2.7548	0.9617	2.8645	8.2054	1	0.0021	15.7179
	Type of CASE Tools				5.2954	2	0.0354	
	Full-lifecycle CASE		Reference CASE tools					1.0000
	Front-end CASE	2.0987	0.9166	2.2896	5.2424	1	0.0110	8.1554
	Back-end CASE	−0.0709	1.2758	−0.0555	0.0031	1	0.4779	0.9316
	Proportion of active development to maintenance/enhancement projects	0.0020	0.0040	0.5000	0.2507	1	0.3083	1.0020
IS leaders' evaluation of technological factors	Perceived efficacy	0.9156	0.4384	2.0886	4.3624	1	0.0184	2.4982
	Perceived efficiency	0.4840	0.3860	1.2541	1.5727	1	0.1049	1.6226
	Perceived complexity	−0.0363	0.2650	−0.1368	0.0187	1	0.4456	0.9644
Individual factors of IS leaders	Position of the IS leader				12.9567	3	0.0047	
	Lower-level management		Reference Position of the ISD Leader					1.0000
	Operational management	−3.0676	1.2742	−2.4075	5.7960	1	0.0081	0.0465
	Tactical management	−3.4134	1.2885	−2.6491	7.0181	1	0.0041	0.0329
	Strategic management	−6.4129	1.7853	−3.5921	12.9020	1	0.0002	0.0016
	Ln(job tenure of the IS leader)	−1.0124	0.4157	−2.4355	5.9317	1	0.0075	0.3633
	Constant	−9.0451	3.5849	−2.5231	6.3660	1	0.0058	0.0001

Table 8 Descriptive profile of adopter and non-adopter organizations

Variables	*Adopter organization*		*Non-adopter organization*	
	Mean	*SD*	*Mean*	*SD*
Hierarchical position of the IS leader (1–4[a])	2.37	0.97	2.67	0.84
Job tenure of the IS leader (years)	4.68	3.8	7.98	6.47
Perceived efficacy advantage (1–7[a])	5.51	0.73	4.92	1.19
Perceived efficiency advantage (1–7[a])	4.73	1.03	4.44	1.19
Perceived complexity (1–7[a])	3.87	1.20	4.24	1.45
Proportion of active development to maintenance/enhancement Projects in the ISD	23.59	22.48	2.48	0.63
ISD size (number of employees)	121.07	195.243	52.35	115.89
Time elapsed since CASE evaluation (years)	5.52	2.59	4.11	1.72

[a]shows the range of minimum to maximum scores for the variable.
Notes: S.D. = standard deviation.

increase in the Ln(time elapsed since CASE tools evaluated), or a 2.718-year increase in time elapsed since CASE tool evaluation, increases the odds of CASE adoption by 1471.79% (see Table 7). As CASE is a complex technology, its successful usage requires that systems developers possess significant methodology skills and expertise, which take time to acquire. The more time that passes since organizations first evaluate CASE tools, the more time they get to acquire requisite methodology skills and expertise for CASE adoption. Elaborating, CASE is a Type II technology in Fichman's (1992) framework, in which Type II technologies are characterized by high knowledge barriers, significant user interdependencies, or both. Future research should examine if the time elapsed since IS innovations are evaluated is higher for adoption decisions across all innovations that pose high knowledge barriers (e.g., structured systems analysis tools, stand-alone computer-aided design drawing systems), exhibit significant user interdependencies (e.g., e-mail, voicemail), or exhibit both characteristics (e.g., material resource planning systems, integrated computer-aided design/manufacturing, CASE).

Our results show that the type of CASE tools the organizations evaluated significantly differentiate CASE adopters from non-adopters ($P = 0.0354$). In particular, the evaluation of front-end CASE tools differentiates CASE adopters and non-adopters ($P = 0.0110$). Evaluating front-end CASE tools as opposed to full-lifecycle CASE tools increases the odds of CASE adoption by 715.54% (see Table 7). A breakdown of the CASE tools evaluated shows that while the use of full-lifecycle and back-end CASE tools was considered almost equally by both adopter and non-adopter organizations, a significantly higher percentage of adopters considered using front-end CASE tools (Table 9). Front-end CASE tools are considerably easier to use than back-end and full-lifecycle CASE tools. Moreover, the use of front-end CASE tools minimizes the incidence of critical errors that may be introduced in the early phase of systems development, which if undetected will be propagated to later stages, making them more costly and time consuming to fix. Adopters may have used this rationale when

Table 9 Difference between adopter and non-adopters on type of CASE tools evaluated

Type of CASE tools evaluated by the organization	*Adopter organizations (N)*	*Non-Adopter organizations (N)*	*Percentage of adopters*	*Percentage of non-adopters*
Full lifecycle	33	44	71.74	74.58
Front-end	9	9	19.56	15.25
Back-end	2	5	4.35	8.47
Missing	2	1	4.35	1.69
Total	46	59	100.00	100.00

considering front-end CASE tools to a greater extent than non-adopters. We note that this finding should be viewed with caution because of our small adopter sample size. (Only 9 out of 46 adopters considered using front-end CASE tools.) Using a large and balanced sample, future research should examine if the type of CASE tools examined by organizations indeed differentiates adopters from non-adopters.

The task-related control variable (i.e., proportion of active development projects to maintenance/enhancement projects) did not significantly differentiate CASE adopters from non-adopters ($P = 0.3083$). An important reason for organizations' CASE adoption may be their desire to conduct new development projects efficiently within highly constrained resource environments. With almost 60–90% of the overall IT budget being spent on maintenance, organizations are often confronted with tight resource availability for new systems development efforts (Koskinen, 2003). By using CASE for new development, adopting organizations would need to utilize fewer resources for maintaining these systems in the future (Finlay & Mitchell, 1994), thereby reducing the resource requirements for maintenance and consequently easing the constraints for undertaking new development projects. Accordingly, we expected that adopting organizations of CASE would have a higher proportion of active development projects to maintenance/enhancement projects than non-adopting organizations. Our results do not support this supposition. However, as we did not consider the time elapsed since adoption, there could be learning curves associated with assimilating complex innovations and realizing benefits from them (Fichman & Kemerer, 1997).

IS leaders' perceptions of technological factors and the CASE adoption decision

Past research has treated relative advantage as one construct. However, our results suggest that IS leaders' perceptions of relative advantage may in fact have two underlying dimensions – perceived efficacy advantage and perceived efficiency advantage. Our findings show that IS leaders' perceptions about the perceived efficacy advantage significantly differentiates CASE adopters from non-adopters ($P=0.0184$), while perceived efficiency does not ($P=0.1049$). IS leaders at adopter organizations perceive CASE to provide significantly higher efficacy advantage (5.51) than non-adopters (4.92) (see Table 8). A one-unit increase in perceived efficacy advantage increases the odds of CASE adoption by 149.82% (see Table 7). Our results show that organizations adopt CASE to increase the quality of their information systems, standardize their systems development procedures, and improve the control and coordination of different systems development activities (see Table 6).

The bi-dimensionality of the relative advantage construct is an intriguing finding and a significant contribution of our study. Relative advantage has been an important variable in almost all IS innovation studies. Conceived as perceived usefulness, it has also been an important variable in the technology acceptance model, the theory of reasoned action, and the unified theory of acceptance and use of technology. As explained earlier, we did not use Moore & Benbasat's (1991) instrument for relative advantage as we argued that it underrepresents the benefits of complex innovations like CASE. Consistent with our formulation of a more nuanced measure of relative advantage for Type 1 innovations in the Swanson typology, our finding of the bi-dimensionality of the relative advantage construct raises the question of whether relative advantage is one simple construct or a complex construct with more than one dimension. Our *post-hoc* findings show that we may want to treat relative advantage at a more granular level, at least when it comes to IS leaders' appraisals of the advantages associated with complex process technologies. This more granular conceptualization will enable us to identify the contexts (e.g., type of IS innovation, target population, time of implementation (e.g., pre-implementation, post-acceptance phases, etc.) in which one or the other aspect of relative advantage is more or less influential. For this reason, it may be worthwhile for future research to explore the dimensionality of the relative advantage construct, particularly in the context of complex IS innovations that pose a significant knowledge barrier for organizational adoption.

Perceived complexity was not found to significantly differentiate adopter and non-adopter organizations ($P=0.4456$), which is consistent with the findings of Premkumar & Potter (1995) and Iivari (1996).

IS leaders' individual factors and the CASE adoption decision

After we accounted for the control variables and the factors for IS leaders' perceptions of technology, both IS leaders' individual factors (i.e., hierarchical position and job tenure) significantly differentiated CASE adopters from non-adopters. Our results show that CASE adoption is negatively associated with IS leaders' hierarchical position ($P=0.0047$). IS leaders in non-adopter organizations occupied significantly higher ranks in the organizational hierarchy (mean = 2.67) than those in adopter organizations (mean = 2.37) (see Table 8). Moving IS leaders up one level in the organizational hierarchy from lower management (Level 1) to operations management (Level 2) reduces the odds of CASE adoption by 95.35% (see Table 7). Thus, decision makers who adopt CASE came from lower levels of the ISD hierarchy. This finding is contrary to our theorized direction, which was based on IS leaders' resource-allocation capabilities. Our finding suggests that resource allocation may not be important in the adoption decision stage for CASE. However, this finding is consistent with March's (1991) observations that lower-level decision makers in ISDs are closely associated with IS development and maintenance activities and their associated problems and are more likely to adopt an innovation like CASE that will solve these problems.

Our second individual factor – IS leaders' job tenure – also significantly differentiated adopter organizations from non-adopter organizations ($P=0.0075$). CASE adoption is negatively associated with IS leaders' job tenure. A one-unit increase in the Ln(job tenure of the ISD leader), or a 2.718-year increase in job tenure, decreases the odds of CASE adoption by 63.67% (see Table 7). IS leaders in adopter organizations had a shorter job tenure (mean = 4.68 years) on average than in non-adopter organizations (mean = 7.98 years) (see Table 8). Again, our expected direction was based on the primacy of resource allocation in organizational innovation adoption processes in the past studies. Our finding is contrary to some past results (Paolillo & Brown, 1979; Kimberly & Evanisko, 1981) but is consistent with others (Larsen, 1993). Although IS leaders with longer tenure may be more capable of finding and allocating resources for CASE, organizational decision-making theory has shown that among successful managers, those who are older and have longer tenure take fewer risks and are less innovative than those who are younger and have shorter tenure (March, 1991). As the CASE adoption decision-making process involves dealing with uncertainty associated with a complex process innovation and entails significant risk, it makes sense that

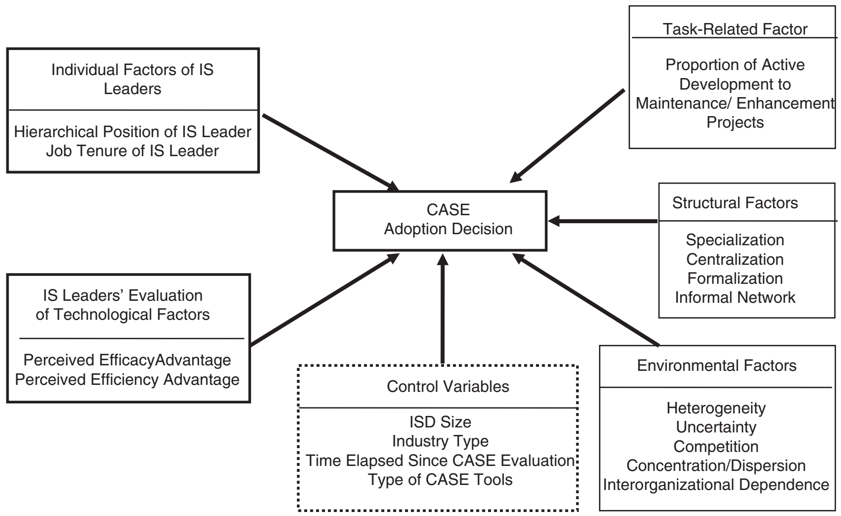

Figure 1 Research model for organizational CASE adoption decision.

managers with shorter job tenure tend to adopt CASE more than managers with longer job tenure. These managers with shorter job tenure are likely to be less entrenched in existing structures and processes and more receptive to innovations that redefine existing practices.

Robustness test

As the time elapsed since an organization first evaluated CASE may be influenced by the organization's CASE adoption decision (thereby introducing endogeneity bias), we conducted a robustness test by estimating the logistic regression model without including this control variable. The results were consistent with the main analysis with one exception pertaining to the hierarchical position of the IS leader: the dummy variable contrasting operations management from lower-level management was not significant. The other two dummy variables contrasting strategic management from lower-level management and tactical management from lower-level management were significant as in the main analysis, with signs also consistent with those in the main analysis. These robustness results support the conclusion from the main analysis that IS leaders at lower levels of the hierarchy are more likely to adopt CASE innovations than IS leaders at higher levels of the hierarchy.

Proposed integrated model of the organizational CASE adoption decision

Given the detected importance in our exploratory study of IS leaders' individual factors and their perceptions of technological factors in organizational CASE adoption decisions, we suggest future studies on the organizational adoption of IS innovations include these individual and technological factors pertaining to IS leaders as well as the structural, task-related, and environmental factors from Kwon and Zmud's framework. An integrated model for the organizational adoption of CASE that includes these factors about IS leaders' individual factors and their perceptions of the technology's relative advantages is shown in Figure 1. While we include IS leaders' perceived efficacy advantage and perceived efficiency advantage in lieu of relative advantage, future studies should validate our finding of the bi-dimensionality of the relative advantage construct. IS leaders' perceptions of complexity are not included in the model as we did not find these perceptions to significantly differ between adopters and non-adopters of CASE. In addition, perceived complexity was also not found to be a significant predictor in two other studies on the organizational adoption of CASE (Premkumar & Potter, 1995; Iivari, 1996). We include industry type in the model even though it was not found to be significant in our study as Bretschneider & Wittmer (1993) found it to be a significant predictor of the organizational adoption of IS innovations. Future studies should evaluate the implications of industry heterogeneity on the adoption of CASE innovation. We also include the proportion of active development projects to maintenance/enhancement projects in ISDs.

Summary of contributions

Our study makes five salient theoretical contributions. First, drawing on Simon's 'vertical division of labor', or vertical specialization, our study develops the theoretical rationale for the inclusion of IS leaders' individual factors in organizational studies of IS innovations. Second, it extends the limited past works of Thong (1999) and Sharma & Rai (2003), which examined the influence of leaders' individual characteristics on the organizational adoption of IS innovations. Thong (1999) studied CEO characteristics in small business organizations where the CEO is typically the owner of the company and there is limited hierarchy. However, research shows that organizational theories and practices that are applicable to small business may not fit large business (Blau *et al*, 1966; Cohn & Lindberg, 1972). Our sample includes small and large organizations, and we control for variations in firm size, thereby indicating that the individual factors of IS leaders play a significant role in explaining adoption decisions across small and large organizations. While Sharma & Rai (2003) had limited their focus on individual factors of IS leaders, we consider IS leaders' individual factors along with their perceptions of technological characteristics. We further extend Sharma & Rai (2003) by evaluating these two types of influences of IS leadership (i.e., individual factors and appraisals of technological characteristics), while including a set of robust control variables that characterize the organizational context (ISD size and industry type), systems development task environment (proportion of development to maintenance projects), and innovation evaluation context (time elapsed since CASE tools' evaluation and type of CASE tools). As such, our results show that it is both the IS leaders' individual factors (i.e., hierarchical position and job tenure) and the IS leaders' perceptions of the efficacy of the technology that are instrumental in influencing adoption decisions. Elaborating in the context of CASE adoption decisions, it is the *IS leader in relation to the organization* (i.e., how proximate they are to the systems development process in which the technology is to be applied and how long they have been at the organization) and the *IS leader in relation to the technology* (i.e., how they evaluate the efficacy of CASE to increase quality, standardize processes, and improve control and coordination) that influence an organization's adoption decision.

Third, this study extends the general line of inquiry on management support for IS innovations by showing that more insights can be gained about this topic by focusing attention on specific leadership characteristics at a lower level of granularity. Past studies have treated leadership characteristics like top management support as a monolithic construct. This study captured IS leaders' hierarchical level by using four categories – namely, strategic management, tactical management, operational management, and lower-level management – and showed that CASE adoption is facilitated by lower-level management that is situated close to the systems development process and is likely to not only have decision rights but, importantly, also the incentives and knowledge to enhance the capabilities of the systems development process through the adoption of suitable IS innovations. This finding probably would have been lost if management support was treated as one monolithic construct without considering IS leaders' position in the organizational hierarchy. Fourth, this study shows that insights can be gained about the influence of relative advantage on organizational adoption decisions by differentiating between efficacy and efficiency advantages. With the differences in objectives among classes of IT (Aral & Weill, 2007), there is a need to define more nuanced assessments of relative advantage in comparison to early studies on IS innovation in which the assessment was primarily on efficiency. Finally, this study expands the set of individual characteristics that influence IS adoption and diffusion. While several individual characteristics have been identified for the *individual* adoption of IS innovations (e.g., computer self-efficacy, computer playfulness, personal innovativeness, and cognitive absorption), this study has identified two individual characteristics – namely, the IS leader's hierarchical position and job tenure – that are likely to be influential in the *organizational* adoption of IS innovations, thus bridging the dominant micro-level focus of individual-level studies and the dominant macro-level focus of organizational-level studies on IS innovations.

From a practice perspective, this research has implications for technology vendors and potential adopter organizations of IS process innovations, particularly CASE. For technology vendors, this research has identified the profile of IS leadership at organizations that are more likely to adopt CASE. These organizations have IS leaders who are at a lower level of the organizational hierarchy, are in close proximity to systems development work, have shorter job tenure, and perceive CASE as providing significant efficacy advantages over existing systems development methodologies. This nuanced profile provides vendors with a basis to differentiate organizations that are more/less likely to be adoption candidates and to target marketing and promotion effectively. The implication for potential adopters is to evaluate how their IS leaders designated with decision-making power about CASE adoption compare with the profile of IS leaders at adopter organizations and to make necessary adjustments. Potential adopters can increase their likelihood of adopting CASE by assigning CASE innovation adoption decisions to managers closely involved in systems development and with shorter job tenure and by providing benchmarking information to decision makers on the efficacy advantages of CASE relative to other systems development methodologies.

Limitations and implications for future research

A limitation of this study is the *ex post facto* nature of the research. This is typically a problem with much of the empirical work on innovation, hence making the research susceptible to respondents' memory recall abilities. A second limitation is that the sample used for data analysis may be skewed toward non-adopters as it consists of 46 adopters and 304 non-adopters. A third limitation may be with the operationalization of IS leaders' position in the organizational hierarchy. The same position in different organizations may have different responsibilities and authority.

Although this study presents an important step toward a deeper understanding of the organizational adoption of CASE, it raises many questions and has implications for both research and practice. Past studies of CASE have investigated the importance of management support for CASE adoption and usage in organizations. Even though there are some inconsistencies in findings across studies, there is compelling evidence of the importance of management support. These studies did not examine the hierarchical level of IS management support and its consequences for the organizational adoption and usage of CASE. As a result, while management support is generally recognized as important, it is unclear what patterns of hierarchical support are necessary to promote and sustain CASE innovations. Future research should examine this issue in more detail.

From a broader perspective on organizational innovation, the IS literature – and for that matter the organizational literature – has not developed a theory on the hierarchical level of management support for different types of innovation and stages in the organizational diffusion process. Different types of IS innovations require different degrees of resource commitments because of their scope and complexity. The degree of resource commitments also changes as the innovation diffuses through different phases – from initiation, adoption, adaptation, and routinization to infusion. If the level of IS hierarchy represents IS leaders' resource-allocation capabilities as well as their managerial specialization and evaluative expertise as the literature and our study suggest, it is reasonable to expect that adoption decision making, championship, and subsequent post-adoption management support for different IS innovations will come from different levels of the IS hierarchy. Future studies may want to examine these issues. Future studies should also evaluate how IS leaders' individual factors in relation to the organization (i.e., hierarchical position and job tenure) and their appraisals of technology are influenced by environmental, task-related, and structural factors.

From a practice perspective, this study suggests that developing a typology for the relationship between IS leaders' profiles and different types of IS innovations across different adoption and post-adoption phases could be very helpful to IS practitioners. Such a typology, if validated, may be able to serve as a roadmap for sources of managerial expertise and possible championship for adoption decisions, resource commitment, and political support for implementation and usage.

Conclusion

We examined the relatively unexplored role of individual and technological factors pertaining to IS leaders in the organizational adoption of a complex IS innovation. The findings suggest that IS leaders' individual factors in the context of their organization and their perceptions of technological factors, specifically the efficacy of the IS innovation, significantly differentiate adopter and non-adopter organizations. Our findings also suggest that for complex IS innovations targeted at core IS processes (e.g., CASE targeted at systems development), a more nuanced view of relative advantage is warranted. As these findings augment our understanding of the organization adoption of CASE in particular and IS innovations in general, we propose that these factors should be included in future studies of organizational adoption of IS innovations. To that end, this study presents a more comprehensive research model of the organizational adoption of CASE incorporating all five factors from Kwon & Zmud's (1987) framework, which could be tested in future research.

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References

Albizuri-Romero MB (2000) A retrospective view of CASE tools adoption. *ACM SIGSOFT Software Engineering Notes* **25(2)**, 46–50.

Anthony RN (1965) *Planning and Control Systems: A Framework for Analysis*. Harvard Business School Division of Research Press, Boston.

Aral S and Weill P (2007) IT assets, organizational capabilities, and firm performance: how resource allocations and organizational differences explain performance variation. *Organization Science* **18(5)**, 763–780.

Baldridge JV and Burnham RA (1975) Organizational innovation: individual, organizational and environmental impacts. *Administrative Science Quarterly* **20**(**2**), 165–176.

Blau PM, Heydebrand WV and Satuffer RW (1966) The structure of small bureaucracies. *American Sociological Review* **31**(**2**), 179–191.

Bretschneider S and Wittmer D (1993) Organizational adoption of microcomputer technology: the role of sector. *Information Systems Research* **4**(**1**), 88–108.

Chau PYK and Tam KY (1997) Factors affecting the adoption of open systems: an exploratory study. *MIS Quarterly* **21**(**1**), 1–24.

Chwelos P, Benbasat I and Dexter AS (2001) Research report: empirical test of an EDI adoption model. *Information Systems Research* **12**(**3**), 304–321.

Cohn T and Lindberg RA (1972) *How Management is Different in Small Companies*. American Management Association, New York.

Compeau DR and Meister DB (1997) *Measurement of Perceived Characteristics of Innovating: A Reconsideration Based on Three Empirical Studies*. DIGIT, Atlanta.

Copeland L (2001) More for the money. *Computerworld*, [WWW document] http://www.computerworld.com/news/2001/story/0,11280,63423,00.html (accessed 19 October 2012).

Damanpour F (1991) Organizational innovation: a meta-analysis of effects of determinants and moderators. *Academy of Management Journal* **34** (**3**), 555–590.

Finlay PN and Mitchell AC (1994) Perceptions of the benefits from the introduction of CASE: an empirical study. *MIS Quarterly* **18**(**4**), 353–370.

Fichman RG (1992) Information technology diffusion: a review of empirical research. In *Proceedings of the Twelfth International Conference on Information Systems* (Degross JI, Becker JD and Elam JJ, Eds) pp 195–206, ACM, Dallas.

Fichman RG and Kemerer CF (1997) The assimilation of software process innovations: an organizational learning perspective. *Management Science* **43**(**1**), 1345–1363.

García-Magariño I, Fuentes-Fernándeza R and Gómez-Sanza JJ (2010) A framework for the definition of metamodels for computer-aided software engineering tools. *Information and Software Technology* **52**(**4**), 422–435.

Gatignon H and Robertson TS (1989) Technology diffusion: an empirical test of competitive effects. *Journal of Marketing* **53**(**1**), 35–49.

Gorry GA and Scott Morton MS (1989) A framework for management information systems. *MIT Sloan Management Review* **30**(**3**), 49–61.

Grover V, Fiedler K and Teng J (1997) Empirical evidence on Swanson's tri-core model of information systems innovation. *Information Systems Research* **8**(**3**), 273–287.

Hage J and Dewar R (1973) Elite values versus organizational structure in predicting innovation. *Administrative Science Quarterly* **18**(**3**), 279–290.

Hall RH (1982) *Organizations: Structure and Process*. Prentice-Hall, Englewood Cliffs, NJ.

Iivari J (1996) Why CASE tools are not used? *Communications of the ACM* **39**(**10**), 94–103.

Kimberly JR and Evanisko MJ (1981) Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management Journal* **24**(**4**), 689–713.

Koskinen J (2003) Software maintenance costs. ELTIS-Project, Information Technology Research Institute (TITU), Univ. of Jyväskylä, Technical Report.

Kurke LB and Aldrich HE (1983) Mintzberg was right: a replication and extension of the nature of managerial work. *Management Science* **29**(**8**), 975–995.

Kwon TH and Zmud RW (1987) Unifying the fragmented models of information systems implementation. In *Critical Issues in Information Systems Research* (Boland JR and Hirschheim R, Eds), pp 227–251, John Wiley, New York.

Larsen TJ (1993) Middle managers' contribution to implemented information technology innovation. *Journal of Management Information Systems* **10**(**2**), 155–176.

Lee C and Shim J (2007) An exploratory study of radio frequency identification (RFID) adoption in the healthcare industry. *European Journal of Information Systems* **16**(**6**), 712–724.

MacKenzie SB, Podsakoff PM and Podsakof NP (2011) Construct measurement and validation procedures in MIS and behavioral research: integrating new and existing techniques. *MIS Quarterly* **35**(**2**), 293–334.

March JG (1991) How decisions happen in organizations. *Human-Computer Interaction* **6**(**2**), 95–117.

Melymuka K (2002a) Salary survey: one step forward, two back. *Computerworld*, [WWW document] http://www.computerworld.com/careertopics/careers/story/0,10801,75467,00.html (accessed 19 October 2012).

Melymuka K (2002b) Salary survey: keeping the recession at bay. *Computerworld*, [WWW document] http://www.computerworld.com/careertopics/careers/story/0,10801,75468,00.html (accessed 19 October 2012).

Mintzberg H (1980) Structure in 5's: a synthesis of research on organizational design. *Management Science* **26**(**3**), 322–342.

Moore GC and Benbasat I (1991) Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research* **2**(**2**), 192–222.

Otondo R, Pearson A, Pearson R, Shaw J and Shim J (2009) Managerial problem-solving in the adoption of radio frequency identification technologies. *European Journal of Information Systems* **18**(**6**), 553–569.

Paolillo J and Brown W (1979) A multivariate approach to perceived innovation in R&D subsystems. *IEEE Transactions on Engineering Management* **26**(**2**), 36–39.

Pinsonneault A and Rivard S (1998) Information technology and the nature of managerial work: from the productivity paradox to icarus paradox? *MIS Quarterly* **22**(**3**), 287–311.

Premkumar G and Potter M (1995) Adoption of computer-aided software engineering (CASE) technology: an innovation adoption perspective. *DATA BASE Advances* **26**(**2–3**), 105–124.

Premkumar G, Ramamurthy K and Nilakanta S (1994) Implementation of electronic data interchange: an innovation diffusion perspective. *Journal of Management Information Systems* **11**(**2**), 157–186.

Rai A and Patnayakuni R (1996) A structural model for CASE adoption behavior. *Journal of Management Information Systems* **13**(**2**), 205–234.

Ravichandran T (2000) Swiftness and intensity of administrative innovation adoption: an empirical study of TQM in information systems. *Decision Sciences* **31**(**3**), 691–724.

Rogers EM (2003) *Diffusion of Innovations*, 5th edn., Free Press, New York.

Schach SR (2004) *An Introduction to Object-Oriented Anaysis and Design with UML and the Unified Process*. McGraw-Hill, Irwin, New York.

Schmidt DC (2006) Model-driven engineering. *IEEE Computer* **39**(**2**), 25–31.

Sharma S and Rai A (2003) An assessment of the relationship between ISD leadership characteristics and IS innovation adoption in organizations. *Information & Management* **40**(**5**), 391–401.

Simon HA (1997) *Administrative Behavior*, 4th edn., The Free Press, New York.

Swanson EB (1994) Information systems innovation among organizations. *Management Science* **40**(**9**), 1069–1092.

Tate G, Verner J and Jefferey R (1992) CASE: a test bed for modeling, measurement and management. *Communications of the ACM* **35**(**4**), 65–72.

Taylor MS, Audia G and Gupta AK (1996) The effect of lengthening job tenure on managers' organizational commitment and turnover. *Organization Science* **7**(**6**), 632–648.

Teng JTC, Grover V and Guttler W (2002) Information technology innovations: general diffusion patterns and its relationships to innovation characteristics. *IEEE Transactions on Engineering Management* **49**(**1**), 13–27.

Thong JYL (1999) An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems* **15**(**4**), 187–214.

Tornatzky LG and Fleischer M (1990) *The Processes of Technological Innovation*. D.C. Heath and Company, Lexington, MA.

Tornatzky LG and Klein L (1982) Innovation characteristics and innovation-implementation: a meta-analysis of findings. *IEEE Transactions on Engineering Management* **29**(**1**), 28–45.

Whitten JL and Bentley LD (2007) *Systems Analysis and Design Methods*, 7th edn., McGraw-Hill, Irwin, New York.

Worrall L and Cooper C (2004) Managers, hierchies, and perceptions: a study of UK managers. *Journal of Managerial Psychology* **19**(**1**), 41–68.

Wynekoop JL (1991) An innovation study of the implementation of computer-aided software engineering tools. Doctoral Dissertation, Georgia State University, Atlanta.