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Factors influencing organizational information systems implementation in Thai public universities

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Abstract

Purpose – This study aims to understand how public sector organizations can successfully implement organizational information systems (IS). It identifies the factors that contribute to the success of organizational IS implementation in public universities.

Design/methodology/approach – Both qualitative and quantitative research methods are used. The proposed research model is based on previous studies and primary qualitative research, including in-depth interviews, telephone surveys and mail surveys using semi-structured questionnaires to identify the determinants and measures of implementation success. Based on the first mail survey's results, quantitative research is conducted to test the research hypotheses. The data are gathered from university personnel at 40 public universities, and the study focuses on the implementation of student registration systems.

Findings – The results suggest that successful implementation of organizational IS includes the decisions of both those in authority and users. The external and internal organization and individual user factors have direct relationships with the measure of implementation success, which suggests significant differences between authorities and users.

Research limitations – The analysis is based on the viewpoint of public university personnel; however, the findings suggest the need for further research on other public organizational IS as well as other public service operations.

Practical implication – The study clearly suggests a set of factors to guide public universities in successfully implementing organizational IS for local conditions of a developing country.

Originality/value – The study contributes to the understanding of effective IS implementation in public universities in a developing country.

Keywords Public organizational information systems, Public university,
Information systems implementation, Implementation success, Structural equation modeling, Thailand

Paper type Research paper

1. Introduction

In contemporary organizations, information systems (IS), which are computer-based systems operating within the bounds of organizational functions, are important tools for facilitating an organization's operations. Investments in IS have increased significantly in public and private sector organizations because of the recognition of its usefulness; this is also true for Thailand. With the rapidly growing use of IS by the Thai government, public universities as agencies of the government are also required to deploy IS to facilitate and improve their operations.

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In Thailand, public university operations are governed by civil service laws and regulations; hence, public universities are controlled by the government and paid for by public taxation. Public university administrators are expected to make effective investments in IS. However, not all public organizations are able to use IS effectively and to justify the investments. Therefore, improving the effectiveness of IS implementation, and thereby ensuring effective investment, remains a challenging task for public university administrators.

Research on IS implementation is based mostly on business organizations, especially private sector organizations or a combination of public and private sector organizations (Rosacker and Olson, 2008). In fact, only a limited number of studies has researched organizational IS in public universities and on limited topics, such as the management and benefits of public organizational IS (Swain *et al.*, 1995; Vest *et al.*, 2014). Despite certain similarities between private and public sector organizations, they are distinctive in many ways, including their management and implementation of information technology (IT) (Bretschneider, 1990; Campbell *et al.*, 2009; Caudle *et al.*, 1991).

In the case of information and communication technology (ICT) in developing countries, researchers note that the location of a new technological innovation is usually in an advanced economy, which is a different context to the location of the implementation of innovation, which is usually in a developing country. In addition, the socio-organizational settings of ICT development, and its use within countries or regions, may differ substantially between developed and developing countries. The differences in business environments in developing countries also suggest that there are very different models for IT applications (Avgerou, 2010; Roztocki and Weistroffer, 2011).

Furthermore, as Chen *et al.* (2006) suggested, history and culture, technical staff, infrastructure, citizens and government officers are the main differences between developed and developing countries from the various aspects of government. The study noted that e-government development strategies and experiences from developed countries might not be directly applicable to developing countries because of such differences. The study also suggested that developing countries propose their own strategies to fit with their countries' characteristics and conditions. Indeed, it has been suggested that a formal and often stringent budgeting process restriction is one of the major constraints to the adoption of new technologies in the public sector (Perry and Rainey, 1988; Sarantis *et al.*, 2011).

With regard to the efficacy of IS implementation, despite the development of successful measures for e-government systems (Wang and Liao, 2008), very few studies have assessed the success of public organizational IS. In fact, questions have been raised as to what aspects of organizational IS in the private sector should apply in the public sector (Nutt, 2005).

Lacking knowledge of organizational IS, public universities are far less effective at implementing the organizational IS. For public administrators, the problem is how IS can be implemented successfully. There is a need for research on IS implementation in public sector organizations. Hence, this study develops a model and measurement to identify the factors that influence the successful IS implementation of public sector organizations.

In Thailand, government agencies are one of four types of state agencies in public sector entities. Government agencies make up the bulk of government machinery and serve the basic functions of government by providing administrative public services, including public education. Regarding the public education service, there are 75 public universities out of a total of 96 government institutions of higher education. The remaining 21 institutions are independent government-affiliated universities. Among the total of 75 public universities, 40 are formally named "Rajabhat Universities." These universities originated from teacher training colleges and operate under the supervision of the Ministry of Education. From their

origin as teacher colleges, these institutions expanded into provincial areas. These 40 universities form one of the largest university systems in Thailand. More than half of Thailand's provinces have at least one government Rajabhat University; hence, they are located all over the country. The distribution of these 40 universities is as follows: 6 are in the Bangkok metropolitan area, 8 in the northern region, 12 in the north-eastern region, 9 in the central region and 5 in the southern region groups[1].

As discussed above, the main challenge faced by administrators of these public universities is to ensure the successfulness of their organizational IS implementation. For the purpose of investigation, qualitative and quantitative research approaches were adopted in this study to provide insight into the nature of the IS implementation projects of the universities. For the initial qualitative approach, the initiative stage was conducted case studies and in-depth interviews. As indicated from the interview results, all 40 universities have acquired a student-registration (S-R) system, which has been developed from the same database. The first group of 10 Rajabhat universities acquired their systems through direct sharing of the original database among them. The second group of 12 Rajabhat universities acquired the same systems and then further developed them on their own; however, these systems still have the fundamental functions of the original system. The remaining Rajabhat universities acquired the systems through vendors with the same fundamental characteristics as the other Rajabhat universities. The same characteristics are needed so that all 40 Rajabhat universities operate similarly. Each system was developed only for the use of the registrar's office and not for the use of the university's students. Thus, the registrars of all the universities must assign specific staff to handle all the work for the students, and the systems are not open for the students' use. These 40 universities are almost identical in terms of organizational structure and size. Therefore, the fundamental characteristics of all 40 systems are the same[2].

In addition, the Ministry of Education requires all Rajabhat universities to report student statistics, by which this report is prepared by the registrar's office. Hence, all of the S-R systems in all Rajabhat universities must be similar. Therefore, for the purposes of this research, the S-R system project implementation of the 40 public universities was selected for this study.

Two research questions drive this study:

Q1. What are the factors that influence the successful IS implementation of public universities?

Q2. How can a public university evaluate IS implementation success?

For a developing country, it is important that public sector organizations understand how IS can be implemented successfully. This study attempts to fill this knowledge gap by addressing the factors that contribute to successful implementation to help both administrators and practitioners. This study's findings have important implications for future research and project planning implementation.

The rest of this paper is structured as follows. Section 2 presents a literature review of the research on the implementation of organizational IS and a discussion of the research model. Section 3 presents the research methodology and hypotheses. Section 4 reports the analysis results. Section 5 discusses the findings, and finally, Section 6 presents the conclusion, implications for academia and practitioners and study limitations.

2. Literature review

2.1 Organizational IS implementation

According to early studies of IS development, a computer-based system implementation is an organizational effort to diffuse an appropriate technology within an organizational community. Its completion is recognized only when the system operates as an integral part of the organization's existing systems (Eder and Igbaria, 2001). Thus, it is reliant on the user's commitment to use the innovation (Holahan *et al.*, 2004).

Regarding the adoption and diffusion of innovation, several studies have investigated the adoption and implementation of various business applications, such as spreadsheets, as well as internet-based IS (Hwang *et al.*, 2004). In a study investigating ICT adoption issues in South Africa, Kyobe (2011) identified capacity to adopt and use ICT, exposure to international environment and state policies as three determinants influencing ICT adoption. These implementations have been viewed as organizational efforts to diffuse the implemented technology into a user community to encourage users to become skillful, consistent and committed to the use of the technology (Klein and Sorra, 1996). Hence, it is likely that such factors as "skillful" and "consistent use" are regarded as the dimensions of effective IS implementation.

From the private sector's perspective, implementation of computer-based IS involves managerial decisions and a set of activities that include implementing data storage and manipulating programs. Technically, the implementation of organizational IS involves complex activities and organizational resources (Gichoya, 2005; Hirschhrim *et al.*, 1996). Therefore, organizational IS implementation can be described as a process that includes technical agreement with managerial decisions and activities to select and install new technology.

2.2 The implementation of public organizational IS

A considerable number of studies has investigated public organizations. For example, Rocheleau's (2000) research provided guidance on how to structure and implement public sector IS. Other previous studies have considered specific issues within a single large public entity, but only at the local government level (Beaumaster, 2002). These studies have addressed the management issues of public sector information systems and technology (IS/IT).

Thong *et al.* (2000) conducted a case study in a large public organization, examined the differences between public and private organizations in the implementation of business process reengineering (BPR) and found both similarities and differences in the BPR experiences. Ward and Mitchell (2004) examined the way in which senior-ranking public and private sector information resource executives prioritized 23 information resource management critical success factors (CSFs), and they found that the rank order was statistically similar between the two sectors. Although previous works have studied IS/IT in public organizations, these studies have focused mainly on managerial issues.

2.3 Organizational IS in higher education

In the internet era, universities and higher education institutions have been increasingly providing e-learning options. A considerable number of published works has studied these e-learning systems. For example, Tseng *et al.* (2011) researched the effectiveness of teaching and learning in an e-learning system at a university in Taiwan. Their study presented a general multi-criteria hierarchical framework that could be applied to e-learning system effectiveness measures in various settings. Wu *et al.* (2010) proposed a research model that examined the determinants of student learning satisfaction in a blended e-learning

environment. Based on a literature review and the opinions of 33 experts, Hassenzadeh *et al.* (2012) designed a comprehensive model to measure the success of e-learning systems in universities. In summary, these studies investigated the effectiveness and success of e-learning systems.

The introduction of IS/IT along with the benefits of internet technology have become increasingly helpful in the traditional administration of public universities in Thailand. There are three general types of organizational IS in Thai public universities: library information, student registration and accounting systems. Library information systems are typical library computer systems that are used to catalog, track circulation and inventory a library's assets, including lending resources. The system procedures are simple and essential for the effective functioning and use of the university library. Some public universities use an internet technology integrated library system to allow users to conduct online searches.

In the case of accounting systems, as these universities are organizations in the public sector, they are not typically engaged in standard commercial accounting activities. In government accounting, the entity is responsible for fiscal reporting, which demonstrates compliance in the use of resources in a budgetary context. The universities customize some accounting spreadsheets as computerized accounting systems to process and maintain accounting transactions and records. A computerized accounting system, for instance, is allowed to process only money received for tuition fee transactions and records. In fact, the 40 universities do not have the same library information and accounting systems. However, they all have a similar student registration system. Finally, some public universities may use internet technology to support student registration systems and e-learning systems[3].

As stated in this subsection, e-learning systems differ from typical organizational IS, which facilitates university operations. Very little is known about IS implementation in public organizations (Kamal, 2006). In fact, less research has been conducted on university organizational IS than on other types of organizational IS, and thus, less is known about organizational IS that supports and facilitates public universities' operations and administrations.

2.4 Factors affecting organizational IS implementation

2.4.1 Impact at the organizational level. According to the previous studies, it seems that organizational IS implementation has been based on both technical and managerial factors. Implementation can be considered to be the transformation of a design concept into the actual operation and can be understood as the ability of system users and the organization to gain benefits from it. Based on the diffusion of innovations, adoption and implementation can be investigated to assess diffusion and the factors that contribute to successful diffusion. Lee and Kim (2007) investigated the adoption decision behind internet information systems (IIS). Their study confirmed three determinants of the adoption decision: technological innovation characteristics, organizational factors and factors related to IS.

The technological innovation characteristics were compatibility, relative advantage and complexity of IIS. The organizational factors included customer interaction and top management support. The factors related to IS included IS infrastructure, IS expertise and the importance of IS security.

Bradford and Florin (2003) examined the implementation of an enterprise resource planning system, which is a business application, and suggested three predictors of success. The first predictor is innovation characteristics, including technical compatibility, perceived complexity and business process reengineering. The second predictor is organizational characteristics, including top management support, organizational objectives consensus and

training. The third predictor is environmental characteristics, which are primarily composed of competitive pressures.

Frambach and Schillewaert (2002) and Gallivan (2001) suggested that, in implementing organizational technologies, organizational adoption involves two types of organizational decisions: primary and secondary decisions. Primary decisions involve decisions by those in charge, referred to as authority decisions, while secondary decisions involve the decisions of individual users. Indeed, primary decisions that occur at the management level will be followed by actual implementation, which involves individual user adoption decisions.

Regarding actual implementation, it seems likely that the primary decisions are associated with organizational environments, both external and internal (Vaidya *et al.*, 2013; Woodside and Biemans, 2005). Consequently, secondary decisions are involved in actual use, which is explained as the phenomenon of user exposure to the implemented technology and the understanding of its functions through use. A secondary decision leads to a user's attitude and affects the user's autonomous behavior in either the adoption or rejection of the technology (Rogers, 2003). Accordingly, it is possible that both the authority and individual user decisions are determinants of the outcome of organizational IS implementation; hence, these determinants then contribute to successful implementation.

2.4.2 Impact at the individual user level. As stated in the previous section, of the two types of organizational decisions that are part of the technology adoption process, the secondary decision involves individual users. Several theories have been developed to explain the individual adoption of technology, ranging from innovation adoption and the theory of reasoned action to the technology acceptance model (TAM) (Davis, 1989). According to the theory of reasoned action and the TAM, perceived beliefs and affections held toward an innovation are a fundamental principle of an individual's "acceptance" of innovation (Davis *et al.*, 1989). The unified theory of acceptance and use of technology (UTAUT) model was also adopted to explore the factors that determine the adoption of e-government services in a developing country, such as Kuwait (Awadhi and Morris, 2008). Overall, it has been suggested that the success of IS implementation based on adoption, and its use, must be commonplace. Furthermore, organizational factors, such as organizational norms concerning technology, the nature of management and personal innovativeness, potentially influence the success of implementation.

In summary, such factors can be classified into two categories: external organizational environment and internal organizational environment. External organizational environment factors are antecedents, occurring outside an organizational boundary. Internal organizational environment factors are those that occur within the organizational boundary. Both external and internal organizational factors likely play important roles in the implementation of organizational IS. Thus, Table I lists the factors found in previous studies that affect the implementation of organizational IS/IT, related to organizations and individual users.

2.5 IS success and measurement

In an empirical investigation into public sector entities within the USA, Rosacker and Olson (2008) tested the CSFs to IS project implementation proposed in the existing literature. The results suggest that there were significant differences between private and public sector IT projects and the authors concluded that the project implementation success concept is a matter of perception.

According to Roztocki and Weistroffer (2011), the determinants of IT project success in developed economies with fully developed infrastructure would be different from those in developing countries. The authors suggested that laws and regulations, government control,

Decision type	Factors	Source
Related organization: External environment factors	Vendor, consultant, external expert Competitive pressure, degree of competition, external market factors	Aguila-Obra and Padilla-Melendez (2006); Chwelos *et al.* (2001); Gichoya (2005); Kim and Galliers (2004); Vaidya *et al.* (2013)
Internal organization factors	Organizational issues Structure, size, business process Need, objective Top management and supervisor (behavior) Support, monetary support involvement, decision making/ planning strategy Top management and supervisor (characteristics) IS/IT knowledge, experience, attitude Existing champion Technology issues Infrastructure Existing IS/IT	Al-Tit (2016); Amoak-Gyampah and Salam (2004); Chwelos *et al.* (2001); Hong and Kim (2002); Kuruppuarachchi *et al.* (2002); Liu and Ma (2006); Nah and Delgado (2006); Ngai and Gunasekaran (2004); Somers and Nelson (2001); Vaidya *et al.* (2013)
Related Individual User	Perceived compatibility Benefit, relative advantage, usefulness, positive attitude towards IS/IT System/ information quality Perceived complexity Ease of use, user friendly, Education/training Involvement, participation User characteristics IS/IT knowledge, experience, skill	Al-Tit (2016); Bradford and Florin (2003); Gichoya (2005); Lee and Kim (2007); Liao and Landry (2000); Liu and Ma (2006); McFarland and Hamilton (2006); Wu and Wang (2006); Zhang *et al.* (2005)

Table I.
Factors impacting organizational IS implementation in previous studies

workforce characteristics, management styles, customer characteristics and economic conditions are specific business environment factors that determine IT project success; nevertheless, in many developing countries, these business factors are hardly predictable. Moreover, Mursu *et al.* (2000) conducted 36 interviews in 11 software companies to obtain a general view of the software industry in Nigeria. This exploration was part of a large joint research project that explored factors related to IS implementation. Based on their first empirical results and literature review, the study concluded that special requirements are needed for IS development in Nigeria and other Africa countries, namely, sustainability, affordability, socio-economic justification and community participation.

A more recent effort was Al-Tit's (2016) survey of 25 government institutions in Jordan. The result confirmed that human factors, organizational factors, technological factors and environmental factors influence the adoption of IS in organizations and showed that the factors contributing to the success of MIS implementation are users' skills and experience, IS usefulness, IS ease of use, top-management support, user training, IS confidentiality, system quality, information quality, service quality, overall environment, institutional environment and external pressure.

In an attempt to measure IS success, researchers have attempted to use different measures. For instance, the variable constructs "user satisfaction" and "perceived organizational performance" were applied in evaluating the success of implementation (Bradford and Florin, 2003; Campbell *et al.*, 2009; Livari, 2005). To ensure e-government success, Wang and Liao (2008) suggested the adaption of DeLone and McLean's (2003) updated IS success model to a system measurement in the government to consumer (G2C) e-government context. Their model measured the success of G2C e-government systems from a citizen's perspective. Thus, it seems likely that the updated IS success model of DeLone and McLean (2003) is a suitable adaptation for measuring the implementation success of organizational IS in public universities.

According to DeLone and McLean's (2003) IS success model, the six measures are system quality, information quality, use, user satisfaction, individual impact and organizational impact.

Their original IS success model offers a model of causal interdependencies among the six factors. In their updated model, a service quality measure and net benefits represent all the "impact" measures that were added to the original proposed model (DeLone and McLean, 2003). Furthermore, perceived organizational performance, system usage, actual use, use, perceived success level, net benefits and perceived benefits of IT were used as components in the measurements of IS success (Seddon and Klew, 1996).

System usage and intention to use are important measures of IS success. The impact and benefit of the implemented IS evidently requires "use" in the first place. "Using IS" is then also associated with the expectation of "net benefits." Consequently, the expectation of gaining benefits from IS equates to the implied success of the implemented IS (Rai *et al.*, 2002). User satisfaction is also derived from the perception of net benefits. System quality and use are also associated with the organizational benefits gained from the implemented IS (Petter *et al.*, 2008, 2013).

3. Research methodology

The main challenge faced by public university administrators is how university IS can be implemented successfully. The aim of this research is to identify the factors that contribute to the success of organizational IS implementation in Thai public universities; hence, a sequence of exploration was conducted to address this issue (Muriithi *et al.*, 2016; Peng *et al.*, 2011; Wu, 2012). Qualitative and quantitative research approaches were applied in collecting and analyzing data. The proposed research model was constructed based on previous studies along with the results of an initial phase of qualitative research, which included multiple case studies, expert interviews, telephone interviews and a mail survey.

3.1 Research model design

As explained in the introduction, a qualitative research strategy was undertaken to gather data concerning the implementation of S-R systems in the form of the opinions of university staff, who were universities' administrators, system developers and system users. Students were excluded. For multiple case studies and expert interviews, the procedure involved conducting case studies at two universities and in-depth interviews of experts. In-depth interviews were conducted with chosen top administrators of 40 public universities involved in the acquisition of IS/IT for their universities. These interviews were flexible and exploratory in nature.

To learn more about the implementation of the S-R system, telephone surveys of the administrators of the Register Offices of these universities were conducted. The telephone interviews were completed for 30 out of the 40 universities, and these 30 respondents

confirmed that their institutions had implemented a database system that facilitates student registration, that is, the S-R system. An interview protocol was prepared to guide the conversations. From the telephone interviews and discussions, information about the acquisition and origination of the S-R system project was acquired. The telephone survey results indicated that all 40 universities had introduced the S-R system. These systems were developed only for the use of the registrar's office and were acquired by universities on their own.

The evidence suggested that variables at organizational, departmental and operational levels were involved in the system implementation; this was based on statements during conversations from the telephone surveys, such as "the decision to use a system originated only from within the department," "registrars originally proposed a system development project at the higher administrative level" and "most registrar office's personnel have participated in the development." In summary, some ideas were gleaned concerning the decision process in a public university context. Consequently, following the telephone interviews, the first mail survey of this study was conducted. The mail survey aimed to obtain further information on the universities' perceptions about the S-R system implementation and the success of the system implementation; the survey applied self-administered questionnaires as the survey tool.

3.1.1 Factors at the organizational level. Considering the evidence from the telephone conversations and knowledge from the review section, it is likely that three classifications of organizational variables were proposed as determinants of the effectiveness of organizational IS implementation at public universities, namely, the External Environment Factor (*CSF1*), Internal Organizational Factor (*CSF2*) and Individual User Level Factor (*CSF3*). These organizational variables could be determinants of the two types of organizational decisions that lead to successful implementation of organizational IS. Thus, Table II lists the organizational variables under the three classifications as the main components of the research model.

3.1.2 Implementation success of organizational IS. In the case of measuring the success of IS implementation, as reviewed in the IS success and measurement issues, the net benefits gained from the use of IS could be an indicator of the success of IS implementation. In the final review, 17 items were collected from the literature. In addition, evidence obtained from the telephone surveys was useful for developing attribute items from the 17 items. Therefore, 17 attributes were constructed as the baseline characterizing organizational IS implementation success for rating scales, and Table III shows these items.

3.1.3 First mail survey. To measure the university's personnel perception, two sets of semi-structured questionnaires were developed and used for the survey. One set was designed to collect the administrators' responses and the other to collect system users' responses. Using ratings of importance, a set of rating scales for the 17 items representing the attributes of implementation success was included in the questionnaires. Each rating was on a five-point scale: 1 = *not important*, 2 = *slightly important*, 3 = *somewhat important*, 4 = *important* and 5 = *very important*. In addition to the rating section, closed-ended and open-ended questions were included to gather additional information to validate the rating results. Overall, a total of 112 usable responses were generated from 33 public universities. Of this total, 50 administrative responses were received from 28 universities, and 62 user responses were received from 26 universities.

"IS Net Benefits" represents the attributes that define implementation success. Factor analysis was performed to examine the inter-correlations between the rating scores of the 17 attributes. Three overarching hypothetical constructs were deduced from the administrators' responses, and two of these hypothetical constructs were deduced from the

Classification	Organizational variables	
External environment factor *(CSF1)*	Political influence	
	Public expectation	
Internal organization factor *(CSF2)*	Administrative	Support/Involvement/Role
		Administrative characteristics
		Management intervention
	Organizational concerns	Existing IT champion
		Organizational structure
		Redesign work process
		Organization need
		Resistance to change/ cooperation within organization
	Resources	Monetary support
		HR support
Individual user level factor *(CSF3)*	Degree of user involvement	
	User characteristics	
	Perceived technology compatibility	
	Plan strategy	

Table II.
Factors affecting implementation of organizational IS in a public university

Attribute	Source
Accessibility of quality information	Bradford and Florin (2003);
Impact on reduction in waste from functioning tasks	DeLone and McLean (2003);
Easiness in functioning task	Hassenzadeh *et al.* (2012);
Impact on service quality provided	Hong and Kim (2002);
Functioning performance improvement	Livari (2005):
Impact on quality decision of users	Markus *et al.* (2000);
Gaining functioning performance as expectation	Petter et al., (2008, 2013);
Overall, user satisfaction with the system	Rai *et al.* (2002);
System functioning as expectation	Seddon and Klew (1996);
Resource sharing with existing system	Seddon *et al.* (1999);
Impact on system quality of data collection, analysis and processing	Wu and Wang (2006);
Being an operable system	Zhang *et al.* (2005)
Actual use of system	
Achieving standard database in accordance with government policy	
Working condition improvement	
Time frame of implementation project	
System implementation budget	

Table III.
Attributes of the success of IS implementation

system user responses. Thus, these hypothetical constructs were posited as important measures of implementation success for university organizational IS. Subsequently, three hypothetical constructs representing the "IS Net Benefits" variables were used as the dependent variables. Finally, Table IV shows the three hypothetical constructs and the observed variables from the 17 items. The three hypothetical constructs are Performance Improvement, Performance Expectation and Implementation Objective.

In conclusion, the collaborative nature of the qualitative research offers more insights into the issues under investigation in this study. All interviews, that is, two cases study, in-depth interviews and telephone interviews, were conducted by the researchers to ensure

Hypothetical construct	Attributes of implementation success
Performance improvement	Accessibility of quality information
	Impact on reduction in waste from functional tasks
	Ease of functional task
	Impact on service quality provided
	Functioning performance improvement
	Impact on quality decision of users
	Gaining functional performance as expectation
Performance expectation	Overall user satisfaction with the system
	System functioning as expected
	Resource sharing with existing system
	Impact on system quality of data collection, analysis, and processing
	Being an operable system
	Actual use of system
	Achieving standard database in accordance with government policy
Implementation objective* (Project timeframe and Budget)	Working conditions improvement
	Timeframe of project implementation
	System implementation budget

Note: *This construct was not found in the user responses

Table IV. Hypothetical constructs representing "IS Net Benefits" variables

flexibility in the interviews and to reduce interviewers' bias. In the case of in-depth interviews with chosen administrators, the interviews with administrators were conducted at both the university level and the Ministry of Education. Thus, the integration of different types of data generated insights into S-R system implementation phenomena (Jokonya, 2016; Peng *et al.*, 2011; Venkatesh *et al.*, 2013).

Moreover, using factor analysis, this study obtained three variable constructs shown in Table IV based on the ratings of the 17 attribute items. In addition to the rating section, a set of closed-ended and open-ended questions were included in the survey tools to validate the rating scores; furthermore, the results of these questions were used as evidence to justify the three variable constructs. In fact, for each factor, reliability analysis was performed to check internal consistency, and the Cronbach's alpha values satisfied the criteria (Hair *et al.*, 2006; Hinton *et al.*, 2014).

In addition to the factor analysis result, certain information obtained from the closed-ended and open-ended questions included in the survey tools was useful for sorting through organizational variables from previous studies (referred to Table II). In this regard, the results from the in-depth interviews and the telephone surveys, in combination with a statistical analysis, were used to further validate the results of this qualitative research approach. In conclusion, the proposed research model was constructed based on previous studies along with the results of this qualitative approach.

3.1.4 Research model. Based on the literature and the qualitative research results, a research model was designed in which a conceptual framework represents the causal relationships among the three classifications of the organizational variables (i.e. external, internal and individual) and the "IS Net Benefits" variables. Thus, this model aimed to identify the organizational variables that influence the two types of organizational decisions (primary and secondary) that lead to successful implementation of organizational IS at public universities. Figure 1 depicts the research model.

3.2 Quantitative approach deriving research hypotheses

A quantitative approach was used to validate the proposed research model. Structural equation modeling (SEM) was also used for three specific objectives: to obtain and test the hypothesized

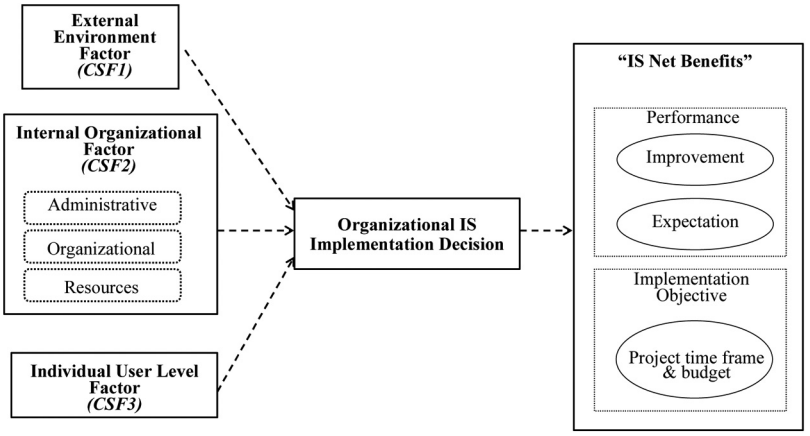

Figure 1.
Research model

measurement models, construct the structural models and estimate and test the causal relationships. A second mail survey gathered perceptions from administrators and system users at the 40 public universities. Two structured questionnaires were developed to measure perceptions around the implementation of the S-R system. The perceptions were measured on a five-point Likert-type scale and a semantic differential scale.

A total of 670 questionnaires were sent directly to the target respondents. Of these, 382 usable responses were returned, giving an effective response rate of 57.0 per cent, from all 40 universities. The participants in the administrative group were predominantly male (66.9 per cent) and those in the user group were predominantly female (68.1 per cent). A majority of the administrators were in the age range of 41-60 years (71.4 per cent), and in terms of education, nearly 90 per cent of them had at least a master's degree. In addition, 65.7 per cent of the user group was in the age range of 31-50 years, and in terms of education, 52.9 per cent had a bachelor's degree. Finally, 56.2 per cent of the administrators and 54.9 per cent of the users had worked at their present positions for more than 5 years (see Tables AI and AII in the Appendix). The following subsection explains how the model variables were obtained.

3.2.1 Model variables. Exploratory factor analysis was performed to identify a set of variable constructs underlying the observed variables. Two initial questionnaires contained 65 observed variables for the administrative group and 61 observed variables for the user group. These observed variables measured the organizational variables and the "IS Net Benefits" variables. After refinement and reliability testing, the questionnaire items were reduced to 40 and 35 observed variables for the administrative and user groups, respectively.

Using LISREL 8.72, confirmatory factor analysis (CFA) was performed to confirm the variable constructs, and the results were statistically significant at the $p = 0.01$ level (*t-values* > 2.58), representing the organizational variables and the "IS Net Benefits" variables. Tables V and VII show the CFA results confirming the five constructs that constitute the organizational variables from the administrative responses and user responses, respectively. For the variable constructs defining the "IS Net Benefits"; Table VI shows that three constructs were confirmed from the administrative responses; and Table VIII shows that two variable constructs were confirmed from the user responses.

Moreover, to crosscheck the variable constructs resulting from the CFA, a reliability test was performed, and the alpha values showed acceptable results of the measurement models

of the organizational variables and the "IS Net Benefits" variables from both groups (Tables V-VIII). In Table V, only the alpha value of *Perceived Technology Compatibility* (X_{A5}) did not meet the criteria of 0.70 ($\alpha = 0.607$). This alpha value was somewhat lower than the criterion for a strong relationship of the scale. Nevertheless, according to Hair *et al.* (2006) and Hinton *et al.* (2014), alpha values within 0.5 and 0.7 are generally acceptable

Table V.
CFA results of organizational variables for administrative responses

Organizational variables (XAi)	α
External environment factor (*CSF1*)	
External factor (X_{A1})	0.770
Internal organizational factor (*CSF2*)	
Redesign work process (X_{A2})	0.798
Resource support (X_{A3})	0.792
Individual user level factor (*CSF3*)	
Participation and cooperation (X_{A4})	0.843
Perceived technology compatibility (X_{A5})	0.607[nc]

Note: [nc]= Did not meet criteria for Cronbach's alpha ($\alpha > 0.70$)

Table VI.
CFA results of "IS Net Benefits" variables for administrative responses

Three "IS Net Benefits" variables (Y_{Aj})	α
Performance improvement (Y_{A1})	0.855
Overall expectation (Y_{A2})	0.809
Objective achievement (Y_{A3})	0.780

Table VII.
CFA results of organizational variables for user responses

Organizational variables (X_{Ui})	α
External environment factor (*CSF1*)	
External factor (X_{U1})	0.777
Internal organizational factor (*CSF2*)	
Developing strategy (X_{U2})	0.877
Project and resource evaluation (X_{U3})	0.861
Individual user level factor (*CSF3*)	
Participation and cooperation (X_{U4})	0.918
Perceived technology compatibility (X_{U5})	0.787

Table VIII.
CFA results of "IS Net Benefits" variables for user responses

Two "IS Net Benefits" variables (Y_{Uj})	α
Overall expectation (Y_{U1})	0.845
Performance improvement (Y_{U2})	0.861

for indicating a moderately reliable scale. In addition, the fitness of the measurement models for both response groups was examined, and the fit indexes were generally satisfactory (see Tables AIII and AIV in the Appendix). As a result, the measurement models were confirmed for identifying the structural models that best fit the response data of both groups.

3.3 Research hypotheses

Using the review of previous IS studies and analyzing the findings from a qualitative approach, this study was able to anticipate connections between the constructs to formulate a comprehensive model for testing and identifying the relationships (Tables II and IV). In Figure 1, the proposed research model shows that the hypothesized organizational variables could influence the organizational decisions leading to successful implementation. In fact, the first mail survey results provided further support for the hypotheses that the organizational variables impact the two types of organizational decisions: primary and secondary. Therefore, these two types of organizational decisions lead to success in implementing organizational IS at public universities.

3.3.1 Administrative responses. Of the three classifications (*CSF1*, *CSF2* and *CSF3*), five organizational variables (Table V) are expected to be involved in primary decisions at the authority level. These organizational variables are likely to have a positive effect on three "IS Net Benefits" variables (Table VI). Indeed, the five independent variables and three dependent variables have causal relationships; hence, this study developed 15 hypotheses as follows:

External Environment Factor (*CSF1*)
External Factor (X_{A1})

Ha1. External Factor is positively related to Performance Improvement (Y_{A1}).

Ha2. External Factor is positively related to Overall Expectation (Y_{A2}).

Ha3. External Factor is positively related to Objective Achievement (Y_{A3}).

Internal Organizational Factor (*CSF2*)
Redesign Work Process (X_{A2})

Hb1. Redesign Work Process is positively related to Performance Improvement (Y_{A1}).

Hb2. Redesign Work Process is positively related to Overall Expectation (Y_{A2}).

Hb3. Redesign Work Process is positively related to Objective Achievement (Y_{A3}).

Resource Support (X_{A3})

Hc1. Resource Support is positively related to Performance Improvement (Y_{A1}).

Hc2. Resource Support is positively related to Overall Expectation (Y_{A2}).

Hc3. Resource Support is positively related to Objective Achievement (Y_{A3}).

Individual User Level Factor (*CSF3*)

Participation and Cooperation (X_{A4})

Hd1. Participation and Cooperation is positively related to Performance Improvement (Y_{A1}).

Hd2. Participation and Cooperation is positively related to Overall Expectation (Y_{A2}).

Hd3. Participation and Cooperation is positively related to Objective Achievement (Y_{A3}).

Perceived Technology Compatibility (X_{A5})

He1. Perceived Technology Compatibility is positively related to Performance Improvement (Y_{A1}).

He2. Perceived Technology Compatibility is positively related to Overall Expectation (Y_{A2}).

He3. Perceived Technology Compatibility is positively related to Objective Achievement (Y_{A3}).

3.3.2 User responses. Similarly, the five organizational variables (Table VII) are expected to be involved in the secondary decisions of the individual users. Then, these organizational variables are likely to have a positive effect on two "IS Net Benefits" variables (Table VIII). Thus, this study developed 10 hypotheses as follows:

External Environment Factor (*CSF1*)
External Factor (X_{U1})

Hf1. External Factor is positively related to Overall Expectation (Y_{U1}).

Hf2. External Factor is positively related to Performance Improvement (Y_{U2}).

Internal Organizational Factor (*CSF2*)
Developing Strategy (X_{U2})

Hg1. Developing Strategy is positively related to Overall Expectation (Y_{U1}).

Hg2. Developing Strategy is positively related to Performance Improvement (Y_{U2}).

Project and Resource Evaluation (X_{U3})

Hi1. Project and Resource Evaluation is positively related to Overall Expectation (Y_{U1}).

Hi2. Project and Resource Evaluation is positively related to Performance Improvement (Y_{U2}).

Individual User Level Factor (*CSF3*)
Participation and Cooperation (X_{U4})

Hj1. Participation and Cooperation is positively related to Overall Expectation (Y_{U1}).

Hj2. Participation and Cooperation is positively related to Performance Improvement (Y_{U2}).

Perceived Technology Compatibility (X_{U5}).

Hk1. Perceived Technology Compatibility is positively related to Overall Expectation (Y_{U1}).

Hk2. Perceived Technology Compatibility is positively related to Objective Achievement (Y_{U2}).

4. Analysis and results

LISREL 8.72 with the program PRELIS 2.72 was used to perform a normality distribution assessment and the data screening of missing inputs. The analysis reported that the responses of both groups were considerably well distributed. Thus, with the confirmatory results, the structural models were identified. By maximum likelihood estimations, the parameter estimates of the measurement equations were obtained, and they were statistically significant at the $p = 0.05$ level (*t-values* > 1.96). These significant results suggest that the observed variables were free, to a high degree, from measurement error. Thus, it can be assumed that the observed variables were reasonably successful as measures of the organizational variables and the "IS Net Benefits" variables in the models (Diamantopoulos and Siguaw, 2005).

Furthermore, the SEM analysis provides the fitness of the estimated models for the structural models. Table IX shows the six common goodness-of-fit indexes that satisfactorily fit the acceptable criteria for both response groups (Hooper *et al.*, 2008). Thus, the measurement models underlying the full structural equation models were acceptable for both response groups. The structural models fit the data well, and the organizational variables could be hypothesized to predict the "IS Net Benefits" variables.

4.1 Hypothesis testing

4.1.1 Results from administrative responses. The parameter estimates of the relationships in the structural models were calculated. Figure 2 presents the results of the structural model analysis. From the 15 hypotheses, the analysis resulted in 11 significant causal relationships, as shown in Table X. The R^2 values are indicated next to the dependent variables.

In Figure 2, these results indicate that *External Factor* (X_{A1}), *Redesign Work Process* (X_{A2}) and *Perceived Technology Compatibility* (X_{A5}) had significant relationships with all

Fit Indices	Criteria[1]	Administrative responses Structural model	Accept	User responses Structural model	Accept
χ^2/df	$0 < \chi^2/df \leq 3$	1.2674	✓	1.5460	✓
NNFI	Close to 1 and >1	0.9832	✓	0.9757	✓
CFI	$0.95 \leq \text{CFI} \leq 1.0$	0.9874	✓	0.9801	✓
SRMR	$0 \leq SRMR \leq 0.10$	0.05186	✓	0.04526	✓
RMSEA	$0 \leq RMSEA \leq 0.08$	0.04006	✓	0.0546	✓
Largest Std. Residual	< 2 to 4	3.814	✓	3.8872	✓

Note: [1]Hooper *et al.* (2008) and Müller (2003); NNFI = Non-Normal fit index; CFI = Comparative fit index; SRMS = Standardized RMR; RMSEA = Root mean square error of approximation

Table IX. Overall goodness-of-fit of structural models

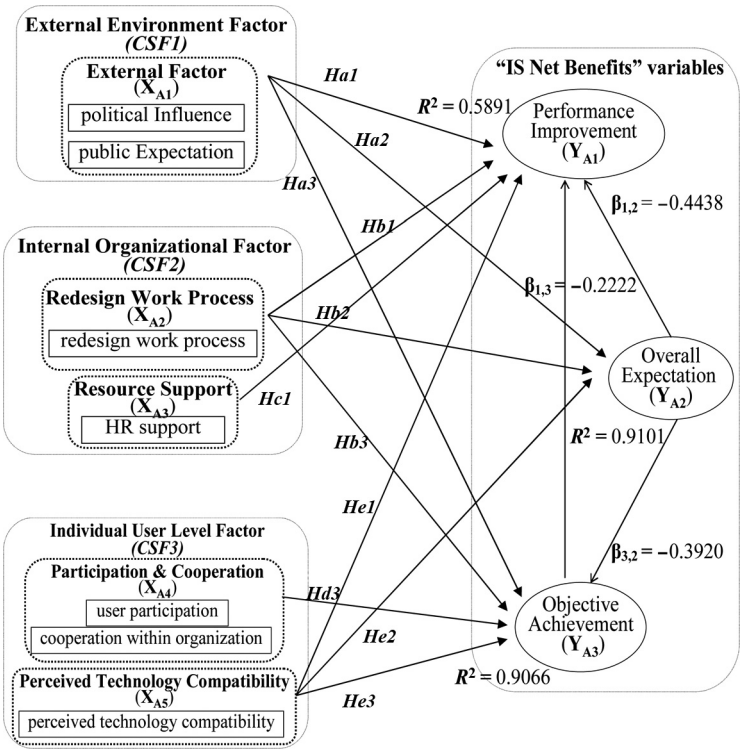

Figure 2.
Path diagram of hypothesis test results from administrative responses

three "IS Net Benefits" variables (i.e. *Performance Improvement* (Y_{A1}), *Overall Expectation* (Y_{A2}) and *Objective Achievement* (Y_{A3})). In addition, two causal relationships between *Resource Support* (X_{A3}) and *Performance Improvement* (Y_{A1}) and between *Participation and Cooperation* (X_{A4}) and *Objective Achievement* (Y_{A3}) were found to be significant.

Table X shows that *Hc2*, *Hc3*, *Hd1* and *Hd2* were not supported. *Hc2* and *Hc3* state that *Resource Support* (X_{A3}) is positively related to *Overall Expectation* (Y_{A2}) and *Objective Achievement* (Y_{A3}), respectively. *Hd1* and *Hd2* state that *Participation and Cooperation* (X_{A4}) is positively related to *Performance Improvement* (Y_{A1}) and *Overall Expectation* (Y_{A2}), respectively. It is apparent that both *Resource Support* (X_{A3}) and *Participation and Cooperation* (X_{A4}) were not significantly related to *Overall Expectation* (Y_{A2}). *Resource Support* (X_{A3}) was also not significantly related to *Objective Achievement* (Y_{A3}) and *Participation and Cooperation* (X_{A4}) was not significantly related to *Performance Improvement* (Y_{A1}).

The R^2 statistic of the structural model indicates variance in the dependent variables. As Figure 2 reports, first, 58.91 per cent of the variance in *Performance Improvement* (Y_{A1}) could be explained by the four organizational variables (i.e. X_{A1}, X_{A2}, X_{A3} and X_{A5}). Second, 91.01 per cent of the variance in *Overall Expectation* (Y_{A2}) could be explained by three organizational variables (i.e. X_{A1}, X_{A2} and X_{A5}). Third, 90.66 per cent of the variance in *Objective Achievement* (Y_{A3}) could be explained by the four organizational variables (i.e. X_{A1}, X_{A2}, X_{A4} and X_{A5}).

*External environment factor (*CSF1*)*	
External factor (X_{A1})	
Ha1: Positively related to performance improvement (Y_{A1})	Support
Ha2: Positively related to overall expectation (Y_{A2})	Support
Ha3: Positively related to objective achievement (Y_{A3})	Support
Internal organizational factor (CSF2)	
Redesign work process (X_{A2})	
Hb1: Positively related to performance improvement (Y_{A1})	Support
Hb2: Positively related to overall expectation (Y_{A2})	Support
Hb3: Positively related to objective achievement (Y_{A3})	Support
Resource support (X_{A3})	
Hc1: Positively related to performance improvement (Y_{A1})	Support
Hc2: Positively related to overall expectation (Y_{A2})	Not Support
Hc3: Positively related to objective achievement (Y_{A3})	Not Support
Individual user level factor (CSF3)	
Participation and cooperation (X_{A4})	
Hd1: Positively related to performance improvement (Y_{A1})	Not Support
Hd2: Positively related to overall expectation (Y_{A2})	Not Support
Hd3: Positively related to objective achievement (Y_{A3})	Support
Perceived technology compatibility (X_{A5})	
He1: Positively related to performance improvement (Y_{A1})	Support
He2: Positively related to overall expectation (Y_{A2})	Support
He3: Positively related to objective achievement (Y_{A3})	Support

Table X. Hypothesis test results from administrative responses

The SEM results show indirect effects among the three dependent variables, and the estimated path coefficients are specified next to the links. *Performance Improvement* (Y_{A1}) and *Objective Achievement* (Y_{A3}) were both negatively influenced by *Overall Expectation* (Y_{A2}). In addition, *Performance Improvement* (Y_{A1}) was negatively influenced by *Objective Achievement* (Y_{A3}). Overall, these indirect effects indicate that *Overall Expectation* and *Objective Achievement* behave as mediating variables, with both having a negative influence in the model.

4.1.2 Results from user responses. Figure 3 shows the path diagram result, and Table XI shows the four significant, positive causal relationships that were found for the 10 hypotheses. *Hf2*, *Hg1*, *Hj2* and *Hk1* were the four hypotheses that revealed significant relationships.

Support was found for *Hf2* and *Hj2*, showing that *External Factor* (X_{U1}) and *Participation and Cooperation* (X_{U4}) were positively related to *Performance Improvement* (Y_{U2}). Support was also found for *Hg1* and *Hk1*, showing that *Developing Strategy* (X_{U2}) and *Perceived Technology Compatibility* (X_{U5}) were positively related to *Overall Expectation* (Y_{U1}). These results suggest that *Developing Strategy* (X_{U2}) and *Perceived Technology Compatibility* (X_{U5}) would positively influence *Overall Expectation* (Y_{U1}), and *External Factor* (X_{U1}) and that *Participation and Cooperation* (X_{U4}) would positively influence *Performance Improvement* (Y_{U2}).

By contrast, *Hf1*, *Hg2*, *Hj1* and *Hk2* did not indicate significant relationships. These results indicate that *External Factor* (X_{U1}) and *Participation and Cooperation* (X_{U4}) would have no influence on *Overall Expectation* (Y_{U1}), and *Developing Strategy* (X_{U2}) and *Perceived Technology Compatibility* (X_{U5}) would have no influence on *Performance Improvement* (Y_{U2}).

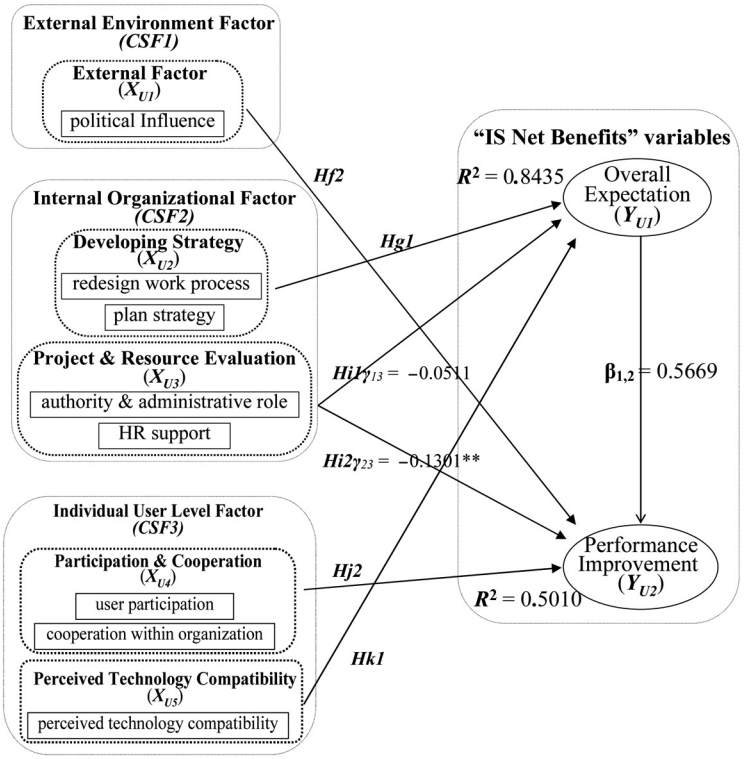

Figure 3.
Path diagram of hypothesis test results from user responseszero in the population

Notes: The *t*-value determines whether a particular parameter is significantly different from zero in the population; **significant at the $p < 0.05$ level (*t*-value = 1.96)

In Figure 3, *Project and Resource Evaluation* (X_{U3}) shows negative relationships with *Overall Expectation* (Y_{U1}) and *Performance Improvement* (Y_{U2}). The estimated path coefficients are specified next to these two links. In addition, the path results show an indirect effect where *Overall Expectation* (Y_{U1}) positively influenced *Performance Improvement* (Y_{U2}). This also means that *Overall Expectation* behaved as a mediator that had a positive influence in the model.

Furthermore, the R^2 values are indicated next to the dependent variable. For *Overall Expectation* (Y_{U1}), 84.35 per cent of the variance could be explained by *Developing Strategy* (X_{U2}), *Project and Resource Evaluation* (X_{U3}) and *Perceived Technology Compatibility* (X_{U5}). Furthermore, 50.10 per cent of the variance in *Performance Improvement* (Y_{U2}) could be explained by the *External Factor* (X_{U1}), *Project and Resource Evaluation* (X_{U3}) and *Participation and Cooperation* (X_{U4}).

Table XII summarizes the R^2 values and indirect effects among the "IS Net Benefits" variables from the two response groups, including two negative causal relationships found in the user responses. The R^2 values of Y_{A2} and Y_{U1} (*Overall Expectation* in each response group) indicate that these two dependent variables could be inferred to be the most powerful indicators of implementation success.

External environment factor (CSF1)	
External factor (X_{U1})	
Hf1. Positively related to overall expectation (Y_{U1})	Not Support
Hf2. Positively related to performance improvement (Y_{U2})	Support
Internal organizational factor (CSF2)	
Developing strategy (X_{U2})	
Hg1. Positively related to overall expectation (Y_{U1})	Support
Hg2. Positively related to performance improvement (Y_{U2})	Not Support
Project and resource evaluation (X_{U3})	
Hi1. Positively related to overall expectation (Y_{U1})	Negative relation
Hi2. Positively related to performance improvement (Y_{U2})	Negative relation
Individual user level factor (CSF3)	
Participation and cooperation (X_{U4})	
Hj1. Positively related to overall expectation (Y_{U1})	Not Support
Hj2. Positively related to performance improvement (Y_{U2})	Support
Perceived technology compatibility (X_{U5})	
Hk1. Positively related to overall expectation (Y_{U1})	Support
Hk2. Positively related to performance improvement (Y_{U2})	Not Support

Table XI.
Hypothesis test results from user responses

		Administrative responses	
Dependent variables	R^2 value	Performance improvement (Y_{A1})	Objective achievement (Y_{A3})
Performance improvement (Y_{A1})	0.5891		
Overall expectation (Y_{A2})	0.9101	$\beta_{1,2} = -0.4438$	$\beta_{3,2} = -0.3620$
Objective achievement (Y_{A3})	0.9066	$\beta_{1,3} = -0.2222$	
User responses			
Dependent variables	R^2 value	Overall expectation (Y_{U1})	
Overall expectation (Y_{U1})	0.8435		
Performance improvement (Y_{U2})	0.5010	$\beta_{1,2} = 0.5669$	
Negative causal relations			
Dependent variable			
Independent variable		Overall expectation (Y_{U1})	Performance improvement (Y_{U2})
Project and resource evaluation (X_{U3})		$\gamma_{13} = -0.0511$	$\gamma_{23} = -01301$

Table XII.
Summary results of R^2 values, indirect effects and negative causal relations

Overall, Tables XIII and XIV summarize the structural model results of the organizational variables and the "IS Net Benefits" variables, including their indicators, from the two response groups.

5. Discussion

This study attempted to identify the factors that influence successful IS implementation in public universities by identifying the determinants of effectiveness, including the "IS Net Benefits" variables as the operational elements of implementation success.

Table XIII. Structural model results of independent variables

Classification	Administrative responses				
Classification	External environment factor *(CSF1)*	Internal organizational factor *(CSF2)*		Individual user level factor *(CSF3)*	
Organizational variables	External factor (X_{A1})	Redesign work process (X_{A2})	Resource support (X_{A3})	Participation and cooperation (X_{A4})	Perceived technology compatibility (X_{A5})
Observed variables	political influence public expectation	redesign work process	HR support	user participation cooperation within organization	perceived technology compatibility
User responses					
Classification	External environment factor *(CSF1)*	Internal organizational factor *(CSF2)*		Individual user level factor *(CSF3)*	
Organizational variables	External factor (X_{U1})	Developing strategy (X_{U2})	Project and resource evaluation (X_{U3})	Participation and cooperation (X_{U4})	Perceived technology compatibility (X_{U5})
Observed variables user participation	political influence cooperation within organization perceived technology compatibility	redesign work process plan strategy	authority and	administrative role	HR support

As shown in Tables XIII and XIV, there are causal relationships between the five organizational variables and the "IS Net Benefits" variables in both response groups: administrators and users. Thus, these results seem to support the existence of primary and secondary decisions. Five organizational variables were found under the three classifications (i.e. *CSF1*, *CSF2* and *CSF3*) as the determinants contributing to the implementation success. However, the results obtained from the administrators differed from those of the users in the identified determinants and the measure of implementation success.

The different results suggest that administrators and system users think differently about organizational IS implementation. First, the external factors (X_{A1} and X_{U1}) differed in their indicators. "Political influence" and "public expectation" were the two indicators for the administrators, while "political influence" was the only indicator for users.

Second, the administrators differed from the users in their opinions on internal organizational factors (i.e. *CSF2*). The administrators identified *Redesign Work Process* (X_{A2}) and *Resource Support* (X_{A3}) as the organizational variables that behave as determinants. However, the users identified *Developing Strategy* (X_{U2}) and *Project and Resource Evaluation* (X_{U3}) as the most important.

Third, from the administrators' perspective, *Performance Improvement* (Y_{A1}), *Overall Expectation* (Y_{A2}) and *Objective Achievement* (Y_{A3}) were found to be the key attributes defining implementation success; however, only *Overall Expectation* (Y_{U1}) and *Performance Improvement* (Y_{U2}) were identified from the users' perspective. These differences can be obviously explained by their different accountability at universities, which certainly leads to different decisions, including different opinions regarding the implementation of organizational IS.

Fourth, in Figure 2, the indirect effects found among three dependent variables (i.e. Y_{A1}, Y_{A2} and Y_{A3}) were negative links; however, Figure 3 shows only a positive link between two dependent variables (i.e. Y_{U1} and Y_{U2}). The findings of these indirect effects raise interesting questions regarding the nature and extent of these effects, and this is an important issue for future research.

However, the results also suggest similarities between the two response groups. *Participation and Cooperation* (X_{A4} and X_{U4}) and *Perceived Technology Compatibility* (X_{A5} and X_{U5}) were identified as determinants for the individual user factors (*CSF3*) for both groups. This commonality could come from a general need to have a better understanding of the process of IS implementation among both administrators and users, so that can better understand the problems and difficulties thereof. Furthermore, technology compatibility issues concern both administrators and users, because the technical function of an implemented IS should meet the work process requirement.

Finally, the finding that *Project and Resource Evaluation* (X_{U3}) had negative effects on *Overall Expectation* (Y_{U1}) and *Performance Improvement* (Y_{U2}) was unexpected. A possible reason for this result is that the resources assigned to the implementation project would be a sensitive matter when evaluated.

Finally, a comparison of this study's findings with those of previous studies is presented. As Table XV shows, *Participation and Cooperation* and *Perceived Technology Compatibility* were

Table XIV. Structural model results of dependent variables

	"IS Net Benefits" variables		
Administrative responses	Performance improvement (Y_{A1})	Overall expectation (Y_{A2})	Objective achievement (Y_{A3})
User responses	Overall expectation (Y_{U1})	Performance improvement (Y_{U2})	

Table XV. Comparison of the study finding with those of previous studies

	Administrative				
Classification	External environment factor (***CSF1)***	Internal organizational factor ***(CSF2)***		Individual user level factor ***(CSF3)***	
Organizational variable	External factor (X_{A1})	Redesign work process (X_{A2})	Resource support (X_{A3})	Participation and cooperation (X_{A4})	Perceived technology compatibility (X_{A5})
Observed variables Literature[1]	political public influence expectation competitive pressure	redesign work process reorganize/ restructure	HR support top management support/ involvement	user cooperation within participationorganization education/training; involvement, participation	perceived technology compatibility perceived compatibility
Comparison	Not consistent	Not consistent	Not consistent	Consistent	Consistent
User responses					
Classification	External environment factor ***(CSF1)***	Internal organizational factor ***(CSF2)***		Individual user level factor ***(CSF3)***	
Organizational variable	External factor (X_{U1})	Developing strategy (X_{U2})	Project and resource evaluation (X_{U3})	Participation and cooperation (X_{U4})	Perceived technology compatibility (X_{U5})
Observed variables Literature[1]	Political influence competitive pressure	redesign work plan process strategy reorganize/ restructure	authority and HR administrative role support top management support/ involvement	user cooperation within participationorganization education/training; involvement, participation	perceived technology compatibility perceived compatibility
Comparison	Not consistent	Not consistent	New Finding	Consistent	Consistent

Note: [1]= Referring to previous studies (Table I and IS success model)

found to be determinants, which is consistent with the results of previous studies. Moreover, this study found a new determinant, *Project and Resource Evaluation* (X_{U3}). Table XVI compares the attributes of IS implementation success. While *Overall Expectation* and *Performance Improvement* were identified as attributes in previous studies, *Objective Achievement* (Y_{A3}) was found to be a new success attribute in this study. In fact, the results computed from the SEM technique effectively confirmed the variable constructs and the causal relationships. Furthermore, these findings were obtained from the research model developed based on the local context of public universities in Thailand; thus, these findings expand knowledge of public organizational IS in a developing country.

6. Conclusion and implications

The results of SEM for the data from the two response groups found causal relationships between the organizational variables under three classifications, that is, the external environment factors, internal organizational factors and individual user factors and the variable constructs defining the "IS Net Benefits." These causal effects support the existence of the two types of organizational decisions (i.e. primary and secondary) that are part of the process of implementing organizational IS at public universities.

6.1 Academic implications

This study offers important implications for future research in the IS public sector arena. First, the significant proof of the causal relationships identified help to gain an understanding of organizational IS implementation within the public university environment and suggest that both administrators and users should be considered in further study with a focus on management of IS functions. Further research should also examine other public service operations to establish the viability of this study's conceptual framework.

Second, in the public university context, this study evaluated the success of implementation of a university IS. In this regard, measurement of success requires development of proper features or dimensions for its organizational environment. Analyzing rating scores on 17 attributes, this study discovered three hypothetical constructs as important dimensions to the success of evaluating IS implementation of these public universities: *Performance Improvement*, *Performance Expectation* and *Implementation Objective*.

In fact, these three dimensions are associated with information quality, use, user satisfaction and net benefits. Information quality, use and net benefits were also noted as being interrelationships at the organizational level of analysis. Moreover, user satisfaction

Administrative responses			
"IS Net Benefits"	Performance improvement (Y_{A1})	Overall expectation (Y_{A2})	Objective achievement (Y_{A3})
Literature[1]	system quality	user satisfaction	
Comparison	Consistent	Consistent	New finding
User responses			
"IS Net Benefits"	Overall expectation (Y_{U1})	Performance improvement (Y_{U2})	
Literature[1]	user satisfaction	system quality	
Comparison	Consistent	Consistent	

Note: [1]= Referring to previous studies (Table I and IS success model)

Table XVI. Comparison of the measures of organizational IS implementation success with those of previous studies

was not found to be a single dimension of the measurement in this study (Al Athmay *et al.*, 2016; Petter *et al.*, 2008). Apparently, these dimensions better reflect IS success measure for evaluation of the implementation success of university IS.

In terms of public universities, their service operation encompasses both external and internal organizational environments, such as organizational behavior and practice, public concerns and expectation and government policy, which have changed over time. Although the current study confirmed the dimensions of implementation success for public university organizational IS, when evaluating any IS success, further examination is still necessary to confirm proper dimensions for measurement. In addition, the different organizational functions of public universities could bring forth different perspectives on how to measure IS implementation success. Thus, more research is needed to explore university functions other than student registration.

In the case of hypothesis testing, the results identified *Performance Improvement*, *Overall Expectation* and *Objective Achievement* from the administrators' perspective, and only *Overall Expectation* and *Performance Improvement* were identified from the users' perspective. The test results support the idea that for IS research in a developing country environment, evaluation of the success of IS requires development of proper features, as they should be appropriate for organizational context and the purpose of organizational IS (Andoh-Baidoo, 2017; Petter *et al.*, 2013; Roztocki and Weistroffer, 2011).

Third, from the user responses, the analysis found negative effects of *Project and Resource Evaluation* on *Overall Expectation* and *Performance Improvement*. This result raises questions regarding the nature and extent of this organizational variable. Several questions need to be answered concerning these negative relationships; hence, more work is needed to understand these effects fully, including establishing the cause of these negative relationships. Moreover, further research in other university functions is essential to confirm whether these negative effects would hold. Finally, further research should extend this current study to incorporate the influences of regional differences.

6.2 Practical implications

For IS practitioners and public universities, first, the findings have important implications for project implementation of organizational IS, including the need to pay more attention to the causal effects of the organizational variables. The determinants of implementation success, specifically, external factors, internal organizational factors and individual user factors, could offer managerial guidance on project planning. Public university administrators and development teams should pay attention to these organizational variable constructs and their indicators.

Second, the possibility that *Project and Resource Evaluation* (X_{U3}) could hinder the implementation of projects should be considered. In this study, project evaluations and resource allocations were considered sensitive matters among users. Therefore, administrators and development teams must understand these matters to avoid any project difficulties.

Third, *Participation and Cooperation* and *Perceived Technology Compatibility* suggest that the implementation process requires active user participation. Moreover, creating a cooperative environment within the organization appears to be necessary. Indeed, the participation of both administrators and users could help address technological compatibility issues.

6.3 Limitations

This study has certain limitations. First, the total administrative responses were slightly less than 200; thus, the response number did not meet the requirement (approximately 200) for the SEM analysis (DeCoster, 1998). This could cause insignificant parameter estimates. Second, the study focused on 40 public universities located across the country and the S-R system project implementation. Regional differences, such as in the context of human resources, may have affected the results. Thus, caution should be exercised when generalizing the results to other university functions or other organizations.

Notes

1. Information was obtained from: https://en.wikipedia.org/wiki/State_agencies_of_Thailand, http://education.stateuniversity.com/pages/1532/Thailand-TEACHING-PROFESSION.html, and The Ministry of Education
2. Information was obtained from conducting telephone surveys.
3. Information was obtained from conducting case study at two Rajabhat Universities and in-depth interviews with administrators at the Ministry of Education.

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Appendix

The interview protocol for telephone survey:

Q1. At present, how do students register for their class? (Probe: What are the procedures?)

Q2. Please explain how the student registration system at your university works? What are the features and functions of the system?

Q3. How was the system acquired?

Q4. Who was involved in the acquisition of the system? Have those people encountered any problems?

Q5. Who participated during the development/installation process? The registrar staff and faculty? (Probe: If yes, how? What are their activities/responsibilities? If no, why? What was the reason?)

Table AI.
Description of return responses from 40 universities

	Total	Administrator	User
Target population	670	329	341
Return and usable	382	178	204
Response rate (%)	**57.0**	**52.19**	**62.0**
Return from (universities)	40	40	40

Table AII.
Participants' profiles

	Administrator	(%)	User	(%)
Gender				
Male	119	66.9	63	30.9
Female	58	32.6	139	68.1
Missing	1	0.6	2	1.0
Age Range				
younger than 31 years	2	1.1	36	17.6
31 to 40 years old	26	14.6	84	41.2
41 to 50 years old	45	25.3	50	24.5
51 to 60 years old	82	46.1	30	14.7
older than 60 years	15	8.4	–	–
Missing	8	4.5	4	2.0
Education level				
Vocational training	–	–	6	2.9
Bachelor's Degree	11	6.2	108	52.9
Master's Degree	102	57.3	65	31.9
Doctoral Degree	57	32.0	20	9.8
Other	–	–	5	2.5
Missing	8	4.5	4	2.0
Length of time worked within present position				
less than 1 year	28	15.7	21	10.3
1 to 4 years	42	23.6	70	34.3
5 to 8 years	37	20.8	35	17.2
9 years or longer	63	35.4	77	37.7
Missing	8	4.5	1	0.5

Fit indices	Criteria[1]	Organizational variable	Accept	IS Net Benefits variable	Accept
χ^2		115.14		17.9333	
df		94		17	
χ^2/df	$0 < \chi^2/df \leq 3$	1.224	✓	1.0547	✓
NNFI	Close to 1 and >1	0.9373	✓	0.9881	✓
CFI	$0.95 \leq CFI \leq 1.0$	0.9509	✓	0.9928	✓
SRMR	$0 \leq SRMR \leq 0.10$	0.07603	✓	0.04738	✓
RMSEA	$0 \leq RMSEA \leq 0.08$	0.05205	✓	0.02557	✓
Largest Std. Residual	< 2 to 4	3.2882	✓	1.9123	✓

Notes: χ^2 = Chi-square; *df* = degrees of freedom; NNFI = Non Normal fit index; CFI = Comparative fit index; SRMS = Standardized RMR; RMSEA = Root mean square error of approximation
Sources: [1]Hooper *et al.* (2008); Müller (2003)

Table AIII.
Goodness-of-fit of CFA results for administrative responses

Fit indices	Criteria[1]	Organizational variable	Accept	IS Net Benefits variable	Accept
χ^2		98.3706		30.4444	
Df		80		8	
χ^2/df	$0 < \chi^2/df \leq 3$	1.229	✓	3.805	
NNFI	Close to 1 and >1	0.9799	✓	0.9031	✓
CFI	$0.95 \leq CFI \leq 1.0$	0.9847	✓	0.9483	✓
SRMR	$0 \leq SRMR \leq 0.10$	0.05559	✓	0.07103	✓
RMSEA	$0 \leq RMSEA \leq 0.08$	0.05023	✓	0.1728	
Largest standard Residual	< 2 to 4	2.6532	✓	5.0421	

Notes: χ^2 = Chi-square; *df* = degrees of freedom; NNFI = Non Normal fit index; CFI = Comparative fit index; SRMS = Standardized RMR; RMSEA = Root mean square error of approximation
Sources: [1]Hooper *et al.* (2008); Müller (2003)

Table AIV.
Goodness-of-fit of CFA results for user responses

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