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ORIGINAL ARTICLE

Impacts of collaborative IS on software development project success in Indian software firms: a service perspective

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Abstract The collaborative work of team members has become a common occurrence in software development projects. Collaborative information systems (CIS), designed to facilitate and support teamwork, appear critical for software project success. However, the quality and convenience of the services and functions delivered by CIS have not received robust attention in academia. Hence, the current study investigates the role of the CIS service characteristics of service quality and service convenience in teamwork and software development project success using DeLone and McLean's (D&M) Information System (IS) Success Model as the theoretical framework. This study incorporates the success indicators of teamwork quality, teamwork performance, and project success as measured by software quality and project performance. Data from 153 Indian software companies confirm that collaborative IS services, as well as teamwork quality/performance, are central to software development project success. We believe that the findings of this study will be helpful to project managers of software development firms.

Keywords Collaborative information system (CIS) · Service convenience · Service quality · Software development · Project success · Teamwork

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1 Introduction

Software development is a high growth industry in the near future. Software development projects, in which many specialized teams may collaborate, are highly complex, risky, and unpredictable (Bravo et al. 2013; Na et al. 2004; Robillard and Robillard 2000). This is partly due to the global distribution of developers, which increases the unpredictability of software development (Bosch and Bosch-Sijtsema 2010; Bravo et al. 2013). Thus, many software development projects fail to meet schedules, budgets, and required performance thresholds (Han and Huang 2007). In software development projects, software developers often collaborate using multidisciplinary information from multiple sites in different phases of the project development process (Bagheri and Ghorbani 2009; Bravo et al. 2013). The collaborative information systems (CIS) are information systems (IS) that support the collaboration of participants such as business analysts, architects, project managers, developers, testers, and end-users in fulfilling project requirements. CIS provide developers with powerful environments for working together while enabling users to effectively manage projects, improving project performance (Saeed 2012). They have become critical for software development project success.

In the process of software development, CIS acts as an information service provider, delivering information from different sources to team members. However, information from multiple sources is often neither error-free nor reliable (Bagheri and Ghorbani 2009). The effectiveness of information service characteristics, such as service quality, is thus a critical concern of management (Kettinger and Lee 1994), because it impacts project performance (Bernroider 2008; Lee and Yu 2012; Tsai et al. 2011). Hence, for software development firms, it is necessary to assess the service features delivered by the CIS to ensure software development project success. The effect of service characteristics such as service quality on project success has been discussed in the literature. However, these studies were primarily concerned with service quality and ignored other important service characteristics such as service convenience. Though the concept of service convenience has been explored in marketing (Berry et al. 2002; Seiders et al. 2007), IS (Lai and Wibowo 2012), and e-commerce (Dai et al. 2008; Jiang et al. 2011; Lai 2014), the impact of service characteristics on software project success in collaborative production has been underestimated. Hence, the primary objective of this study is to examine the impacts of CIS service characteristics, i.e., service quality and service convenience, on developer teams and software development project success and to explore how they affect software project development success, in order to provide a more in-depth explanation of the effect of the collaborative environment. From this proposed model and our findings, software makers and future researchers can understand better the role of service characteristics in successful software project development.

2 Literature review

2.1 Indian software industry

The Indian software industry began in the late 1970s (Bhatnagar 2006). The first software exports began with Tata consultancy services, a company that developed inventory control software for an electricity generation unit in Iran (Pandey et al. 2006). With strong government programs in the 1980s, including human resource development and software and technology park programs, the industry took off. Over the ensuing two decades, the software and the IT service industry built a robust infrastructure to support the global requirements of IT businesses. World-class software giants such as GE and IBM opened software centers in India (Bhatnagar 2006; Pandey et al. 2006). For western software companies, developing software in India offered cost advantages and enabled a 24-h software development cycle (Edwards and Sridhar 2003). Today, India's software and IT service export industries are considered one of the most successful IT industries in the world (Chatterjee 2014), with revenues nearing \$120 billion. As a result, Indian software exports registered sustained growth that reached over \$12 billion by 2005, when India's software and IT service industries had matured and become world-class (Bhatnagar 2006). The industry continued to grow at about 30 % annually until 2008, and 14 % annually between 2008 and 2013 (Chatterjee 2014). India's IT and service industries became an outsourcing magnet for foreign investors such as Citigroup and GE. India's domestic software market also began developing rapidly, exceeding \$10 billion by 2013. With a 13 % growth in exports, and 9.5 % growth in the domestic market (NASSCOM 2013), the revenue of the overall Indian software and IT service industries is expected reach \$117 billion in 2014. Today, India's software and IT service export industries are considered one of the most successful IT industries in the world (Chatterjee 2014).

2.2 Collaborative software development

Software development is a multi-stage, iterative, expensive, knowledge-intensive and unpredictable process, where collaborative work patterns are commonly used (Robillard and Robillard 2000; Bagheri and Ghorbani 2009; Nguyen-Duc et al. 2015; Peng et al. 2014). Although there are a number of software development lifecycle (SDLC) models, including the waterfall, spiral, iterative, V, agile, and product line as ongoing projects demand (Highsmith 2013; Ruparelia 2010; Tian and Cooper 2006), they may be categorized into the requirement analysis, design, development/architecture, verification(/implementation), and (release/)maintenance stages (Nguyen-Duc et al. 2015). As shown in Fig. 1, the first phase begins with customer defined specifications followed by a requirement analysis in which the customer's needs are understood and documented. Collaborative team members such as project and product managers, system architects, developers or end-users may be involved. After the requirements are mapped out, detailed specifications are proposed in the design stage through collaboration between project managers,

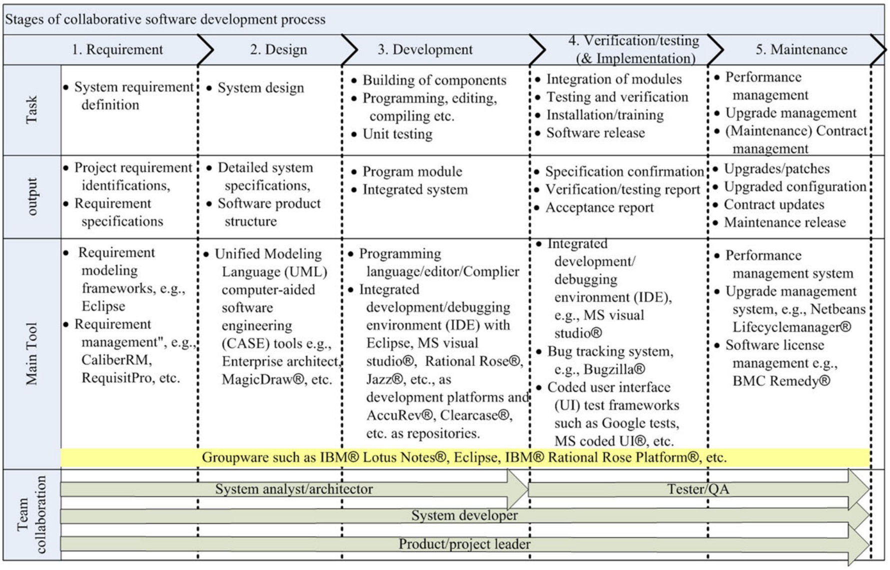

Fig. 1 Stages of collaborative software development process

product managers, system architects, and developers. In the next stage the components required for the software are developed and the actual coding begun. The system architects will separate the system into smaller modules, which can be more easily and collaboratively developed by small coding units (Jalote 2008). Developers, architects, and QA teams are also involved in unit testing. The verification stage includes integration, system testing, verification, and implementation. To perform tasks at this stage, the QA team has to work with the product and project managers and follow the user acceptance tests. After the software is released to its customers, it enters the maintenance stage in which the technical support team must work with other development teams on modifications, bug-fixing, and other changes (Saleh 2009). To support collaboration throughout the software development process, collaborative development tools such as email, forums, text/audio/video chat, wikis, intranets, groupware (Bravo et al. 2013; Saeed 2012), collaborative UML diagrams (Gallardo et al. 2012; Whitehead 2007), and collaborative programming tools such as editors, compilers, and debuggers (Bravo et al. 2013; Gallardo et al. 2012) are required.

2.3 Collaborative information system for software development

A collaborative information system "integrates and co-ordinates information from diverse sources" (El-Bibany et al. 1991). It has been applied in fields such as new product development, crisis management, human–computer interaction, and teamwork. Bafoutsou and Mentzas (2002) provided a functional classification of collaborative services such as project management, document management, and communication, including email, conferencing, chat, and other tools required for e-collaboration. Saeed (2012) explored the value of “collaboration systems” and observed that a collaboration system is an IS that is structured to support project-related activities through services including group email, discussion boards, instant messengers, and wikis, to enable collaboration between developers. Saeed (2012) identified three types of services that support collaborative work: resource management for sharing project related files, co-ordination for communication among team members, and evaluation for monitoring and evaluating project teams.

Because of the broad scope and complexity of software development projects, the supporting tools, and the participants and teams involved at different stages, collaborative project members cannot rely on a single IS. Instead, they generally use a number of information systems for facilitating collaboration in task and job completion. Thus, in this study, a CIS is viewed as a collection of information systems that provide IS services such as project management, resource management, and knowledge management, in support of collaborative completion of tasks in the software development processes (Fig. 2). Services such as project management, engineering management, and requirement management (Portillo-Rodríguez et al. 2012) are generally used by business analysts, system architects and project managers for supporting logistical and requirement aspects of a project. These services are critical in the initial stages of software development. For design and development support (Bravo et al. 2013), testing, QA, and configuration management (Portillo-Rodríguez et al. 2012) are the core services of a software's architecture, modeling, programming, and testing that track the progress of a software product lifecycle. These services are primarily used by project managers, developers, and testers, especially in the design and development stage. Several key support services such as knowledge management (Portillo-Rodríguez et al. 2012) and communication tools and co-ordination support (Saeed 2012) are indispensable for each development stage. They not only support the knowledge management process of creation and diffusion of knowledge but also facilitate communication between team members. These services are frequently used by project team

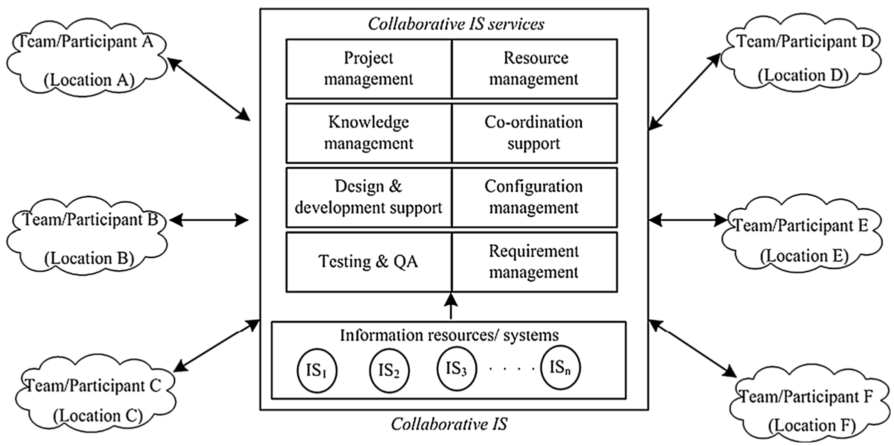

Fig. 2 A collaborative information system and services for software teamwork

members on a daily basis. Furthermore, CIS offer miscellaneous services such as resource management services (Saeed 2012) for managing and sharing files and documents. These services are also used in every stage by most project members. CIS services thus support development teams in each stage and profoundly affect project success.

2.4 Service quality and service convenience

Parasuraman et al. (1988) defined service quality as “the extent of the difference between customer expectation of the service and the real affection after being served”. Researchers have developed instruments such as SERVQUAL (Parasuraman et al. 1988) and SERVPERF (Cronin Jr and Taylor 1992) to measure service quality using five major dimensions: tangible, reliability, responsiveness, assurance, and empathy. The SERVQUAL instrument has been widely adopted with appropriate modifications by IS, e-commerce, and m-commerce studies (Gorla et al. 2010; Jiang et al. 2002; Lee and Park 2013; Papaioannou et al. 2015). The concept of the internal customer emerged in the mid-1980s. It suggests that employees can be viewed as internal customers and higher level internal service quality will lead to greater job satisfaction and business performance (Pantouvakis 2011). Although researchers debate whether an additional instrument for measuring internal service quality is necessary, in many cases, researchers acknowledge that SERVQUAL with appropriate modifications is useful for measuring internal service quality (Edvardsson et al. 1997; Kang et al. 2002). Hence, this study adopts SERVQUAL for measuring employee perceptions of (internal) service quality.

Another stream of the literature relevant to service characteristics proposes a concept called *service convenience,* proposed and conceptualized by Berry et al. (2002) and later be operationalized and measured by the SERVCON instrument using decision, access, transaction, benefit, and post-benefit convenience (Seiders et al. 2007). Researchers have extended service convenience and SERVCON to e-commerce and IS, usually measuring it in terms of perceived time, effort expenditure, and psychological cost (Dai et al. 2008; Jiang et al. 2011; Lai and Wibowo 2012; Lai 2014). However, to avoid model complexities due to the higher-order, multi-dimensionality of a construct or to suit research goals, some researchers employ service convenience as a generalized first-order construct in their research (Reimers et al. 2014; Zhang and Prybutok 2005). While this study integrates constructs from IS and project management literature for investigating CIS success as a research goal, consistent with Reimers et al. (2014) and Zhang and Prybutok (2005), this study adopts service convenience as a generalized first-order construct.

In the software development process, knowledgeable IS employees and CIS services that are prompt (responsiveness), accurate (reliability), offer individualized attention (empathy), and induce trust and confidence (assurance) in team members, can likely influence software development because better quality CIS services can support robust communication between team members. Service convenience has thus become an important factor in software development since it is a time-consuming and effort-intensive process. Access convenience can mainly be seen as availability and accessibility of the various CIS services. Benefits convenience mainly concerns time and efforts required for finding required information using CIS while post-benefit convenience is referred as the time and effort required for reporting and resolving team member complaints on the CIS. The (internal) service quality and service convenience of IS services as a whole is crucial for software development performance and success.

3 Research framework and hypotheses formulation

3.1 Software project success model

Evaluation of IS success has been a key research area for MIS researchers (DeLone and McLean 1992; Lee and Yu 2012; Pitt et al. 1995; Seddon 1997). The original D&M Model (1992) consisted of six success constructs: information quality, system quality, use, user satisfaction, individual impact, and organizational impact. However, the increasingly important role of service quality in the IS and e-commerce contexts and debates about variance and causal models led DeLone and McLean (2003) to propose an updated D&M model in which 'service quality' was included as an additional construct. In the revised model, individual benefits and organizational benefits were replaced by a separate variable, 'net benefits' and the 'use' construct was replaced by 'intention to use' and formulated as an attitude rather than a behavioral outcome. The D&M IS Success Models have been used in the literature on project management success (Lee and Yu 2012; Raymond and Bergeron 2008). Lee and Yu (2012) developed a success model of Project Management Information System (PMIS) in the construction industry. Raymond and Bergeron (2008) studied the impact of PMIS on project managers and project success. Tsai et al. (2011) conducted an empirical study of the project success of ERP. Caniëls and Bakens (2012) studied the effects of PMIS on decision making in a multi-project environment. Bernroider (2008) studied the role of IT governance in driving ERP project success. Table 1 summarizes the critical features of studies that have re-specified the D&M model in project management.

Table 1 Studies using the re-specified D&M model in project management

Technical/service variables	Semantic variables	Effectiveness variables	References
System quality, information quality, service quality	Intention to use, user satisfaction	Impact of efficient, and effective construction management	Lee and Yu (2012)
System quality, information quality	Use	Impacts on project success, impacts on project manager	Raymond and Bergeron (2008)
Information quality	Use, user satisfaction	Quality of decision making	Caniëls and Bakens (2012)
Service quality	The achievement level of PM	Degree of improvement	Tsai et al. (2011)

Given the importance of the research context, project management researchers have extended the IS Success Model by incorporating contextual success indicators. The present study examines the impact of the service characteristics of service quality and service convenience, on teams and software development project success. Since software development is a highly collaborative process (Robillard and Robillard 2000), in which teamwork is indispensable (Moe et al. 2010), semantic variables were developed from the perspective of development teams. Team dynamics is a key indicator of software project success (Pedrycz et al. 2011) and teamwork quality and performance are vital success measures of team dynamics. They can also be viewed as the general perceptual measures of software project success. Following (Subramanian et al. 2007), we define software project success as both software quality and project performance, and frame it as a second-order construct (Fig. 3).

3.2 CIS services and teamwork

A team can be defined as "a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable" (Katzenbach and Smith 1993). The technological revolution increased competitive pressures in globalization, as outsourcing, shorter product lifecycles, and scarce human resources have caused formation of teams that can work together from different locations and time zones to overcome resource limitations and increase project performance (Durham 2007). Consequently, distributed team structures are commonly used in many work environments, especially in software development (Nguyen-Duc et al. 2015). A distributed or virtual team has been defined as "groups of geographically, organizationally and/or time dispersed workers brought together by information and telecommunication technologies to accomplish one or more organizational task" (Powell et al. 2004), and their impact on team and project performance has been explored (Espinosa et al. 2007; Nguyen-Duc et al. 2015).

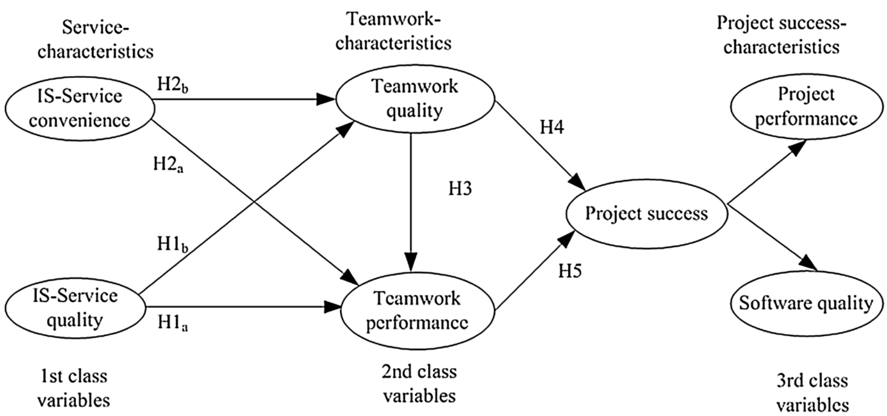

Fig. 3 Research framework

Virtual or distributed teams stretch organizational boundaries by involving team members from various countries, languages, and cultures, and time zones (Kossler and Prestridge 2004). The degree of team dispersion is typically measured in terms of space, time, and culture (Fisher and Fisher 2000). Since virtual teams are temporary in nature, team members are likely to have weak or non-existent social ties and knowledge of each others' work styles (Steinfield 2002). Research also indicates that distributed teams are not only heterogeneous but also less efficient in communication due to the temporal, socio-technical, and geographical distance between team members, lack of awareness of other team members' expertise, and responsibilities, and incompatibilities in business practices, informal work habits, and corporate culture (Herbsleb 2007).

Whether the team structure is face-to-face, collocated, or distributed, team members must rely on the CIS when working on a software development project. Therefore, the scope and settings of this study do not capture attributes of a particular team structure such as a distributed team. Hence, to avoid biases arising from the use of temporary teams created specifically for laboratory experiments (Easley et al. 2003) and to better fit the scope and the research objective, the generic term 'team' was adopted in this work. It refers to a managed group of human resources that are working together to complete shared tasks in the software development process and which may or may not be located in different locations, from different floors of a building to different cities.

Teamwork is considered an important success factors when using collaborative technology (Easley et al. 2003), particularly for software development, where a distributed work structure is common (Moe et al. 2010). Software developers, while working in a team, are required to share knowledge, responsibilities, and risks (Pedrycz et al. 2011; Robillard and Robillard 2000) and rely on the CIS to support teamwork. Given that software development projects have uncertain requirements and put time and schedule pressure on developers, CIS services are vital. Higher levels of service quality and service convenience are likely to impact teamwork performance and teamwork quality. Thus:

H1$_a$ The service quality is positively related to the software development team performance.

H1$_b$ The service quality is positively related to the software development team quality.

H2$_a$ The service convenience is positively related to the software development team performance.

H2$_b$ The service convenience is positively related to the software development team quality.

3.3 Teamwork and project success

According to the literature, teamwork quality is a predictor of teamwork performance (Easley et al. 2003; Hoegl and Proserpio 2004; Liu et al. 2010).

Teamwork quality is typically quantified by task-related interactions such as communication and co-ordination, as well as social interactions such as mutual support and cohesion among team members (Easley et al. 2003; Hoegl and Parboteeah 2006, 2007). In high-quality teamwork, the team members are likely to perform unanimous communication, coordinate individual activities with teamwork activities, contribute and share relevant information and knowledge, set high effort norms, provide mutual support for team and individual work, and foster team cohesion (Hoegl and Parboteeah 2006). Teamwork quality also influences the team members' domain-related skills that are crucial when projects are unpredictable, a common problem in software development (Hoegl and Proserpio 2004; Hoegl and Parboteeah 2007; Moe et al. 2010; Saeed 2012). Better teamwork quality enhances team members' understanding and evaluation of problems, brainstorming, and solution development (Hoegl and Parboteeah 2007). It also improves their understanding of the norms and values held by the team as a social unit (Hoegl and Proserpio 2004). Using the CIS, team members are expected to communicate openly, coordinate individual activities, infuse the project with knowledge, provide mutual support in discussions and for individual tasks, and foster cohesion, which is likely to boost teamwork performance.

H3 The teamwork quality of software development team using CIS is positively related to teamwork performance.

As seen in the previous literature (Subramanian et al. 2007) this study also considers software project success in terms of two second-order constructs, project performance and software quality. A common practice among researchers is to define project performance in terms of the project's ability to meet project goals, usually adherence to time and adherence to schedule. Software quality is generally measured in terms of functionality, reliability, maintainability, usability, and performance of the software (Kannabiran and Sankaran 2011). Research in project management as well as in software shows that teamwork influences project success (Hoegl and Proserpio 2004; Moe et al. 2010). The CIS aids teamwork processes by fostering effective communication through tools such as discussion forums, instant messaging, and the project calendar, which supports the collaboration needs of the team and tasks related to the project (Saeed 2012). Team members often experience challenges from uncertain project requirements along with time and schedule pressure (Li et al. 2010) which may complicate decision-making. Further, the nature of software development projects is highly innovative, and complexity thus creates interdependencies among team members (Strode et al. 2012). With the help of CIS, teamwork becomes more efficient and affects project success. Thus, we hypothesize:

H4 Teamwork-quality is positively related to software project success.

H5 Teamwork-performance is positively related to software project success.

4 Methodology

This study addresses the issue of software project success using CIS. The variables used in this study refer to IS and project management disciplines and measurement scales were developed from the literature. In this study, service quality is described in terms of responsiveness, reliability, empathy, and assurance, typical measures in the literature (Jiang et al. 2002). Following Zhang and Prybutok (2005) and Reimers et al. (2014) service convenience is presented as a first-order construct. However, we framed the service convenience construct by looking at its various convenience facets, such as access, search, benefit, and post-benefit convenience, as discussed by Seiders et al. (2007). This study operationalizes teamwork using teamwork quality and teamwork performance based on the literature (Easley et al. 2003; Hoegl and Parboteeah 2007; Hoegl and Proserpio 2004). Here, teamwork quality is composed of several teamwork characteristics such as communication, coordination, mutual support, and cohesion among the team members, while teamwork performance is defined in terms of productivity, efficiency, and overall performance in the software development environment. An item pool was developed from the literature. The items were then screened with the help of expert scholars in Taiwan, as well as professional experts working in the Indian software development area. The items were modified after their feedback, and a pilot test was conducted to determine whether the questions were readable, clear, and easy to understand by respondents. The questionnaire was modified based on comments from the pilot study and re-checked with the help of the experts in Taiwan. The final questionnaire comprised 25 items. Table 2 indicates the measures adopted and their sources. Since the data was collected from Indian software companies, the questionnaire was administered in English, which is one of the official languages of India.

The printed questionnaire was distributed to experienced software developers such as quality assurance engineers, architects, operational managers, and systems engineers in India. This study adopts a questionnaire survey approach and employs a 5 point Likert scale with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree for data collection. We distributed 450 questionnaires and received 174. After screening these questionnaires, only 153 were found valid. Table 3 shows the demographic details of the respondents.

5 Data analysis

This study employs a partial least squares (PLS) approach to examining the proposed hypothesized relationships. It is considered superior to a covariance-based approach, such as LISREL because of its flexibility in handling distributional assumptions, its excellent capability with small samples, and its strength in complex predictive models (Chin 1998; Henseler et al. 2009). Since PLS supports both confirmatory and exploratory type of research (Hair Jr et al. 2014), it is viewed as a suitable approach for assessing theories in the early stages of development (Lee and Choi 2011). Well known PLS software tools include PLS-graph, SmartPLS, and

Table 2 Scales used in this study

Construct/item description		Loading	t value
Service quality (IS-SQ) (CR = 0.91; AVE = 0.71) (Jiang et al. 2002)			
IS-SQ1	The IT people give prompt support/services when I have problems on CIS	0.82	24.67
IS-SQ2	The CIS allows secure access to software development data	0.85	24.95
IS-SQ3	The IT people understand particular needs of the users of CIS	0.88	34.99
IS-SQ4	The IT department provides upgraded software and hardware to support CIS	0.83	15.69
Service convenience (IS-SCON) (CR = 0.88; AVE = 0.55) (Seiders et al. 2007)			
IS-SCON1	The information across all CIS is possible to access	0.72	09.26
IS-SCON2	Any information/tools on CIS can be accessed anytime, whenever I need	0.73	10.33
IS-SCON3	The CIS is well-organized	0.72	09.86
IS-SCON4	Formulation of search queries on CIS is simple	0.72	08.67
IS-SCON5	The information retrieval using CIS is fast	0.80	10.51
IS-SCON6	On CIS, my complaints are quickly resolved	0.76	10.14
Teamwork quality (TQ) (CR = 0. 91; AVE = 0.71) (Hoegl and Parboteeah 2007; Hoegl and Proserpio 2004)			
TQ1	The CIS improves communication among team members	0.84	25.78
TQ2	The CIS improves coordination among team members	0.84	23.53
TQ3	The CIS improves mutual support among team members	0.86	35.75
TQ4	The CIS improves cohesion among team members	0.84	28.68
Teamwork performance (TP) (CR = 0. 87; AVE = 0.69) (Hoegl and Parboteeah 2007)			
TP1	The CIS enhances the productivity of team members	0.78	14.14
TP2	The CIS enhances the efficiency of the team members	0.88	38.13
TP3	The CIS improves overall teamwork performance in a distributed development environment	0.83	27.30
Project performance (PP) (CR = 0. 92; AVE = 0.80) (Subramanian et al. 2007)			
PP1	The CIS allows us better to achieve the project goal	0.82	20.09
PP2	The CIS allows us better to complete the project on time	0.92	50.05
PP3	The CIS allows us better to control project costs within the budget	0.94	77.76
Software quality (SO) (CR = 0. 88; AVE = 0.61) (Kannabiran and Sankaran 2011)			
SO1	The software we developed can fulfill functional requirements	0.79	15.14
SO2	The developed software products showed a high level of stability under different load and test conditions	0.68	09.51
SO3	The developed software was highly modular, extensible and easy to fix (e.g., add new artifact types, modify server-based process workflows, or add new security rules)	0.84	19.21
SO4	The software we developed is usable and has a high pass rate of user acceptance tests	0.74	11.82
SO5	Response time of the software we developed is good and meets user expectations	0.83	15.81

Table 3 Respondent demographics

Variables	Categories	Frequency	Percentage
Gender	Male	101	66
Age	Female	52	34
Education	<30	72	47
Software development experience	>30	81	53
	Undergrad	92	60
	Master	61	40
	<2	25	16
	<5	51	33
	<10	51	33
	>10	26	18
Project duration	<2 years	60	39
	2–5 years	58	38
	5–10 years	29	19
	>10 years	6	4
No. of employees	<50	2	1
	<100	12	8
	<200	24	16
	<500	38	25
	>500	77	50
Team size	<15	74	48
	<25	43	28
	<50	20	13
	>50	16	11

Visual PLS. We opted for the SmartPLS 2.0.M3 for the data and structural path analysis because of its popularity in the IS field (Peng and Lai 2012). The literature stipulates that the minimum sample size for PLS should be larger than either 10 times the number of items of the most complex construct/formative construct or 10 times the largest number of structural paths directed at a particular construct in the inner path model (Henseler et al. 2009). In the proposed research model, the most complex construct has 6 items (IS-SCON) and the largest numbers of structural paths directed at a particular variable were 3 (TP). Thus our sample size of 153 surpasses the minimally required sample of 60 and 30 and is considered satisfactory. The data was analyzed in two steps: confirmatory factor analysis (CFA) and structural modeling.

The purpose of the CFA is to assess the measurement model by testing the reliability and validity of the constructs. All constructs used in this study are reflective of type. Therefore, psychometric properties were assessed via the factor loading of the scales, composite reliability, average variance extracted (AVE) and square root of AVE for their reliability and validity (Peng and Lai 2012). This study omits the multi-collinearity test and the nomological validity test as these tests are typically conducted for assessing formative constructs (Hair Jr et al. 2013; Peng and Lai 2012) which are not part of our study. Convergent validity can be confirmed by testing item loadings, composite reliability, and AVE. "Loading factors should be at least than 0.5, and ideally 0.7 or higher… (Hair et al. 2006)". As seen in Table 2, a factor loading of 0.6 (SQ5) shows a mediocre level and a factor loading of 0.68 (SO2) indicates a good level. Factor loadings above 0.7 lead to variance explained by over 50 % (Hair et al. 2006), and above 0.63 lead to variance explained by over 40 %, which are both high (Comry and Lee 1992). This study is consistent with these empirical studies that recommend (Comry and Lee 1992; Hair et al. 2006) and use (Agarwal and Prasad 1998) 0.63 as a cut-off threshold factor loading. It is, however, important to note that 24 of 25 scales used in this study loaded over 0.70 while only one item (SO2) loaded at 0.68. Since the remaining four items of the SO construct loaded at more than 0.74, the factor loading of SO2 (0.68), which is slightly less than the recommended threshold of 0.7 (Hair Jr et al. 2014), is unlikely to affect its validity and reliability. The loading and t-values of the scales were significant at the level of 0.001, as listed in Table 5. Composite reliability (CR) and AVE corresponding to each construct surpassed the thresholds of 0.7 and 0.5 as recommended by Hair et al. (2006). According to Table 4, the square root of AVE was found to be higher than the inter-construct co-relations, which confirms the discriminant validity criterion defined by Fornell and Larcker (1981).

To test the structural relationships, this study uses the PLS approach with a bootstrap re-sampling frequency of 300 to determine the path significance of the causal relationships. Figure 4 shows the standardized path coefficients and the R-square values of the hypothesized relationships. The results were found to be consistent when the bootstrap was run at re-sampling frequencies of 600 and 900. It is clear that all the proposed hypotheses except $H2_b$ are supported (see Table 5 as well). Moreover, The structural model quality was assessed in terms of R^2 (coefficient of determination), Q^2 (cross-validated redundancy), and f^2 (effect size) (Hair Jr et al. 2014; Peng and Lai 2012). Several researchers, for example, Tenenhaus et al. (2005) have recommended a fitness index for goodness of fit (GoF) for PLS based models. However, its usefulness has been challenged empirically as well as conceptually. Hence, we followed the recommendation of Hair Jr et al. (2014) and did not use GoF in this study.

Table 4 Correlations among constructs

Construct	$\sqrt{AVE}$	1	2	3	4	5	6
1. IS-SQ	0.84	1					
2. IS-SSCON	0.74	0.17	1				
3. TQ	0.84	0.39	0.18	1			
4. TP	0.83	0.43	0.27	0.38	1		
5. PP	0.89	0.52	0.19	0.37	0.52	1	
6. SO	0.78	0.30	0.41	0.15	0.17	0.14	1

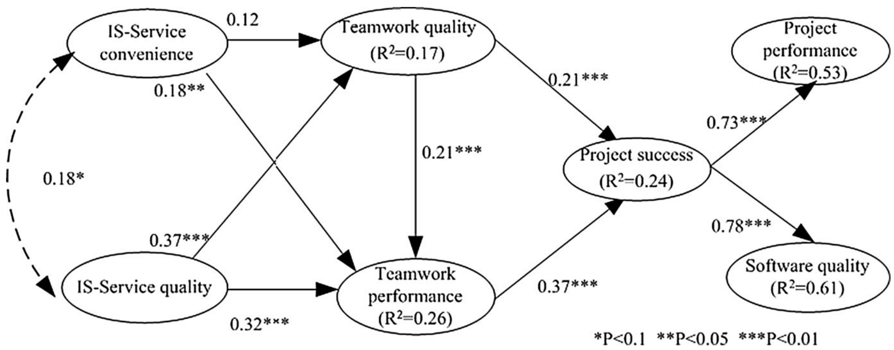

Fig. 4 Model testing results

T-statistics, 95 % confidence intervals, and corresponding significance levels for all structural paths are presented in Table 6. The R^2 values of all endogenous constructs, TP, TQ, and PS, are small at 26, 17, and 24 %, respectively. Since there are two exogenous constructs, IS-SQ and IS-SCON, predicting two endogenous constructs, TP and TQ, Cohen's f^2 (1998) indicator was used as a measure of their relative effect sizes for the path models. The f^2 for each particular path was calculated as $f^2 = (R^2_{\text{included}} - R^{2)}_{\text{excluded}}/(1 - R^2_{\text{included}})$, where R^2_{included} is the R^2 of that particular endogenous construct in the full model and R^2_{excluded} is the R^2 of the same endogenous construct after elimination of the given exogenous construct (Cohen 1988; Hair Jr et al. 2014). The size effects of most of the paths are small but acceptable, which indicates that the corresponding exogenous constructs weakly contribute to explaining the relevant endogenous constructs. However, the f^2 value for the path IS-CON–TQ was 0.004, reflecting that IS-Service convenience does not meaningfully affect TQ. Stone–Geisser's Q^2 is typically used to assess the predictive relevance of structural models (Hair Jr et al. 2014; Peng and Lai 2012). Using the SmartPLS blindfold function, with a recommended omission distance of 7 (Hair Jr et al. 2013), Stone–Geisser's Q^2 for each endogenous construct was calculated and found to be positive. Positive Q^2 values confirm the structural model's predictive relevance (Hair Jr et al. 2014).

6 Results and discussion

This study examines the impact of CIS service characteristics on software development teams and software project success. The results of this study indicate that service quality is the most important service characteristic influencing teamwork quality and teamwork performance. Service convenience has a weaker (but still meaningful) impact on teamwork performance than service quality while its impact on teamwork quality was not significant. Further, teamwork quality has a significant effect on teamwork performance. Teamwork performance has a stronger influence on software project success than teamwork quality though both of these teamwork characteristics have significant impacts on software project success.

Table 5 Path relation results

Path	Coefficient	T value	95 % CI	f^2	Sig.
1. IS-SQ–TP	0.32	4.24	(0.3172, 0.3428)	0.07	***
2. IS-SQ–TQ	0.37	5.46	(0.2778, 0.3021)	0.03	***
3. IS-SCON–TP	0.18	2.21	(0.1675, 0.1925)	0.03	**
4. IS-SCON–TQ	0.12	1.28	(−0.1198, 0.1502)	0.00	–
4. TP–TQ	0.21	2.76	(0.1883, 0.2117)	–	***
5. TP–PS	0.37	3.73	(0.3408, 0.3792)	–	***
6. TQ–PS	0.21	2.86	(0.1972, 0.2228)	–	***

CI confidence interval, *Sig* significance level

Table 6 R^2 and Q^2 coefficients

Construct	R^2	Q^2
1. IS-SQ	–	–
2. IS-SCON	–	–
3. TP	0.26	0.18
4. TQ	0.17	0.12
5. PS	0.24	0.08
6. SO	0.61	–
7. PP	0.53	–

Software quality is found to be a stronger contributor to software project success than project performance. Overall, service quality and service convenience are shown to be significant predictors of teamwork and project success.

This study finds that both service quality and service convenience significantly support collaborative work. Service quality was found to have significant impacts on teamwork quality and teamwork performance. Service convenience being a meaningful predictor of teamwork performance indicates its importance in the collaborative environment. Service quality determines the performance of the services from a developer's perspective while service convenience reflects a developer's perception of time and effort spent when interacting with the CIS. According to this study, service quality has a much stronger influence on teamwork quality and performance than service convenience, which indicates that developers designate more value to the performance of the services than their time and cost expenditure. In addition, this study determines a significant correlation between service convenience and service quality, which is consistent with previous marketing research (Chang et al. 2013). The significant correlation between service convenience and service quality shows that developers tend to use the time and effort they expend to judge service quality. In other words, developers use the 'convenience' lens to determine 'quality' of the services, which means that their perception of the service quality depends on the service convenience experienced by the developer.

This study finds that teamwork quality contributes to the teamwork performance of the software development team, partly consistent with the literature (Hoegl and

Parboteeah 2007). This study also finds that teamwork quality partially mediates service quality and teamwork performance. This demonstrates that CIS service characteristics aid team members by boosting task-related and social interactions among the team members, which in turn influences teamwork performance. Teamwork quality being a key construct highlights the importance of the task-related and social factors among team members. The CIS provide platforms for enhancing teamwork quality, which not only enables them to communicate and coordinate, but also develops them as a social unit. As a result, team members improve their task efficiency and productivity, enhancing the overall performance of the team. Finally, this study recognizes that both teamwork quality and performance drive software project success, which is defined in this study as project performance and software quality. The CIS helps software developers to complete projects on time and within budget, while achieving the expected goals, as the literature demonstrates. We also find that all dimensions of software quality, functionality, reliability, maintainability, usability, and performance, are high contributors to software project success. Because software development projects fail primarily due to the inability of the team members to understand other team members' needs for support, teamwork characteristics are vitally important.

7 Conclusions

The purpose of this study was to determine the effect of CIS service characteristics on teamwork characteristics and software development project success from a software developer's perspective at the intra-organizational level. In this study we attempt to portray the linkage between the CIS service characteristics in terms of service quality, and service convenience, teamwork characteristics in terms of teamwork performance and teamwork quality, and project success in terms of project performance and software quality based on the IS Success Model. The present study developed its theoretical framework on the basis of D&M IS success. A questionnaire survey was administered to collect data from Indian software companies, which was analyzed by the PLS structural modeling technique. The results of this study show that CIS services and teamwork are significant components of project success.

This study makes the following contributions. First, this study explores the role of CIS in collaborative software development projects. Second, it also determines the effect of the service characteristics of service quality and service convenience, on CIS success defined as teamwork quality and teamwork performance. Third, this study combines insights from several research disciplines, including IS, and software project management, thus expanding the boundaries of the literature. Since this present study attempts to investigate the impact of service convenience on CIS success and project success in a collaborative context, we believe it to be a pioneering research effort in the IS field. We hope that this study can help managers of software development firms determine the strengths and weaknesses of their existing IS, and improve collaborative work performance, software development performance, and project performance.

7.1 Managerial implications

Managers are responsible for drafting service specifications for the programmers and for assessing of CIS services to enhance teamwork efficiency. They should understand that service delivery is crucial in collaborative environments and for project success. Similar arguments have received extensive attention in service and marketing research, which not only recognizes customer satisfaction as a key predictor of customer behaviors (Doll and Torkzadeh 1991) but also offers robust strategic frameworks such as the 'System to value chain' (Doll and Torkzadeh 1991) and 'Service-Profit Chain' (Heskett et al. 1994) for improving customer satisfaction. System to Value chain establishes relationship between system attributes, end-user's beliefs and attitudes in using the system, and net benefits to ultimate customers (Doll and Torkzadeh 1991). The Service-Profit Chain fundamentally determines the linkages between internal service quality attributes like workplace design, and culture, and employee satisfaction, loyalty, and productivity, and customer loyalty and profitability (Heskett et al. 1994). While CIS are indispensable for software development and central to employee and customer satisfaction, firms should recognize CIS as an essential resources for strategy formulation.

Figure 5 shows CIS service to value chain and indicates that CIS services directly influence internal customers (employees) and in turn external customers. For the Service-Profit Chain and System to Value Chain, the more value employees perceive in using the CIS, the more value they can deliver to the external customers. In other words, services are converted to internal value and then to external value. Therefore, CIS is strategically aligned with internal and external customers. IT managers should thus make sure that employee value perceptions of CIS are high. Service characteristics such as service quality and service convenience are vital because employees will perceive a higher value when CIS services are quick, reliable, and secure, resolve their specific needs, and save time and efforts. Given the importance of service characteristics in collaborative environments, the presence of sound service architecture is indispensable for improvement in service design and the selection of better tools. Furthermore, managers must establish and sustain a sound service-oriented culture to enhance employee value perception. Employees may have little knowledge about the effects of tradeoffs between various services, tools, methods, and practices on CIS and their applicability. Therefore, the IT

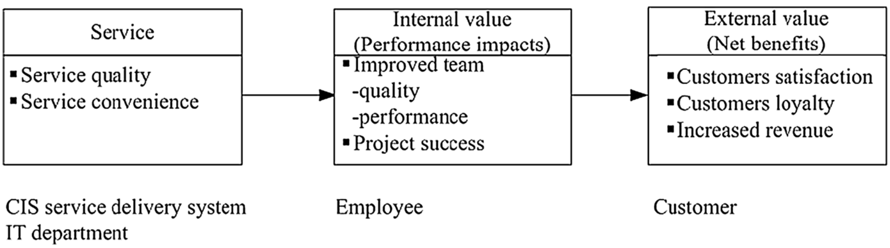

Fig. 5 CIS service to value chain

department should train and promote efficient practices in order to improve employee job performance, teamwork efficiency, and project requirements.

7.2 Limitations and future research

This study has a few limitations. First, because of resource limitations, the collaborative information system context empirically investigated in the Indian firms did not have identical settings with the same IS infrastructure, development tools, or collaborative platforms at the different firms. However, as mentioned earlier, the fundamental services such as project management and resource management used in a software development environment are common to any CIS. Thus, we suggest that future studies should generalize our findings with caution. Further, this study employs a convenient sampling approach and has a valid sample size of (N = 153), which is adequate but could be much larger. Second, the respondents of the questionnaire were software engineers in India. The existence of data bias is likely due to cultural norms and business practices. Research shows that project success factors vary in different cultures (Pereira et al. 2008). Hence, researchers should conduct similar studies in different countries and cultures. Third, this is conducted from a software developer's perspective at the intra-organizational level and does not offer customer perspectives on project success. Hence, future research should focus on the inter-organizational level. Fourth, this study does not explore the impacts of team size or a specific type of team such as face-to-face, collocated, or distributed on team performance when using CIS. Therefore, future research should explore CIS effects on specific team types and compare the effects of CIS across different team types and sizes. Future research should also explore the impacts of different team types and sizes on project performance. Fifth, this study has operationalized its service convenience construct using access, search, benefit, and post-benefit convenience. Future research should consider other convenience features such as security and privacy. Sixth, it also possible for future research to explore the individual impacts of CIS on internal value variables such as employee job satisfaction and job usefulness. Finally, a possible limitation of this study is that the framework used in this study contains only six project success measures. Given that the CIS makes significant contributions to project success, researchers should identify and test new success measures.

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References

Agarwal R, Prasad J (1998) A conceptual and operational definition of personal innovativeness in the domain of information technology. Inf Syst Res 9(2):204–215

Bafoutsou G, Mentzas G (2002) Review and functional classification of collaborative systems. Int J Inf Manage 22(4):281–305

Bagheri E, Ghorbani AA (2009) A belief-theoretic framework for the collaborative development and integration of para-consistent conceptual models. J Syst Softw 82(4):707–729

Bernroider EWN (2008) IT governance for enterprise resource planning supported by the DeLone–McLean model of information systems success. Inf Manag 45(5):257–269

Berry LL, Seiders K, Grewal D (2002) Understanding service convenience. J Mark 66(3):1–17

Bhatnagar S (2006) India's software industry. In: Chandra V (ed) Technology, adaptation, and exports: how some developing countries got it right. The World Bank, Washington, DC, pp 49–81

Bosch J, Bosch-Sijtsema P (2010) From integration to composition: on the impact of software product lines, global development and ecosystems. J Syst Softw 83(1):67–76

Bravo C, Duque R, Gallardo J (2013) A groupware system to support collaborative programming: design and experiences. J Syst Softw 86:7

Caniëls MC, Bakens RJ (2012) The effects of Project Management Information Systems on decision making in a multi project environment. Int J Project Manag 30(2):162–175

Chang M-Y, Chen K, Pang C, Chen C-M, Yen DC (2013) A study on the effects of service convenience and service quality on maintenance revisit intentions. Comput Stand Interfaces 35(2):187–194

Chatterjee C (2014) Innovation and internationalisation in the Indian software industry: Wipro-Going forward: interview with Rishad Premji, Chief Strategy Officer, Wipro Limited. IIMB Manag Rev 26(1):59–64

Chin WW (1998) The partial least squares approach to structural equation modeling. Mod Methods Bus Res 295(2):295–336

Cohen J (1988) Statistical power analysis for the behavioral sciences, 2nd edn. Lawrence Erlbaum, Hillside

Comry AL, Lee HB (1992) A first course in factor analysis. Lawrence Erlbaum Associates, Hillsdale

Cronin Jr JJ, Taylor SA (1992) Measuring service quality: a reexamination and extension. J Mark 56(3):55–68

Dai H, Salam AF, King R (2008) Service convenience and relational exchange in electronic mediated environment: an empirical investigation. Paper presented at the 29th ICIS, Paris, France, 14–17 Dec 2008, AISeL, pp 1–20

DeLone WH, McLean ER (1992) Information systems success: the quest for the dependent variable. Inf Syst Res 3(1):60–95

DeLone WH, McLean WR (2003) The DeLone and McLean model of information systems success: a ten-year update. J Manag Inf Syst 19(4):9–30

Doll WJ, Torkzadeh G (1991) The measurement of end-user computing satisfaction: theoretical and methodological issues. MIS Q 15(1):5–10

Durham M (2007) Distributed teams. http://www.spspro.com/brochures/guest/Distributed%20Teams%20070615%20-%20Michelle%20Durham.pdf. Accessed 24 Mar 2015

Easley RF, Devaraj S, Crant JM (2003) Relating collaborative technology use to teamwork quality and performance: an empirical analysis. J Manag Inf Syst 19(4):247–268

Edvardsson B, Larsson G, Setterlind S (1997) Internal service quality and the psychological work environment: an empirical analysis of conceptual interrelatedness. Serv Ind J 17(2):252–263

Edwards HK, Sridhar V (2003) Analysis of the effectiveness of global virtual teams in software engineering projects. System Sciences, 2003. In: Proceedings of the 36th Annual Hawaii international conference on. IEEE, 9 pp

El-Bibany H, Katz G, Vij S (1991) Collaborative information systems: a comparison of the electronics and facility design industries. Center for Integrated Facility Engineering, Technical Report # 48:1–15

Espinosa JA, Slaughter SA, Kraut RE, Herbsleb JD (2007) Familiarity, complexity, and team performance in geographically distributed software development. Organ Sci 18(4):613–630

Fisher K, Fisher M (2000) The distance manager: a hands on guide to managing off-site employees and virtual teams. Mcgraw-Hill, NY

Fornell C, Larcker DF (1981) Evaluating structural equation models with unobservable variables and measurement error. J Mark Res 18(1):39–50

Gallardo J, Bravo C, Redondo MA (2012) A model-driven development method for collaborative modeling tools. J Netw Comput Appl 35(3):1086–1105

Gorla N, Somers TM, Wong B (2010) Organizational impact of system quality, information quality, and service quality. J Strateg Inf Syst 19(3):207–228

Hair JE, Black WC, Babin BC, Anderson RL (2006) Multivariate data analysis, 6th edn. Prentice-Hall, Upper Saddle River

Hair JF Jr, Hult GTM, Ringle C, Sarstedt M (2013) A primer on partial least squares structural equation modeling (PLS-SEM). Sage, Thousand Oaks

Hair JF Jr, Sarstedt M, Hopkins L, Kuppelwieser VG (2014) Partial least squares structural equation modeling (PLS-SEM): an emerging tool in business research. Eur Bus Rev 26(2):106–121

Han W-M, Huang S-J (2007) An empirical analysis of risk components and performance on software projects. J Syst Softw 80(1):42–50

Henseler J, Ringle CM, Sinkovics RR (2009) The use of partial least squares path modeling in international marketing. Adv Int Mark 20:277–319

Herbsleb JD (2007) Global software engineering: the future of socio-technical coordination. In: Future of software engineering, Minneapolis, MN, 23–25 May 2007. IEEE Computer Society, pp 188–198

Heskett JL, Jonesw OT, Lovemen WG, Sasser E, Leonard AS (1994) Putting the service-profit chain to work. Harv Bus Rev 72(2):164–174

Highsmith J (2013) Adaptive software development: a collaborative approach to managing complex systems. Addison-Wesley, Boston

Hoegl M, Parboteeah P (2006) Autonomy and teamwork in innovative projects. Hum Resour Manag 45(1):67–79

Hoegl M, Parboteeah KP (2007) Creativity in innovative projects: how teamwork matters. J Eng Tech Manag 24(1):148–166

Hoegl M, Proserpio L (2004) Team member proximity and teamwork in innovative projects. Res Policy 33(8):1153–1165

Jalote P (2008) A concise introduction to software engineering. Springer, New York

Jiang JJ, Klein G, Carr CL (2002) Measuring information system service quality: SERVQUAL from the other side. MIS Q 26(2):145–166

Jiang L, Jiang N, Liu S (2011) Consumer perceptions of e-service convenience: an exploratory study. Procedia Environ Sci 11:406–410

Kang G, Jame J, Alexandris K (2002) Measurement of internal service quality: application of the SERVQUAL battery to internal service quality. Manag Serv Qual 12(5):278–291

Kannabiran G, Sankaran K (2011) Determinants of software quality in offshore development–An empirical study of an Indian vendor. Inf Softw Technol 53(11):1199–1208

Katzenbach JR, Smith DK (1993) The discipline of teams. Harv Bus Rev 71(2):111–120

Kettinger WJ, Lee CC (1994) Perceived service quality and user satisfaction with the information services functions. Decis Sci 25(5/6):737–766

Kossler ME, Prestridge S (2004) Leading dispersed teams (ideas into action guidebooks). Center for Creative Leadership, Greensboro

Lai J-Y, Wibowo S (2012) How service convenience influences information system success. Int J Future Comput Comm 1(3):217–220

Lai J-Y (2014) E-SERVCON and E-Commerce success: applying the DeLone & McLean Model. J Organ End User Comput 26(3):1–22

Lee J-N, Choi B (2011) Effects of initial and ongoing trust in IT outsourcing: a bilateral perspective. Inf Manag 48(2):96–105

Lee J, Park M-c (2013) Factors affecting the smartphone users to use the mobile portal services: focusing on Korean mobile portals. Inf Syst and eBus Manag 11(2):235–252

Lee S-K, Yu J-H (2012) Success model of project management information system in construction. Autom Constr 25:82–93

Li Y, Chang K-C, Chen H-G, Jiang JJ (2010) Software development team flexibility antecedents. J Syst Softw 83(10):1726–1734

Liu JY-C, Chen HH-G, Jiang JJ, Klein G (2010) Task completion competency and project management performance: the influence of control and user contribution. Int J Project Manag 28(3):220–227

Moe NB, Dingsøyr T, Dybå T (2010) A teamwork model for understanding an agile team: a case study of a Scrum project. Inf Softw Technol 52(5):480–491

Na K-S, Li X, Simpson JT, Kim K-Y (2004) Uncertainty profile and software project performance: a cross-national comparison. J Syst Softw 70(1):155–163

NASSCOM (2013) Annual report 2013–2014

Nguyen-Duc A, Cruzes DS, Conradi R (2015) The impact of global dispersion on coordination, team performance and software quality—a systematic literature review. Inf Softw Technol 57:277–294

Pandey A, Aggarwal A, Devane R, Kuznetsov Y (2006) The Indian diaspora: a unique case? In: Kuznetsov Y (ed) Diaspora networks and the international migration of skills: how countries can draw on their talent abroad. The World Bank, Washington, DC, pp 71–97

Pantouvakis A (2011) Internal service quality and job satisfaction synergies for performance improvement: some evidence from a B2B environment. J Target Meas Anal Mark 19(1):11–22
Papaioannou E, Assimakopoulos C, Sarmaniotis C, Georgiadis CK (2015) Investigating customer satisfaction dimensions with service quality of online auctions: an empirical investigation of e-Bay. Inf Syst eBus Manag 11(2):313–330
Parasuraman A, Zeithaml VA, Berry LL (1988) Servqual. J Retail 64(1):12–37
Pedrycz W, Russo B, Succi G (2011) A model of job satisfaction for collaborative development processes. J Syst Softw 84(5):739–752
Peng DX, Lai F (2012) Using partial least squares in operations management research: a practical guideline and summary of past research. J Oper Manag 30(6):467–480
Peng X, Babar MA, Ebert C (2014) Collaborative software development platforms for crowdsourcing. IEEE Softw 31(2):30–36
Pereira J, Cerpa N, Verner J, Rivas M, Procaccino JD (2008) What do software practitioners really think about project success: a cross-cultural comparison. J Syst Softw 81(6):897–907
Pitt LF, Watson RT, Kavan CB (1995) Service quality: a measure of information systems effectiveness. MIS Q 19(2):173–189
Portillo-Rodríguez J, Vizcaíno A, Piattini M, Beecham S (2012) Tools used in global software engineering: a systematic mapping review. Inf Softw Technol 54(7):663–685
Powell A, Piccoli G, Ives B (2004) Virtual teams: a review of current literature and directions for future research. ACM Sigmis Database 35(1):6–36
Raymond L, Bergeron F (2008) Project management information systems: an empirical study of their impact on project managers and project success. Int J Project Manag 26(2):213–220
Reimers V, Chao F, Lee N, Dennis C (2014) The role of convenience in a recreational shopping trip. Eur J Mark 48(11/12):2213–2236
Robillard PN, Robillard MP (2000) Types of collaborative work in software engineering. J Syst Softw 53(3):219–224
Ruparelia NB (2010) Software development lifecycle models. ACM SIGSOFT Softw Eng Notes 35(3):8–13
Saeed KA (2012) Evaluating the value of collaboration systems in collocated teams: a longitudinal analysis. Comput Hum Behav 28(2):552–560
Saleh KA (2009) Software engineering. J. Ross Publishing, Fort Lauderdale, FL
Seddon PB (1997) A respecification and extension of the DeLone and McLean model of IS success. Inf Syst Res 8(3):103–108
Seiders K, Voss GB, Godfrey AL, Grewal D (2007) SERVCON: development and validation of a multidimensional service convenience scale. J Acad Mark Sci 35(1):144–156
Steinfield C (2002) Realizing the benefits of virtual teams. IEEE Comput 35(3):104–106
Strode DE, Huff SL, Hope B, Link S (2012) Coordination in co-located agile software development projects. J Syst Softw 85(6):1222–1238
Subramanian GH, Jiang JJ, Klein G (2007) Software quality and IS project performance improvements from software development process maturity and IS implementation strategies. J Syst Softw 80(4):616–627
Tenenhaus M, Vinzi VE, Chatelin Y-M, Lauro C (2005) PLS path modeling. Comput Stat Data Anal 48(1):159–205
Tian K, Cooper K (2006) Agile and software product line methods: are they so different. In: 1st international workshop on agile product line engineering
Tsai W-H, Shaw MJ, Fan Y-W, Liu J-Y, Lee K-C, Chen H-C (2011) An empirical investigation of the impacts of internal/external facilitators on the project success of ERP: a structural equation model. Decis Support Syst 50(2):480–490
Whitehead J (2007) Collaboration in software engineering: a roadmap. In: Future of software engineering, 2007. FOSE ‘07, 23–25 May 2007, pp 214–225. doi:10.1109/FOSE.2007.4
Zhang X, Prybutok VR (2005) A consumer perspective of e-service quality. Eng Manag IEEE Trans 52(4):461–477