Business user impact on information system projects

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Abstract

Purpose – There are differing views and results in the literature regarding whether the user's participation has a positive or negative impact, if any, on the success of an information system (IS) project. The purpose of this paper is to develop a comprehensive model with four main hypotheses to test the relationships between seven constructs using survey data conducted in the USA.

Design/methodology/approach – The authors develop a structural equation model (SEM) with four constructs defining the activities the user participates in and three constructs defining user satisfaction as a measure of project success. As such, the proposed SEM is the most comprehensive among the models offered in the literature to date, and includes, for the first time, a presentation requirement construct as a specific system requirement for possible user participation.

Findings – The authors find that a business user's participation in functional requirements benefits project outcome, whereas business users should not participate in gathering presentation requirements unless they are experienced middle managers.

Research limitations/implications – This study surveyed many industries across the USA and provided a solid statistical base for analysis. Future research should consider exploring IS projects in other countries since various cultures can differ in how they approach to such projects. Additionally, industries are known to have dissimilar needs; therefore, a study exploring specific industries would add to the available research.

Practical implications – The authors find that when the general business user participates in certain activities that relate to presentation of the system, his/her involvement negatively impacts the project success. However, if that business user is a middle manager, he/she has a positive impact on the project success. Similarly, when the business user participates in managing the projects, that involvement negatively impacts the project outcome (although the amount of negative impact is relatively small). These results should have an influence on the way the IS project managers allocate business resources to activities, and their decisions regarding whether and where the business users participate.

Social implications – The authors expect higher levels of business user satisfaction on IS projects if they are allocated to a limited subset of project activities that has a positive impact on project outcomes.

Originality/value – The authors believe these findings contribute to this research domain considerably since they are based on a large sample size on a new comprehensive model of business users that can be generalized across industries. The separation of business requirements into functional and presentation requirements has suggested that there are differing impacts to the project depending on the type of business user involved.

Keywords Project management, Project success, Comprehensive, Business requirements, Functional requirements, Presentation requirements, User participation

Paper type Research paper

Introduction

Today, one of the most common type of projects implemented in corporations is an information system (IS) project; its successful completion is a foremost concern due to its implications across all departments and business units. Accordingly, in the project management literature, the search for and identification of critical success factors in IS development projects has been intense for over 30 years and has traversed industries, geographies, and technologies. There is a general assumption that user participation (UP) of

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some sort is always beneficial to project success. Barki and Hartwick's (1989) review referred to numerous studies that found UP to be a significant factor positively affecting IS project outcomes. However, a more in-depth analysis of the extended literature indicates inconclusive or even contradictory findings regarding the positive correlation between UP and project success. It was mentioned that the discrepancy among the studies is due to methodological differences, varying construct definitions, and in some cases inadequate theory development (McKeen *et al.*, 1994; Ives and Olson, 1984; Locke *et al.*, 1986; Gemino *et al.*, 2008; Brodbeck, 2001; Heinbokel *et al.*, 1996). The greatest risk affecting software projects is considered to be software requirement specification variability (Sharma *et al.*, 2011). In this study, we claim that the discrepancy comes from a lack of comprehensive modeling that displays multiple relationships between project activities and user satisfaction measures when the user participates, and offer a more comprehensive structural equation model (SEM) to unravel this problem.

This study is motivated by the lack of a broad understanding of the business user's participation throughout IS projects, and whether and how it impacts project outcome. We develop a comprehensive yet realistic model that uses user satisfaction as the measure for the project success. Rather than looking at the user's participation as a single factor that directly impacts the project outcome as typically done in the literature, we engage four constructs to describe activities where the user participates in decision making and investigate the impact of each activity to each of three constructs that describe user satisfaction. The model and the relations among the constructs are tested empirically using survey data collected across the USA. They provide important results that shed light on the discrepancies in the literature, and will improve project management practices in businesses. In addition, we focus our study on business users rather than IS professionals. Literature suggests that the business users, compared to IS professionals, have a different perspective on project activities as well as their perception of satisfaction. Yet many of the studies in the IS literature do not differentiate the two groups. Ali *et al.* (2008) suggest that user-perceived performance is valued by business users over the classical measures of time, budget, and scope favored by IT project managers. This paper develops a business functionality construct designed to address the unique goals of a business user. In this study, we define the business user as a non-IS business person that either uses the system as part of their regular work routines, oversees employees that regularly use the system, or the business analyst that liaisons between the business users and the technical design and development team.

The rest of the paper is structured as follows. In the next section, we provide IS literature pertaining to UP and user satisfaction that lay the ground work for the identification of constructs. Then, the description of each construct, the hypotheses describing the relationships between constructs, and the multi-factor user satisfaction SEM are presented. The next sections present the survey methodology, the data collection procedure, the analysis of this model, and results. The last sections are devoted to managerial implications, conclusions, and future research directions.

Literature review of UP

We conducted a comprehensive literature study that guided us to identify the constructs (Eichhorn and Tukel, 2015) in the model; Tables AI and AII summarize the studies. In Table AI, we present 42 studies that develop theory related to UP, and in Table AII, we summarize 67 empirical studies and meta-analyses providing 89 findings that are incorporated in our research along with a description of contribution of each.

The literature on UP can be classified into three areas: literature covering the purpose and the timing of UP in IS projects, the literature identifying the project activities that the user is involved in, and the literature describing user satisfaction constructs. The general consensus among the studies in the literature regarding the purpose of the UP in IS projects is that a high level of customer participation is the best predictor of project success where project success is defined as the likelihood that the project is completed and not redefined or abandoned (Yetton *et al.*, 2000; Swanson, 1974; PM Hut, 2009). Although many researchers and practitioners still believe in relatively high levels of UP, a balanced and holistic approach to user involvement should be considered to address organizational "politics" and other potential conflicts (Howcroft and Wilson, 2003). Numerous studies indicate that benefits from UP are greatest when limited to specific phases. Ives and Olson (1984) find that methodologies frequently prescribe UP during the initial phase when the requirements and design activities are being performed with additional participation being recommended during the implementation phase. Franz and Robey (1986) further clarify UP along temporal lines by studying participation during various phases of the system development life cycle. They find two phases of the life cycle where UP was most impactful: planning and design, and implementation. These studies were later confirmed by Wagner and Newell (2007) who find that selected engagement is the best opportunity to maximize user satisfaction with IT system projects. Early IS methodologies were plan driven in that they focused on generating detailed plans of tasks to be performed and then monitored the execution of that plan; they typically involved users only at the beginning and end of project lifecycles. There are, however, research findings indicating that some aspects of UP should exist in all phases of the development life cycle (Eichhorn and Tukel, 2015).

User activities are often loosely defined and not well integrated toward project success (Amoako-Gyampah and White, 1997). Ariyachandra and Frolick (2008) note the need for specific assignments and responsibilities in their study of critical success factors in business performance management projects (which typically have a broader scope than IS projects, p. 114). The literature suggests three broad user activities for successful IS projects: activities that relate to identification of business requirements, quality assurance activities, and project management activities (Eichhorn, 2014). Thamhain (2013) finds that changing project requirements is both the most frequently cited risk and the risk with the potential for greatest impact to the project's performance.

Many studies use "project success," "project performance," and "user satisfaction" interchangeably (e.g. Baroudi *et al.*, 1986; Geethalakshmi and Shanmugam, 2008; Huovila and Seren, 1998; Kappelman *et al.*, 2006). The consensus is that although there are some definitions of this construct that include both subjective and objective measures, it is fundamentally dependent on the end users' perception of their satisfaction. Users from multiple disciplines and with differing roles and responsibilities consider project performance by multiple and sometimes different measures as confirmed by social perception models (Ives and Olson, 1984; Kyng, 2010; Titlestad *et al.*, 2009). User satisfaction is a multidimensional construct that includes process measures (predominantly related to objective measures such as budget, time and scope) and product measures. The product measures can be further divided into those that convey the degree to which the system meets the business objective that motivated the IS and those that convey the technical implementation and support of the system (Eichhorn, 2014).

Based on conflicting findings from 89 studies that use varying methodologies, Doll and Torkzadeh (1989, p. 1,157) argue that more complex model(s) must be employed to describe the relationship between UP and user satisfaction. An early meta-analysis of 22 papers by Ives and Olson (1984, p. 586) finds that the papers in their study were "poorly grounded in theory and methodologically flawed." A more recent meta-analysis of 82 papers found that UP may only be minimally to moderately beneficial to system development projects with the dominate influence being on attitude and behavioral changes rather than productivity (He and King, 2008). Harris and Weistroffer's (2009) meta-analysis of 28 papers finds support for UP positively impacting user satisfaction which they argue is a proxy for system success. The literature also calls for the use of multiple measures of user satisfaction. Traditional concepts of project performance have focused on the "triple constraint" of budget, schedule and scope. Finally, studies recommend the use of larger sample sizes with focused sample sets while addressing the generality of the research as measured by surveying multiple industries, and a variety of company sizes and geographies. Doll and Torkzadeh (1988) call for studies addressing the type of application. McKeen and Guimaraes (1997) call for an expanded model to include additional measures of UP (specific activities). Millerand and Baker (2010) propose interdisciplinary research across ISs and social science perspectives. Joslin and Muller (2015) recommend an investigation of project methodology elements such as processes, tools, techniques, and capability profiles that impact project success characteristics. Finally, Chen *et al.* (2011) state that further decomposition of selected constructs will improve understanding.

In summary, the literature stresses the need for a more complex model that incorporates the use of multiple user activity constructs, multiple performance measures, multiple industries, and the perspective of the ultimate business user (Wang *et al.*, 2005; Doll and Torkzadeh, 1989). These suggestions in the literature motivated us to develop the model presented in the next section.

Model development

In this section, we present the theoretical foundation of the constructs and the presumed relationships defended in the IS literature. The model is constructed as a multi-factor SEM consisting of seven formative constructs and 12 hypotheses indicating their proposed relationships. All seven constructs follow the criteria for properly specified formative constructs in the IS literature (Petter *et al.*, 2007). The literature contains many IS project constructs yet lacks a model that integrate them to multiple user activities.

User activity constructs

The process of gathering business requirements has traditionally been considered to be a single construct – those concerning the system's traits necessary to perform the data storage, manipulation and retrieval; however, 16 of 19 studies reviewed suggest that there should be a second classification of business requirements that focus on how the user interacts with the IS – i.e. the presentation requirements. These presentation requirements address the human interface to the IS including the input and output forms, specific screen formatting and layouts, report designs and user queries to provide a search capability to the user. The large number of articles in literature referring to a second grouping of requirements brings into question whether a single requirements construct sufficiently describes the requirements gathering activity. Thus, we propose two separate constructs to represent the gathering of system requirements: functional requirements and presentation requirements. Functional requirements address the tactical business purpose of the IS and include what data is to be used, the processes of collecting and validating the data, the data's security, the calculations that employ the data, and the task and system complexity represented by the manifest variables of process, calculations, data storage, security, and task complexity. We propose manifest variables of forms, screens, reports, and queries to represent the construct of presentation requirements.

Quality assurance is the "process of assuring that the standards, processes, and procedures are appropriate for the project and are correctly implemented and checks that the project follows its standards, processes, and procedures," and that the project "produces the required internal and external (deliverable) products" (Fleming, 2012). Hutcheson (2003), Iacob and Constantinescu (2008), and Olalekan and Adenike (2008) recommend the use of quality assurance tools and methods to organize, document and report on the quality assurance progress as well as reducing time spent on repetitive tasks that modern tools can automate. The use of prototypes in IS projects is one technique that has been successfully used to improve software product quality (Tudhope *et al.*, 2000; Khan *et al.*, 2011). Kristensson *et al.* (2008, p. 485) argue that users experiencing a prototype provide better ideas than "undifferentiated and directionless brain-storming activities." Recently, Gingnell *et al.* (2014) find that UP is most important to the project's overall perception of quality. Therefore, we propose the user's participation in test design and execution, use of quality assurance tools, and use of prototypes as manifest variables to define quality assurance.

Project management is a well-studied construct (Eichhorn, 2014). Doll and Torkzadeh (1989) and Kappelman and McLean (1991, 1992) support UP during the implementation phases of IS projects. Robey and Markus (1984) include a number of management and administrative activities in their study of user activities; these include preliminary surveys, feasibility studies, training, conversion, installation and operations. Somers and Nelson (2001) find that there are a number of management and administrative activities that positively influence project success including top management support, project champion, vendor/customer partnerships, project management, steering committee, human resource management, and communication. Finally, Muller and Martinsuo (2015) show that relational norms between the vendor and customer in IS projects are moderated by the managerial flexibility on both ends. Thus, based on the literature, we propose that a business user's participation during schedule development, problem solving, risk and conflict management, non-IS communication, and implementation are the manifest variables defining a business user's participation with the project management of an IS project.

User satisfaction constructs

DeLone and McLean (1992) find that there is no direct measure for the success of an IS project. Ives *et al.* (1983, pp. 785-786) provide a thorough description of the user satisfaction construct. They note that it is a "perceptual or subjective measure" that although in theory is defined by economics, the practical effect cannot be so easily measured. They create a 39 measure instrument for user satisfaction as well as a 13 measure "short form." This instrument was later confirmed by Baroudi and Orlikowski (1988). User satisfaction has been used as the dependent variable in empirical research models as a surrogate of project success and UP (Hsu *et al.*, 2008; Doll and Torkzadeh, 1989; McKeen and Guimaraes, 1997; Ives *et al.*, 1983). Specifically, Hsu *et al.* (2008) note that 18 of the 31 articles they reviewed employed "user satisfaction" as their dependent variable with various types of UP as independent variables. Lech (2013) suggests that multiple factors involved in determining project success should be treated within the context of the organization. One success factor study states that project success has "gradually shifted from project efficiency to project effectiveness" (Shao *et al.*, 2012, p. 47). That same study also supports the need for a more complex or comprehensive model because of the tight relationships between the parts of a project system. Muller and Jugdev's (2012) review of the evolution of project success studies note that project success should be thought of more strategically as critical success factors will vary depending on industry, organization, methodology, and project type.

Given the recommendations from literature to have multiple measures of user satisfaction, the SEM engages three user satisfaction constructs: project delivery, business functionality, and technical functionality. Based on literature, we propose the use of cost, schedule, and scope to measure project delivery; system usage, timely delivery of data, accurate data, system quality (output information being accurate, precise and complete), financial benefits, operational efficiencies, and ease of use as measures determining business functionality; and finally reliability, ease of maintenance, ease of testing, and stability as measures determining technical functionality.

Gaps in the literature. We propose the multi-factor user satisfaction SEM to describe the relationships between the seven constructs (Figure 1). The dashed lines in Figure 1 indicate the correlations that have been studied (proposed) in the literature and the solid lines indicate the new associations that we propose as part of the SEM. Clearly, this model has the potential to provide a holistic explanation of associations, rather than an additional study of a two-factor model. It is important to note that the SEM we develop in this study does not differentiate the business user's involvement in project activities between methodologies such as system development life cycle processes (planning) and agile development processes (iterative).

Relationships between constructs

As previously noted, functional requirements are characterized as those that define processes, calculations, data storage, security, and task complexity of the completed IS. The business user is the only person that fully understands the business needs for the new or enhanced IS. They can provide the details of what and how the system should function and perform. Any errors, omissions, or ambiguity in the functional requirements will

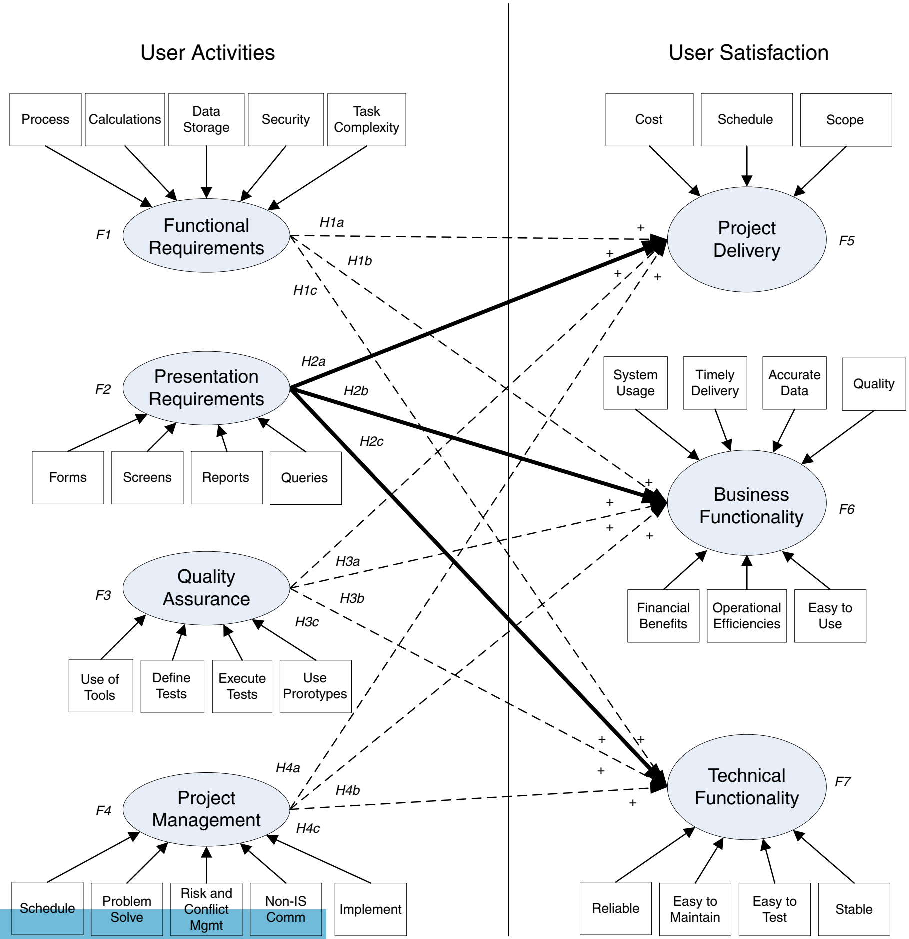


Figure 1.
Multiple factor user satisfaction model – detail

therefore have potentially significant negative consequences on one or more of the project's scope, cost or schedule. Thus, we propose the following hypothesis:

H1a. The creation of IS functional requirements positively impacts project delivery.

A system designed with incorrect processes, inaccurate calculations, incomplete or delayed data storage and retrieval, incorrect or weak security, and overly complex user tasks will negatively impact business functionality. Therefore, since the business user is the best person to provide these requirements, we propose the following hypothesis:

H1b. The creation of IS functional requirements positively impacts business functionality.

Technical functionality addresses the operational dimensions of an IS after it is deployed. Processes that are incorrect or incomplete can negatively affect the stability of an operational system. Similarly, errors in calculations, data storage design, and security design can directly affect a system's reliability, maintainability, and testability. Although a business user may not comprehend the technical components, constraints and opportunities available within the organization, they can still provide the guidelines and constraints that the technicians can use to configure the final environment. Therefore, we propose the following hypothesis:

H1c. The creation of IS functional requirements positively impacts technical functionality.

Business users will be the direct benefactors and users of the IS; the sequence and manner in which they interact with the system can be important to its efficient and effective use. If they do not provide clear direction and examples in a timely manner, there can be a negative impact on the IS project's scope, cost and schedule. Therefore, we propose the following hypothesis:

H2a. The creation of IS presentation requirements positively impacts project delivery.

The various business functional measures of user satisfaction are particularly sensitive to the presentation requirements. For example, a system's ease of use is seriously affected by the design of its forms, screens and reports since they are the user's primary method of understanding and interacting with the data. A screen's ambiguity, or conversely its clarity, directly impacts the user's ability to enter data accurately or interpret the system's output correctly. Therefore, we propose the following hypothesis:

H2b. The creation of IS presentation requirements positively impacts business functionality.

Since the presentation requirements are the primary method that business users interact with the IS, its clarity (or ambiguity) directly affects the system once implemented. If these features are not well understood by users or technicians, the system's technical functionality can be compromised. The specific requirements they provide may force an implementation that is difficult to support, or may leverage capabilities of the technical environment that helps both the user and technical communities. Therefore, we propose the following hypothesis:

H2c. The creation of IS presentation requirements positively impacts technical functionality.

IS quality assurance activities have received significant attention in research. Given the inherent complexity of modern software development projects, quality assurance activities become critical to their successful completion. The project's schedule and cost should experience fewer variations due to special cause variation being reduced as the quality assurance activities increase. The quality assurance activities are typically designed to include the testing of conformance to project scope in an effort to deliver the expected functionality and benefits. Business users provide a unique perspective since they comprehend the implications of erroneous process flows or calculations. Their participation validating critical functions can reduce the implementation and performance risk of the project. Therefore, we propose the following hypothesis:

H3a. The performance of quality assurance activities positively impacts project delivery.

The IS project team can assemble professional quality assurance team members to use the requirements documents to design and execute the necessary tasks, but business UP on the quality assurance tasks will significantly improve results (since they can immediately resolve or interpret ambiguous test results) and address the prioritization of subsequent activities to address discovered software issues. Therefore, we propose the following hypothesis:

H3b. The performance of quality assurance activities positively impacts business functionality.

The business user's participation with the quality assurance tasks can clarify questions as they arise during the test design process and quickly prioritize the remediation tasks given any observed variance from the desired technical functionality. Therefore, we propose the following hypothesis:

H3c. The performance of quality assurance activities positively impacts technical functionality.

Project management is characterized as a set of nine knowledge areas (integration, scope, time, cost, quality, human resources, communication, risk, and procurement) that can be applied to any project to help deliver the intended results as specified (Project Management Institute, 2013). The available project management literature has identified five areas that could involve business users and have a positive impact to the project success: schedule, problem solving, risk and conflict management, non-IS communication, and implementation. Business users can add value to the management of an IS project by helping give the business perspective to the project manager. Their activities will positively impact the system's scope, cost, and schedule since they have the effect of reducing variation within those measures. Based on the literature, we propose the following hypothesis:

H4a. The execution of project management activities positively impacts project delivery.

Business users seek new or improved ISs to improve their operational capabilities; i.e., they desire the new system to have the characteristics associated with the business functionality construct. Ensuring communication with non-IS team staff, managing risk and conflicts, solving problems, addressing schedule changes, and assisting with implementing the system are key activities that reduce the risk of variances between the business user's expectations and the final delivered system. Therefore, we propose the following hypothesis:

H4b. The execution of project management activities positively impacts business functionality.

Modern ISs are complex integrations of hardware, networks, security systems, operating systems, databases, and the specific business application. The technical functionality is critical to the user experience once deployed into their production environment. A business user's participation on these selected tasks can reduce the project's implementation risk. Each measure will positively affect the technical functionality if performed well. Therefore, we propose the following hypothesis:

H4c. The execution of project management activities positively impacts technical functionality.

Methodology and data collection

Methodology

A preliminary survey instrument and cover letter were sent to 17 professionals and academics familiar with the domain of IS projects and reviewed by an academician for purposes of survey validation given their early work in that field; both documents were improved based on their combined feedback. Individual measures for the manifest and control variables were amalgamated from various papers listed in Tables AI and AII. All measures in the survey instrument employ a seven-point Likert scale (following Dvir, 2005; Ravichandran and Rai, 2000). Care was taken to have no reverse scored scales to reduce respondent errors which would reduce the instrument's validity. Further, the questions are worded so that a business user or practitioner would logically recognize the questions (confirmed during the pre-test), thereby increasing their ease of completion and reducing the time to complete the survey. We use 11 control variables found in the literature that are divided into three groups for this research (see Table I): project information (project complexity, project budget, use of commercial software, and project customer), survey respondent (gender, age, years at the company, years of experience using ISs as part of their job responsibilities, and title), and company information (number of employees and industry).

The sample set for this study consists of business users (non-IT professionals that were recently involved in IT projects using any methodology across all industries in the USA) randomly generated from two professional organizations with US chapters (the International Institute of Business Analysts and the Project Management Institute) and a purchased list of business users and managers from Hoovers, Inc. These two professional organizations have members predominantly drawn from business users of interest to this study. The sample set did not restrict economic sectors or industries, and intentionally sought respondents from all 50 states.

Data collection and preliminary analysis

The primary tool for distributing and collecting the survey instruments was an online survey tool, Survey Monkey. The survey instrument was also available in paper form for those who preferred to complete the survey manually. In all, 3,069 surveys were successfully delivered to business users and analyzed during 2013-2014. The survey instrument clarified that the respondent had to have participated in one or more activities on an IS project. The 205 completed surveys represent a 6.7 percent response rate. Among these responses were 15 surveys (7.3 percent) with missing data elements. The resulting 190 valid surveys are 18.8 percent greater than the minimum number derived from the Hatcher (1994) recommendation of 160. Structured equation modeling is used to test the model's fit and analyze the hypothesized relationships; specifically we used the CALIS procedure in SAS Release 9.2 Version TS2M3 (SAS Inc., 2008).

More than half of the projects (54.6 percent) are depicted as either complex or very complex; 52.1 percent of the projects are up to $500,000 in cost; and 47.9 percent are combination efforts of packaged software with customized enhancements or additions. Most of these projects (66.5 percent) are for internal customers alone. In general, there are almost

Project information	Respondent information	Company information
Project complexity	Gender	Company size
Project budget	Age	Industry
Software package type	Year at this company	
System user	Years with IS project experience	
	Title	

Table I.
Control variables

exactly twice as many male respondents as female; 57.7 percent of the respondents are between the ages of 36 and 55; 57.2 percent of the respondents have ten or more years of IS experience as business users; 43.4 percent of the respondents are non-management and 38.1 percent of respondents are middle management. There are 45.7 percent of companies with over 2,500 employees and the two largest identified industries (manufacturing and healthcare/pharmaceutical) represent only 20.0 percent of all responses.

To determine the presence of non-response bias, we used the common testing method of dividing the survey into two groups (Armstrong and Overton, 1977; Lambert and Harrington, 1990). All variables are significant at the 99 percent confidence level. We analyzed the potential impact of common method bias using three methods and found no suggestion of such bias (the Harman single factor test indicates 46.09 percent of the variance may be from the use of a common method; the common latent factor technique indicates a variance of 33.96 percent; and the common marker variable technique indicates a variance of 14.75 percent (all below a threshold of 50 percent).

Analysis

This section presents the analysis of the empirical data. First, we present an analysis of the full covariance model followed by an analysis is of the full path model.

Full covariance model

An analysis of a full covariance model suggests that the data supports the model's reliability and validity, and recommends retaining all manifest variables into the remaining analyses. Our data used seven fit statistics suggesting that the model portrays a good fit (see Table IV).

The normality of the manifest variables was tested and all independent variables are found to have a kurtosis value between −1.76 and 1.92, well within an acceptable range of ±3.0. However, as shown in Table II, nine of the 34 variables show skewness below the lower limit of −1.0 with four of the nine only marginally below −1.0. In all nine cases, this shows that a large majority of business users self-evaluated themselves as "strongly agreeing" with a statement about their participation on the indicated measure. This skewing is a reasonable finding given that the sample set of survey respondents are people who identified themselves as being involved on IS projects.

Table III provides Cronbach's α values and correlation coefficients. We note that all of the user activities and user satisfaction constructs (F1 through F7) have Cronbach's α values well in excess of the standard 0.70 (the smallest being 0.816) which suggest their reliability for this study. The five pairs of constructs with correlations exceeding 0.70 had their manifest variables examined for multicollinearity; however, not only did all pairs have VIF values below 10 (Hair *et al.*, 1995) but all pairs were below 5 (Rogerson, 2014). The two pairs of constructs with high correlations (F1-F2 and F6-F7) were tested with

Table II.
Skewness

Latent variable	Manifest variable	Skewness
Project management	NF27: problem solving	−1.239
Project management	NF28: risk and conflict management	−1.005
Project management	NF29: non-IS communication	−1.146
Business functionality	NF34: system usage	−1.601
Business functionality	NF35: timely delivery	−1.623
Business functionality	NF36: accurate data	−1.663
Business functionality	NF37: quality	−1.098
Business functionality	NF39: operational efficiencies	−1.035
Technical functionality	NF41: reliability	−1.286

exploratory analyses to ascertain whether they each are single constructs. The F1-F2 pair (functional and presentation requirements) had eigenvalues of 18.78 and 1.49 with corresponding proportions of 92.6 and 7.4 percent. The significant difference in proportions and the high covariance value suggest that although they are discrete factors, one factor (in this case, F1 Functional Requirements) carries the predominant information. Similarly, the F6-F7 pair (business and technical functionality) had eigenvalues of 31.99 and 2.34 with corresponding proportions of 93.2 and 6.8 percent; F6 business functionality contains the predominant information of this pair. We also tested the discriminant validity by fixing the correlation coefficient between these pairs and the fit remained good for all measures.

Establishing content validity requires an analysis of the extent to which the sample data measures the concept that it was intended to measure (Churchill, 1979). As discussed previously, the review and subsequent use of 128 studies for the foundation for this research form the basis of this content validity. It is further confirmed as part of the instrument's pre-test by 17 practitioners and one academic.

Construct validity was analyzed in two ways. First, an analysis of paired t-tests across all variables indicates that all t-values are significant with $p < 0.001$, indicating convergent validity for this sample. Second, a confidence interval analysis of paired variables found no variable pairs to have significant correlation, suggesting that the data exhibits discriminant validity.

Finally, the Wald test is used to identify variables to be considered for removal from the model if their removal would improve the model's fit (Kline, 2005). That test does not suggest the removal of any manifest variables since all manifest variables are found to be significant. Therefore, we keep all manifest variables in the measurement model.

Full path model

In this second phase of our analysis, we confirm or reject our various hypotheses and analyze the control variables. Table IV provides the goodness of fit statistics for the full path

	F1	F2	F3	F4	F5	F6	F7
F1: functional requirements	(0.882)						
F2: presentation requirements	0.911**	(0.912)					
F3: quality assurance	0.631**	0.645**	(0.816)				
F4: project management	0.745**	0.592**	0.462**	(0.914)			
F5: project delivery	0.457**	0.374**	0.221*	0.404**	(0.835)		
F6: business functionality	0.616**	0.520**	0.345**	0.575**	0.722**	(0.944)	
F7: technical functionality	0.584**	0.490**	0.331**	0.499**	0.712**	0.947**	(0.911)

Notes: Cronbach's α values are in parentheses. $*p < 0.01$; $**p < 0.001$

Table III. Summary of standardized coefficients of covariances

Statistic	Target value[a]	Full covariance	Full path
Ratio of χ^2 statistic to df	<2.0	1.840	1.872
Standardized root mean square residual (SRMSR)	<0.08	0.067	0.068
Parsimonious goodness of fit index (GFI)	>0.60	0.709	0.711
CFI (Bentler comparative fit index)	>0.90	0.927	0.924
NNFI (Bentler and Bonnet non-normed fit index)	>0.90	0.919	0.915
$\lvert$Residuals$\rvert < 2.0$	Yes	Yes	Yes
Symmetrical	Yes	Yes	Yes

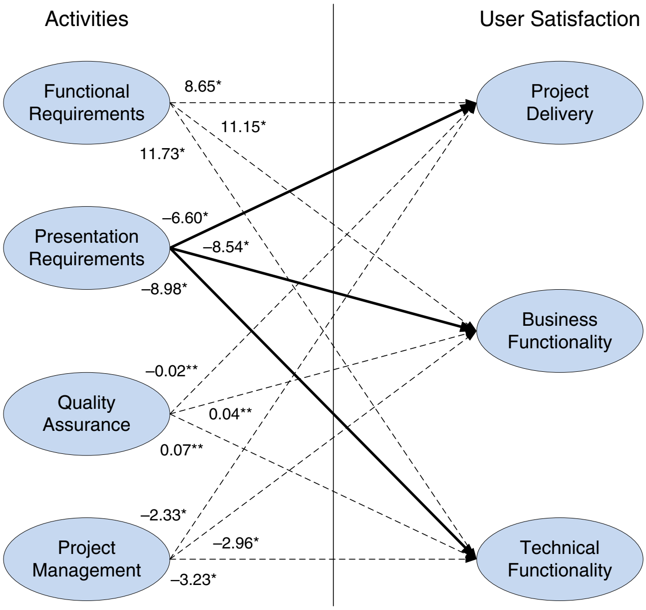
Note: [a]Hatcher (1994)

Table IV. Goodness of fit (full covariance and full path models) model and suggests that the theoretical path model does portray good fit. The distribution of residuals in this analysis is within ±0.3 and is approximately symmetrical around zero. The Wald test suggested analyzing the incremental removal of the paths from the quality assurance activity to the three dependent variables that could indicate a simpler and better model exists as measured by the goodness of fit statistics. The sequential removal of these paths from the theoretical model was analyzed; the three alternative models do not significantly change the model's fit across any of the goodness of fit statistics. The Wald test further identified the removal of all three paths from the project management activity to the three dependent variables. Again, we see no significant change in the model's fit from the original theoretical model. Therefore, given the content validity of these business user activities and their theorized impact on the user satisfaction variables, we retain these paths.

Figure 2 shows the model with the results of the completed analysis.

This study finds support for *H1a-H1c* regarding functional requirements. These impacts have the greatest magnitude of any impact on the three user satisfaction measures. The SEM explicitly measures user satisfaction as three separate latent variables to capture the multidimensionality of user satisfaction and indicates that functional requirements positively influence project delivery, business functionality and technical functionality. Further analysis indicates that the difference between business users who described themselves with high or low levels of participation in functional requirements does not have an impact on the level of user satisfaction.

The data suggest that presentation requirement activities negatively impact all three user satisfaction measures (*H2a-H2b*). That is, the business user's participation in providing presentation requirements to IS projects decreases their satisfaction with the project. This is contradictory to the findings in the literature and also in contrast to one of the foundational concepts of light weight methodologies. This unanticipated finding motivated additional analyses. We found that when the business user is a middle



Notes: *$p < 0.05$; **$p < 0.10$

Figure 2.
Path analysis results

manager, this relationship reverses to become positive as originally hypothesized, but for all other cases it stays negative. The model (where the gathering of requirements is separated into two constructs) and its analysis identified this distinction that had not been detected in previous studies.

Our data suggest that quality assurance activities have an inconsequential impact to any measure of user satisfaction. Further analysis of survey respondents who described their level of participation in quality assurance activities as being either high or low provided similar results to the overall model's results. Business users typically focus on performing their own work; becoming involved in testing someone else's work can be perceived as unproductive for themselves and leave them with a poor perception of the project. Additionally, their participation in this phase will expose them to many errors ("bugs") that would normally have been addressed prior to them seeing the results of the development effort if they had not been involved, which again could leave them with low regard for the development project.

This study finds weak support for all three paths in *H4a-H4c* regarding business user's participation in project management activities. Each path has a small negative relationship with their corresponding user satisfaction measure. These findings may indicate that the typical business user is unaware of the myriad of details involved with managing an IS development project. Their participation exposes them to the number of risks and issues addressed in the day-to-day management of IS projects that normally they would not have a need to know since most are resolved within the development team. Although their participation may be beneficial to the project manager when they can inject the business perspective or address business constraints, the overall affect may be damaging to their own perception of the benefits of project management in general.

The weak relationships were identified to be removed in the full path analyses in an attempt to simplify the model. However the model's fit and relationships did not significantly change as these relationships were removed. Similar to the discussion concerning UP with quality assurance activities, UP with selected project management activities may be perceived as helping other people do their work, even if the specifics of their participation contribute to the project (such as communicating to the business staff, resolving business risks, and coordinating schedules across multiple teams). An analysis comparing respondents with high and low levels of participation on project management suggested results that generally follow those of all respondents combined.

Impact of control variables

In all, 11 control variables were included in this analysis (see Table I). Many of the analyses were statistically insignificant or demonstrated no impact on the general findings already discussed. Eight of 15 analyses performed using these variables on *H1a-H1c* supported the positive relationship of *H1a-H1c*. Six of 15 analyses on *H2a-H2b* supported a negative relationship which aligns with the general findings.

One noteworthy control variable was the respondent's title (they were asked to select one of four possible titles: non-management, middle management, executive management, or support). The data for non-management respondents followed the general findings as noted above while the quantity of data for both executive management and support personnel was insufficient to perform any further analysis. However, although the analysis of respondents identifying themselves as middle management was statistically insignificant, they point to a potentially interesting new result. This data found a negative relationship for *H1a-H1c* and a positive relationship for *H2a-H4c*. This subset of respondents suggests a directly opposite relationship to the dependent variables than all other control variables or the data set as a whole – i.e. they potentially support these original three hypotheses. This is also contrary to the general assumption that can be drawn from the literature.

Managerial implications

The data from this empirical study exhibit exceptional measurement characteristics evidenced by consistently acceptable levels of reliability, validity, and unidimensionality. This indicates that the respondents believe the model's factors to be important and relevant to the process of creating ISs for their use. The results showed that the respondents not only represented a wide range of industries but also having significant experience as business users, which speaks to the generalizability of the findings across industries. The large sample size also contributes to the statistical significance of the findings. An analysis of each control variable found an interesting relationship regarding the respondent's title positively impacting the relationships originating with the presentation requirements' construct. Figure 2 summarizes the analysis of the relationships.

Outcome 1: business user's participation in functional requirements benefits project outcome

UP in the discovery, documentation, and verification of business requirements has been documented in a number of studies and has been found to be a significant contributor to successful completion of IS projects. There are unique challenges to the creation of quality requirements including limited face-to-face opportunities for communication and users with limited technical knowledge which constrains their ability to foresee or articulate their requirements. Our model separates the process of gathering business requirements into two constructs. These two constructs are highly correlated for this sample data but the exploratory factor and multicollinearity analyses indicated that two factors should be kept in the model.

Functional requirements have been the core of requirements research. Previous research propose that UP on such requirements activities has a positive relationship on user satisfaction. This research not only analytically confirms the suggestions in the literature but also enhances them since our sample size, industry diversity, and comprehensive model is a more robust research environment that can generate significant and broadly applicable findings. In addition, our findings remained consistent across all control variables. Therefore, we find that IS project functional requirements benefit from involved business users of all types.

Outcome 2: business users should not participate in gathering presentation requirements unless they are experienced middle managers

We believe that this research is the first empirical study analyzing presentation requirements as a separate construct within SEM. We hypothesized that these characteristics of IS requirements would follow the positive relationship characteristics of UP in gathering the functional requirements. However, we find that a business user's participation in gathering presentation requirements negatively impacts the user's satisfaction with the success of an IS project.

All analyses of this construct by the control variables also suggest this inverse relationship with one exception: an analysis of respondents identifying themselves as "middle management" suggests a positive relationship. The business user who is using the IS as part of their daily responsibilities is closest to the functional requirements of the system. Middle managers are responsible to take the standard outputs and results from ad-hoc queries to make business decisions, therefore they frequently alter their information requirements and report options (such as data sequence, filters, logic, and graphics). In our sample data, middle managers had a slightly higher average level of agreement over non-management users regarding their participation on presentation requirement activities compared to Functional Requirement activities. This is an interesting finding since it suggests that there may be additional constructs or mediating factors (possibly including the business user's title or role) affecting a user's participation with documenting system requirements.

Outcome 3: business user's participation in quality assurance is not a factor for project success

Contrary to the claims in the literature, our data found an insignificant relationship between a user's participation on quality assurance activities and all three user satisfaction constructs. We suspect that involving business users in the various quality assurance activities could benefit the project because they are uniquely qualified to design system tests and interpret the results; however, this greater level of participation may be exposing them to the intricacies of testing ISs – a highly detailed and intensive activity. Additionally, software testing often uncovers numerous defects that are fixed prior to implementation. UP makes the identification and remediation of defects more visible to them and may decrease the user's satisfaction with the final result even if the final product meets their requirements. As a result, they are left with a general impression of how much can go wrong which in turns lowers their general satisfaction with the system. Analyses by the control variables did not suggest any additional factors that may be involved with these results. Note that our study does not measure the quality of the IS project's deliverable, and therefore the product itself may be of good quality as a result of their participation, but their satisfaction may be decreased because of their participation.

Outcome 4: business user's participation in project management is not a factor for project success

Management of IS projects requires that the project manager have some domain knowledge in the technologies being employed. Large business systems often involve business change, coordination, and communication activities that an IS project manager may not be able to adequately perform. Light weight methodologies recommend that users assist with selected project management activities. Our data finds a weak negative relationship between UP on project management activities and the three user satisfaction measures. We speculate that as business users experience the many details and risk management activities performed by an IS project manager, their perception of the overall project is degraded which in turn lowers their overall satisfaction. For example, if they were limited or even excluded from many of the project management activities, the project manager would have an opportunity to address the risks within the development team and report progress shielding them from the technical and functional issues that were identified and resolved.

Conclusions and future research

In this study of a more comprehensive structured equation model of business IS projects, we provide empirical evidence that a business user's participation contributes to their perception of project success but only on a selected subset of project activities. For example, when the general business user participates in certain activities that relate to presentation of the system, his/her involvement negatively impacts the project success. However, if that business user is a middle manager who participates in certain activities that relate to presentation of the system, he/she has a positive impact on the project success. Similarly, when the business user participates in managing the projects it negatively impacts the project outcome (although the amount of negative impact is relatively small). These results should have an influence on the way the IS project managers allocate business resources to activities, and their decisions regarding whether and where the business users participate. We believe these findings contribute to this research domain considerably since they are based on a large sample size of business users that can be generalized across industries; they also demonstrate a need for additional research to increase our understanding of these relationships. Although we argue for business UP in all activities throughout the project life cycle, we find limited impact in both quality assurance and project management activities.

This study surveyed many industries across the USA and provided a solid statistical base for analysis. Future research should consider exploring IS projects in other countries since various cultures can differ in how they approach to such projects. Additionally, industries are known to have dissimilar needs (such as medical, financial, military, and food); therefore, a study exploring specific industries would add to the available research. Research could be expanded regarding the business user's participation in quality assurance and project management activities to determine if there is a subset of these activities that improve project success compared to other activities that reduce project success. Another area for future research is to investigate the impact of project methodology on user satisfaction. For example, there is a growing literature on agile development methods such as scrum for IS project development. Business users' strong and continuous participation as scrum masters in project processes may perhaps have a positive impact on user satisfaction. Finally, this research showed the need to explore the relationships between a business user's title or job function and their project role providing IS requirements since this research showed the potential for varying, potentially opposite, influence on project success.

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Further reading

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(The Appendix follows overleaf.)

Appendix

Subject area	Articles	Finding
UI and UP constructs	Barki and Hartwick (1989)	User involvement is separate from user participation
	Ives and Olson (1984)	Much early work is flawed due to poor theory, measurement and methodologies
Methods and techniques	Beath and Orlikowski (1994)	Methods can have internal contradictions with respect to user involvement
	Beynon-Davies and Holmes (2002)	Scenarios and design breakdowns are useful techniques for gathering IS requirements
	Beynon-Davies *et al.* (2000)	RAD supports increased user involvement
	Gulliksen *et al.* (2003)	Four principles (user focus, active user involvement, usability champion and a user-centered attitude) impact IS success
	He and King (2008)	Meta-analysis found that UP may only be minimally to moderately beneficial to IS projects
	Nelson (2007)	Agile methodologies are recommended if the requirements have not been well defined or significant user involvement is needed
	Wagner and Newell (2007)	Prototypes create a "feedback loop" which enables the analysis and design phases to be performed synchronously by the designers, builders and users
Timing and level of UI	Campbell *et al.* (2007)	UI beneficial during product verification; customers often limited to start and end of projects
	Fortune and White (2006)	Users on successful projects are involved through the entire project although to varying degrees
	Lettl (2007)	Effective UI can vary by phase
	Mahanti (2006)	Stakeholders should remain engaged throughout the agile life cycle
	Mumford and Henshall (1983)	Three levels of participation are proposed: consultative, representative, and consensus A number of moderating factors are proposed
Project success	Cowan *et al.* (1992)	Partnering impacts project performance and partnering is a possible antecedent to effective UI
	Havelka and Rajkumar (2006)	A lack of UI contributes toward troubled projects
	Kamadjeu *et al.* (2005)	Users with vested interests, willingness to participate and some level of technical knowledge positively impact system implementation
	Ngai *et al.* (2008)	Top management is considered as one of 18 critical success factors when adopting ERP systems
	Petter (2008)	User's expectations of project outcomes are a significant factor in the user's satisfaction with the outcomes
	Sheu and Kim (2009)	User readiness correlates to IS project success, but may be moderated by the project complexity
	Slevin and Pinto (1987)	Ten critical success factors for project success
	Upton and Staats (2008)	CEO-level involvement is important on strategic IT projects
Participatory design	Bjerknes (1993)	Specify level of user time commitment; ensure management support
	Buhl and Richter (2004)	Communication methods reduce stress and improve quality
	Cahill and McDonald (2006)	Prototypes impact product success
	Clement and Van den Besselaar (1993)	UI leads to better identification of requirements and ability to adopt technology to the workplace

Table AI.
Analysis of theory building studies

(continued)

Subject area	Articles	Finding
	Schummer *et al.* (2006)	Designers would still perform the major design activities but emphasize communication with users throughout the entire process
IS project	Amoako-Gyampah and White (1997)	Structural integration is insufficient; UI must be managed to be effective
	Biffl *et al.* (2006)	Loosely engaged executives may need extra effort to become active participants
	Coombs *et al.* (2001)	User ownership related to project success; use of best practice methods impacts user attitude
	Dean *et al.* (1997)	Three layers of user involvement
	De Moor *et al.* (2010)	Continuous user interaction is needed
	Keil and Robey (1999)	Six roles help trigger de-escalation of a project's priority
Other	Ariyachandra and Frolick (2008)	Business performance management: users need specific assignments and roles
	Canel *et al.* (1997)	Multiple user groups can cause schedule delays and sub-optimal solutions
	Cavaye (1995)	UP is related to systems with strong external orientation
	Gallivan and Keil (2003)	Identifies four stages of communication for effective requirements gathering and prioritization
	Garrety *et al.* (2004)	Improving communication between "communities of practice" and project teams positively impacts both
	Iivari (2009)	Some users are non-technical and disinterested – only interested in the resulting solution
		UP can be informative, consultative or participative
	Kristensson *et al.* (2008)	The role of co-creator is significant. They also find inconclusive support for various user communication techniques
	Liu *et al.* (2010)	Senior executives focus on different (higher) levels of project risks than IT project managers
	Sashkin (1984)	Three types of contingencies when considering participation as an ethical imperative: psychological, organizational and environmental

Table AI.

	Impact	Contribution to the field
Aladwani (2002)	+	IS project performance is multidimensional
Barki and Hartwick (1994a)	+	User involvement, user participation, user attitude
Barki and Hartwick (1994b)	+	UP impacts conflict which impacts satisfactory conflict resolution
Barki *et al.* (2007)	+	Identifies three activities to improve conceptualization of system use
Baroudi *et al.* (1986)	+	User involvement impacts project success
Baroudi and Orlikowski (1988)	+	A short form questionnaire to determine user satisfaction
Biehl (2007)	+	Detailed planning, flexibility during implementation, competent leadership, high UI from multiple user groups
Brodbeck (2001)	+	Internal communication; user communication in later project phases
	–	Use of tools reduces need for communication
Chen *et al.* (2011)	+	User responsibility impacts UP; user influence impacts IS process quality
Dooley *et al.* (2002)	+	Best practices associated with strategic implementation (which include customer involvement) are more widely adopted
Dvir (2005)	+	Greatest value from UI is found during the development and final user preparation phases
Dvir *et al.* (2003)	+	UI adds value throughout the entire project life cycle, especially the definition of goals and functional and technical specifications
Ewusi-Mensah and Przasnyski (1991)	o	IS projects can be abandoned even when active UP is the norm
Fang (2008)	–	UP when customer connectivity is high
	+	UP when customer connectivity is low
	+	UP on speed to market when customer connectivity is high
	o	UP on speed to market when customer connectivity is low
Faraj and Sproull (2000)	+	Coordinating expertise positively impacts team performance
Filippini *et al.* (2004)	o	Customer involvement is not correlated to NPD time performance
Franz and Robey (1986)	+	UI modestly impacts perceived usefulness of MIS
	o	Organizational context has no significant impact on UI
	+	User's decision making and organizational position impacts system usefulness
Geethalakshmi and Shanmugam (2008)	+	The level of customer and user interaction contributes more to project success than other variables studied
Gemino *et al.* (2008)	o	No relationship is supported between organizational support (which includes UP) and project product performance
Ginzberg (1981)	+	Users with realistic expectations of IS performance are more satisfied than users with unrealistic expectations
Harris and Weistroffer (2009)	+	A meta-analysis of 28 papers arguing that UI during the system development process is important to system success
Hartwick and Barki (1994)	+	UP leads to UI, and UI mediates the relationship between UP and system use
He and King (2008)	+	A meta-analysis of 82 studies finding UI impacts attitudinal/behavioral outcomes and to a lesser degree productivity outcomes
Heinbokel *et al.* (1996)	–	UP is related to low project success
Hoda *et al.* (2011)	+	UI is important on agile projects; its absence can cause challenges
Hsu *et al.* (2008)	+	User should provide requirements
	+	Continued involvement moderates project risk
Hsu *et al.* (2010)	+	Effective UI allowing some level of user control influences project outcomes
Hsu *et al.*	+	User coproduction positively impacts project outcomes
Huang and Kappelman (1996)	+	UP helps generate correct system specifications, enables relevant designs and provides a sense of ownership of the results
Huovila and Seren (1998)	+	UI positively impacts project success
Hyvari (2006)	+	Communications is a significant contributor to project success
	+	Communications in large organizations is even more critical
Ives *et al.* (1983)	+	UP positively impacts user information satisfaction

Table AII.
Analysis of empirical studies

(*continued*)

	Impact	Contribution to the field
Jarvenpaa and Ives (1991)	+	Executive participation supports user involvement and user participation
Jiang and Klein (2000)	–	Lack of clearly defined roles and general user expertise negatively impact project success
	–	Elevated conflict levels decrease the quality of work
Jiang *et al.* (2000)	+	Top management and user support impact project team performance
	+	Higher levels of agreement promote project success
Jiang *et al.* (2002)	+	IS staff and customer partnership is critical to success
	+	User and systems staff agreeing on system objectives prior to the start of the project is important
Kaiser and Bostrom (1982)	+	Differences between users and IS team members may be due to the sensing – intuition personality dimension
Kappelman and McLean (1992)	+	UI and UP are distinct and significant factors affecting IS success
Kappelman *et al.* (2006)	+	Multiple UI and UP factors contribute to IS project success
Khang and Moe (2008)	+	UI and UP throughout all phases of a project is significant
Koch and Turk (2011)	+	Agile methodologies improve information sharing and communication
Kraut and Streeter (1995)	+	Formal and informal communication
Lawrence and Low (1993)	+	User representation
	+	Management support
McKeen *et al.* (1994)	+	User influence and user-developer communication directly impact user satisfaction
	+	UP impacts user satisfaction and is moderated by task complexity and system complexity
McKeen and Guimaraes (1997)	+	Identify five "basic core" user activities
Melton and Hartline (2010)	+	UI positively impacts new service development performance
Millerand and Baker (2010)	+	Users and developers adopt multiple roles that evolve through the development life cycle
Peterson and Kim (2003)	+	Cultural standards can impact perceptions of project risk
Pinto and Slevin (1988)	+	Identify 12 measures for project success
Rasmussen *et al.* (2011)	+	Identify three user groups impacting project success
	+	Selecting users based on a representative cross-section of the users may promote systems that satisfy the users' work requirements
	+	Weighting user samples towards user advocates provides better results
	–	User selection schemes emphasizing users with IT knowledge or experience may systematically bias outcomes that fail to satisfy users
Robey and Farrow (1982)	+	Group meetings provide a means to resolve conflicts
Robey *et al.* (1993)	+	UP has moderate positive influence on project success
	+	Conflict resolution has large positive impact on project success
Saleem (1996)	+	Functional experts with the ability to influence the system design significantly benefit both system quality and system acceptance
	+	Standard information systems may have satisfactory user participation at lower levels
Sethi *et al.* (2001)	+	Senior management's monitoring of a new product development project can be a motivating factor for the team
Soja (2006)	+	Team composition and team involvement are significant across the dimensions of enterprise size, scope and time
Song *et al.* (1998)	+	Participation by different user groups have varying levels of influence by project phase
Sridhar *et al.* (2009)	+	UI positively impacts UP and the quality of IS planning efforts
	+	UP positively impacts the perceived quality of IS projects and the effectiveness of the teams

(*continued*)

Table AII.

	Impact	Contribution to the field
Verner *et al.* (2005)	+	A high level of customer involvement is the best predictor of project success
Wang *et al.* (2005)	+	A reduction in user-IS conflict can motivate improved project success
	+	Overall project success can be improved by reducing conflict between project team members
Wang *et al.* (2006)	+	Both management controls and user-IS personnel interaction positively impact project performance
	+	Active management controls positively influence the user-IS personnel interactions
Wang *et al.* (2008)	+	Suggests two types of external roles: consultant and vendor
Wang *et al.* (2011)	+	User advocacy positively impacts project performance
White and Leifer (1986)	+	A range of technical and process skills are perceived as being important to success
	+	The importance of each skill can vary from one phase to another
	+	The tasks in each succeeding project phase became more routine
Whittaker (1999)	+	Senior management involvement is critical to project success
Wu and Marakas (2006)	+	Users with considerable participation in one project phase do not need to have such participation in additional phases to support user satisfaction with the overall project
Yetton *et al.* (2000)	+	UI in all stages of project development increases the chance of project completion

Table AII.

Notes: Impact on project success: +: significant; o- non-supportive; –: contradictory

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