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An empirical analysis of a maturity model to assess information system success: a firm-level perspective

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ABSTRACT
This research investigates the relationship between IS investment and IS success and the moderating effects of IS maturity. We find the moderating role of IS maturity between IS investment and IS success with a contingency perspective. As administering a group survey of about 300 business executives across multiple industries, the results of this study indicate that IS investment is a critical antecedent of IS success, and IS maturity has a positive moderating effect on this relationship. The implication of the findings implies that global companies should consider the maturity of their IS management: as a crucial factor in maximising the effectiveness of IS investment.

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IS success; IS investment; technological maturity; empirical study

1. Introduction

Efficiently and effectively managed IS investments that meet business and mission needs can create a new value-revenue generation, build important competitive advantages and barriers to entry, improve productivity and performance, and decrease costs (Luftman and Derksen 2012; Suh et al. 2013). However, many scholars and practitioners remain sceptical as to whether they are receiving full value from their IS spending and also whether this spending is being properly directed (Carr 2004; Varian 2004), because consumerisation of IS infrastructure mitigates the potential gains from new IS investment since competitors can easily duplicate a new IS application. On the other side, proponents of IS investment advocate that the value of standardised IS architectures are different across firms because there are significant organisational differences in the way firms implement IS development (Clemons and Row 1991; Hitt and Brynjolfsson 1996). So far, many academic attempts have been made to resolve the relationship between IS investment and its outcomes (e.g. Weill and Aral 2006; Kleis et al. 2012; Bardhan, Krishnan, and Lin 2013).

These polarised discussions in both the academic and practitioner literatures suggest that whether IS investments contribute to IS success is still an open empirical question. More importantly, *under what conditions IS investments contribute to IS success more* (*or less*) has attracted little attention. Admittedly, Delone and Mclean's (1992) IS success model systematically categorised success factors, by combining 180 former related studies. Importantly, Barua, Kriebel, and Mukhopadhyay (1995) have suggested a two-stage model which distinguished (1) intermediate variables such as the performance of production or marketing management and (2) outcome variables such as the market share or profitability of the business unit. Based on this model, our main interest – IS success – can be an intermediate variable between economic input such as IS investment and outcome variables such as market share and return on assets. Prior research has examined the value of IS investment mostly at the macro-level and by adopting outcome variables; however, the mutual relation between the actual investment on IS and IS success may differ across environmental conditions (Xue, Ray, and Sambamurthy 2012). For example, Xue, Ray, and Sambamurthy (2012) suggested that industry environments moderate the effects of IS investment, and a recent study has highlighted the impact of interaction between IS investment and R&D investments on firms' market value – outcome variables (Bardhan, Krishnan, and Lin 2013).

However, we have a limited understanding about whether strategic and organisational factors actually impact on the link between IS investments and IS success as an important intermediate variable. In order to advance the current state of knowledge in this area, we argue that IS investments increasingly create additional IS success through interactions with other contingent

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factors. We specifically focus on the *IS maturity* and examine how investments in IS can interact with and enable the maturity in IS. IS maturity is generally defined as the overall level of IS management, attained through partially controllable context variables from contingency theory (Ein-Dor and Segev 1982). Recently, great attention has been shown to the question of the internal ability of an organisation's IS planning, IS use, and knowledge management (KM) from the perspective of maturity (Chan and Reich 2007; Kruger and Johnson 2010; Kuo and Ye 2010; Zephir, Minel, and Chapotot 2011; Serna 2012). Moreover, prior research suggests that organisational growth with respect to the use of IS should be conceived in terms of clearly defined stages of maturity (Galliers and Sutherland 1991).

In this study, we develop a comprehensive model to explain the role of IS maturity in IS success, which is linked to the ability of an organisation to implement the appropriate IS investment, using a firm-level group survey of about 300 business executives that spans multiple industries. To the best of our knowledge, our study represents one of the first attempts at examining the joint impact of IS investments and IS maturity on IS success using recent firm-level survey data.

This study makes several contributions to the literature. First, our conceptualisation of IS maturity regarding plan, implementation, operation, and evaluation maturity allows for a finer-grained understanding of the moderating effect of IS maturity on the association between IS investments and their success. These insights can shed light on a polarised discussion about the effectiveness of IS investment. Second, our study complements past research on IS investment, which has mostly focused on the direct consequences of IS investments (Weill and Olson 1989; Saunders and Jones 1992; Myers, Kappelman, and Prybutok 1998). Although a few studies have examined the moderator between IS investments and its outcomes (Xue, Ray, and Sambamurthy 2012; Bardhan, Krishnan, and Lin 2013), our study, to our best knowledge, is among the first to quantify the moderating effect of IS maturity as a contingent variable. Third, our study also contributes to the literature on the antecedents of IS success (DeLone and McLean 1992; DeLone and McLean 2003; Zephir, Minel, and Chapotot 2011; Ragowsky, Licker, and Gefen 2012). A large body of literature has examined the antecedents of IS success in general, but there has been little empirical research regarding the moderating impact of IS maturity as a contingent factor on the IS success. Lastly, on a practical front, our findings suggest that firms should tailor their IS investments, depending on the maturity in IS infrastructure, in order to increase the return on investment in IS.

The remainder of this paper is organised as follows: The next section describes the literature review on IS investment, success, and maturity. Section 3 presents our hypotheses, which focus on the moderating role of IS maturity in the relationship between IS investment and IS success. Sections 4 and 5 explain the research design and present the research results. The final section summarises the research, discusses the findings, and presents implications for future research.

2. Literature review

Researchers in the IS discipline have extensively investigated the impact of IS investments on firm performance (Bharadwaj, Bharadwaj, and Konsynski 1999; Kleis et al. 2012; Kohli, Devaraj, and Ow 2012) and antecedents of IS success (DeLone and McLean 1992; Lee and Pai 2003; Trkman 2010; Fearon, McLaughlin, and Jackson 2014). However, there is limited research examining the role of IS maturity in the relationship between IS investment and IS success (Ragowsky, Licker, and Gefen 2012). In this section, we first review IS investment, IS success, then present IS maturity steps that we argue in this study.

2.1. IS investment

Previous studies have treated the characteristics of IS investment differently, classifying IS investment as a capital, asset, or expenditure account depending on the corporate accounting policy (Earl 1989; Bacon 1992; Weill 1992). Importantly, Earl (1989) classified the strategic values of IS by the objective of IS investment: (1) competitive advantage, (2) productivity performance, (3) new way of managing, and (4) new businesses. Recently, in order to manage IS investment as a portfolio, Weill and Aral (2006) added infrastructure type to the existing types of IS investment. These classifications notably presented the different types of IS investment, which are related to system maintenance from an IS infrastructure point of view.

Given that IS investments at different levels have different functional scope and boundary spanning requirements (Xue, Liang, and Boulton 2008), we suggest that all types of IS investment can be aligned into either internal investment or external investment. The internal investment perspective is related to process efficiency and production improvement, within an organisational value chain. This view implies that IS investment is concentrated within decision-making, process adjustment/cooperation, document processing of organisational information, data analysis, and process standardisation. On the other hand, the objective of external investment

is related to the effectiveness of external relations such as customers, suppliers, and distribution channels. Here, IS investment mainly concentrates on the upstream/downstream part of supply chain management (SCM), the differentiated customer relationship management (CRM) service, the cost reduction of distribution, and business-to-business (B2B) transactions.

In this study, we define IS investment as the investment that focuses on the target system and pursues the goal of the system by applying the IS strategy. Based on previous studies (Johnston and Carrico 1988; Earl 1989; Weill and Olson 1989; Weill 1992; Weill and Aral 2006; Xue, Liang, and Boulton 2008), the characteristics of IS investment can be summarised into internal operating efficiency and external competitive advantage guarantee. Therefore, taking two perspectives of IS investment (i.e. internal and external) into account, this research constructs two types of IS investment as follows:

(1) Internal System Investment: IS investment related to efficiency and productivity improvement of core or supporting business activities in an organisational value chain process such as ERP (Enterprise Resources Planning), MES (Manufacturing Execution System), PDM (Product Data Management), KM, EP (Enterprise Portal), DSS (Decision Support System), etc.

(2) External System Investment: IS investment related to the improvement of business efficiency and the effectiveness of external relations or the expansion of customer relations and sales entities such as CRM, SCM, CALS/EC (Commerce At Light Speed/Electronic Commerce), EDI (Electronic Data Interchange), etc.

2.2. IS maturity

IS maturity indicates an organisation's internal ability for IS planning, and utilisation, and it is considered as a major explanatory factor for IS success (Karimi, Somers, and Gupta 2001). Further, IS maturity has been used in research to characterise the evolution of a firm's IS (1) function, (2) use, (3) experience, and (4) management strategy, which are, in turn, related to IS planning, organisation, and control (Nolan 1979; McFarlan, McKenney, and Pyburn 1983; Sabherwal and King 1992; Karimi, Gupta, and Somers 1996; Gupta, Karimi, and Somers 1997; Ragowsky, Licker, and Gefen 2012). Given that IS maturity is generally defined as the overall level of IS management, it includes the company's capabilities of integrating IS, the strategic usage of IS, and the employees' abilities in using IS. Table 1 summarises the IS maturity typologies and characteristics from previous studies.

Table 1. IS maturity typologies and characteristics.

Type	Level/mod	Description	Researcher
Six stages of IS maturity model	Stage 1: initiation	Evolution of IS in organisations begins at the initiation stage	Nolan (1979)
	Stage 2: contagion	This is followed by expeditious spreading of IS in a contagion stage	
	Stage 3: control	After that, a need for control arises	
	Stage 4: integration	Next, integration of diverse technological solutions evolves	
	Stage 5: data administration	Administration/management of data is necessitated, to allow development without chaotic and increasing IS expenditures	
	Stage 6: maturity	Finally, in the maturity stage, constant growth will occur	
IS maturity model	IS planning	Alignment of IS with the business, and use of managerial planning for improving the use of IS throughout the organisation	Karimi, Gupta, and Somers (1996, 2001)
	IS control	Use of a managerial orientation towards measuring IS value, basing controls on benefits, priorities, and standards	
	IS organisation	Roles and responsibilities of users and IS personnel, and the level in the organisation at which IS management resides	
	IS integration	Use of top down planning for IS, increased technology transfer, and greater exploitation of technology throughout the firm	
IS investment management maturity model	Stage 1	At this stage of maturity, an agency selects investments in an unstructured, ad hoc manner. Project outcomes are unpredictable and successes are not repeatable; the agency is creating awareness of the investment process	US general accounting office (2004)
	Stage 2	At this stage, the critical process lays the foundation for sound IS investment processes by helping the agency to attain successful, predictable, and repeatable investment control processes at the project level	
	Stage 3	This stage represents a major step forward in maturity, whereby the agency moves from project-centric processes to a portfolio approach, evaluating potential investments by how well they support the agency's missions, strategies, and goals	
	Stage 4	An agency uses evaluation techniques to improve its IS investment processes and its investment portfolio. It is able to plan and implement the 'de-selection' of obsolete, high-risk, or low-value IS investments	
	Stage 5	At this stage of maturity, which is the most advanced, organisations benchmark their IS investment processes relative to other 'best-in-class' organisations and look for breakthrough information technologies that will enable them to change and improve their business performance	

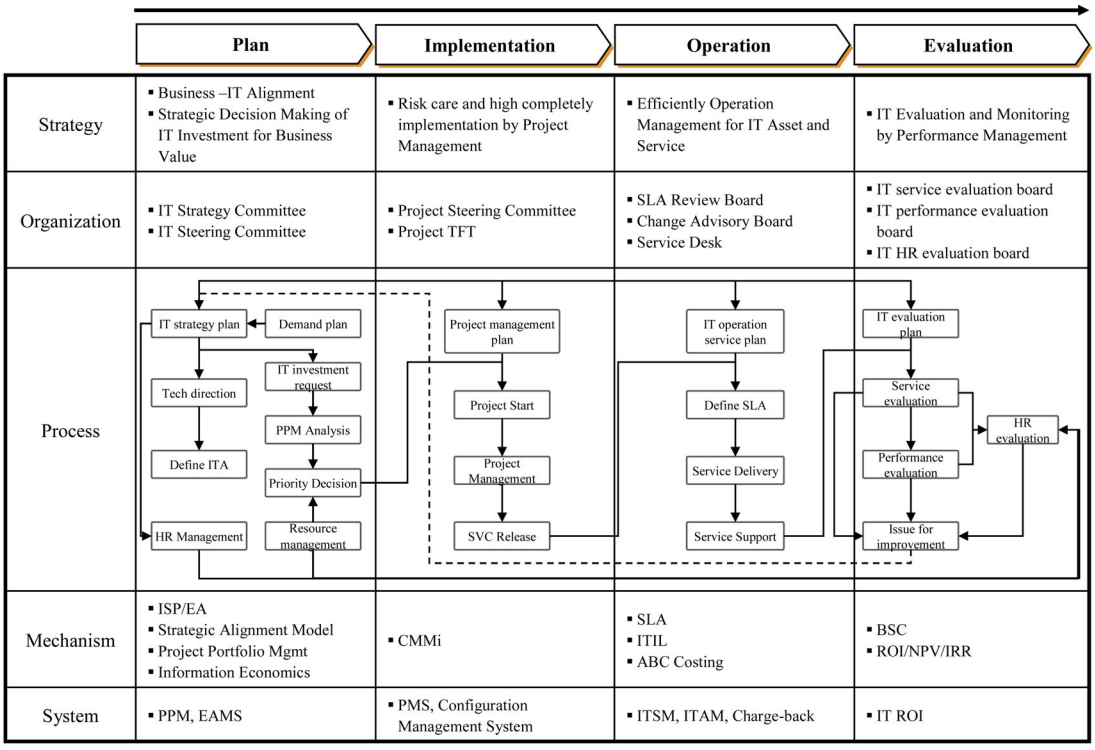

Figure 1. IS maturity framework.

While researchers have extensively investigated the role of IS maturity (Nolan 1979; Karimi, Gupta, and Somers 1996; Karimi, Somers, and Gupta 2001; GAO_US 2004), recently, as IS management expands to IT governance, which is the holistic approach to the IT life cycle, IS maturity has been needed to extend conceptually to IT governance maturity. In this regard, Peterson (2003) suggested that IS maturity should be regarded as a notion of overall management level such as IT governance which deals with IS life cycle. This study differs from the previous concept of IS maturity in that it covers both the front and the rear steps of IS implementation such as planning and evaluation, as it allows the manager to gauge the firm's IS maturity effectively.

We thus draw upon Peterson's model and conceptualise IS maturity as a general IS management level; IS governance maturity, which includes the IS lifecycle (i.e. IS planning → IS implementation → IS operation → IS evaluation), as the basis of IS maturity (Figure 1). Table 2 describes the stages of IS maturity which were employed in this study.

2.3. IS success

Most business executives wonder if their firm's IS investments perform well, and whether the value return is sufficient or not. Thus, many researchers have endeavoured to discover the association between IS investment and its productivity (e.g. Bowena, Cheungb, and Rohde 2007; Xue, Ray, and Sambamurthy 2012; Bardhan, Krishnan, and Lin 2013). In order to evaluate IS success more effectively, the definition of IS success needs to be understood. Even though IS success can be defined in various ways, it is important to differentiate IS success from business success (Norton and Kaplan 2001). Most

Table 2. The stage of IS maturity.

IT process	Definitions and goals
IT planning	For the alignment of business and IT, the IT investment roadmap is set up together with ISP or EAP, and this roadmap is reflected in the review regarding the investment for the business planning so as to help in the calculated investment
IT implementation	Throughout the RFP, the system building company is selected in a detached way. The range of IT and collaboration is sorted and classified so as to do mutual and concurrent project commitment and follow the standard criterion of quality and output control
IT operation	Receipt of service problem and fault and its handling, centred on the service desk, are treated under regulatory processes, overall operation services are guaranteed the optimised operation which is supported by the SLA and service level agreement are evaluated
IT evaluation	General ratings of usage and satisfaction to the system are regularly evaluated, measure of business value to the investment is executed, and the feedback and improvement are reflected in the IT planning

importantly, DeLone and McLean (1992) drew up a six-dimensional model of IS success including dimensions such as system quality, information quality, use, users' satisfaction, individual impact, and organisational impact. According to their study, both system quality and information quality affect use and users' satisfaction. Use and users' satisfaction affect each other in previous studies, and they jointly affect individual impact (Chung, Lee, and Kim 2014; Chung, Lee, and Choi 2015), which eventually evokes organisational impact. At first, individual impact (i.e. personal productivity and decision-making) and organisational impact (i.e. organisational performance) were measured at the benefit level. Further, in their updated model (DeLone and McLean 2003), individual and organisational impacts were integrated into one dimension (i.e. net benefit) to broaden the impact of IS, and service quality was added to the quality dimension.

Extending the seminal IS success model (DeLone and McLean 2003), we conceptualise IS success with three dimensions, which are *quality, usage, and benefit*. Through such re-conceptualisation, we expect that the existing IS success model can be refined succinctly and practical implications for managers can be straightforward. Specifically, we first incorporate service quality measurement into information quality and system quality since service quality could be an important additional construct to IS quality success in recent industry (Suh et al. 2013). Second, we conceptualise the IS usage dimension with IS usage and IS user satisfaction constructs. We thus create a high level of dimension in terms of the IS usage dimension with both usage and user satisfaction to capture firms' IS usage effectively.

Further, we collapsed both individual impacts and organisational impacts into a benefit dimension, namely the net benefit. The benefit of the IS can be defined as the strategic effects on business benefits directly or indirectly through IS investment. From a corporate point of view, IS benefit can be separated into both tangible and intangible benefits (Fearon, McLaughlin, and Jackson 2014). Moreover, IS benefit can be divided further by means of another classification method, into econometrics-oriented benefit and business process-oriented benefit. However, the effect of IS on business performance was generally measured by quantitative values, but in the valuation process we focused on executives' recognised perceptions because corresponding information is usually hard to obtain. The validity of this method has been supported by several researchers (Watson 1990; Jarvenpaa and Ives 1991; DeLone and McLean 2003). Based on Tallon, Kraemer, and Gurbaxani's (2000) IS benefit typologies and related work (Stabell and Fjeldstad 1998; Fearon, McLaughlin, and Jackson 2014), we consider a richer assessment of IS benefit using multiple perspectives based on executives' perceptions; firm-level perspective.

3. Research model and hypotheses

This research proposes the following hypotheses, which consider the association between IS investment and three dimensions of IS success (i.e. quality, usage, and benefit success) and IS maturity as a moderator variable between IS investment and IS success. As discussed above, we assumed IS investment involved two factors: internal investment and external investment. Regarding IS success, first, the quality dimension of IS success depends on three factors: system quality, information quality, and service quality. Second, the usage dimension of IS success includes two factors: usage and user satisfaction. Third, the benefit dimension of IS success involves both operation excellence and strategic positioning factor. Therefore, for IS success, we propose a measurement model that comprised three second-order factors and seven first-order factors. The three second-order factors are latent constructs reflecting quality success, usage success, and benefit success. We then hypothesise the positive association between IS investment and three dimensions of IS success, then propose the level of IS maturity can interact with and complement investments in IS, enhancing the firm's IS value creation potential. The detailed hypotheses are given in the following sections, and the overall research model is shown in Figure 2.

3.1. IS investment and IS success

While researchers in the IS economics disciplines have extensively investigated the business value of IS investments (Bharadwaj, Bharadwaj, and Konsynski 1999; Kleis et al. 2012; Kohli, Devaraj, and Ow 2012), there has been limited research focusing on the impact of IS investment on three dimensions of IS success. Prior research suggests that firms' IS investment behaviours enhance strategic alignment through their IS asset portfolio (Ross and Beath 2002; Aral and Weill 2007). The IS investment by a firm is the result of its intensive investments in IS infrastructure and applications over time. IS investment can contribute to long-run firm performance and firm's intangible value (Bharadwaj, Bharadwaj, and Konsynski 1999). To the extent that IS investments are valuable, an increase in IS investment should lead to higher IS success. We extend these ideas by explicitly linking the IS investment with three dimensions of IS success as depicted in Figure 2; IS quality, usage, and benefit success.

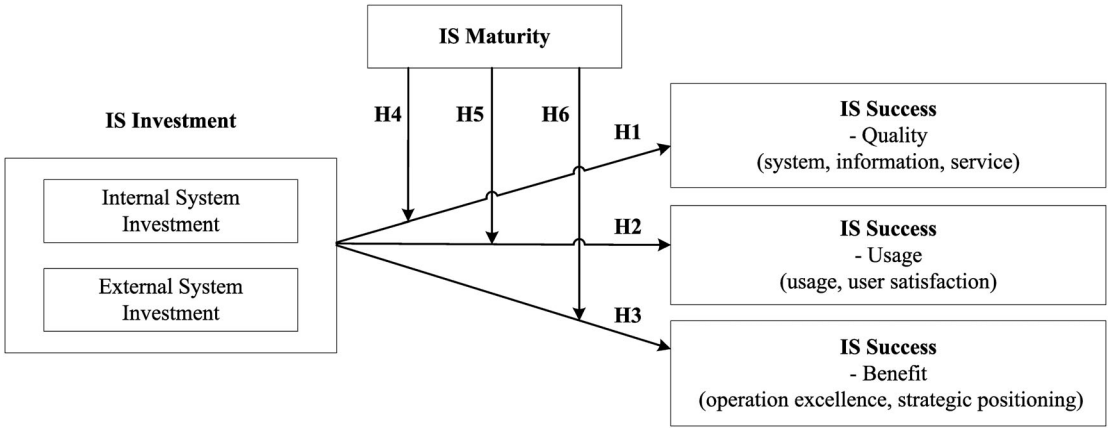

Figure 2. Conceptual framework for the research model.

First of all, if a firm emphasises the high level of IS investment which can take the form of both internal and external system investments, the firm will tend to allocate more resources to its hardware, software, manpower, and consultancy costs (Teo and Wong 1998). Consequently, with more IS investment, a firm would have greater chances of success in terms of enhancing system quality such as the response time, improved information and service quality which will be shown in the end user experience such as the accuracy of information (Raymond 1990; Mahmood and Mann 1993; Ortiz and Clancy 2003). In this study, by extending the findings from previous studies on the impact of IS investment (Raymond 1990; Mahmood and Mann 1993; Teo and Wong 1998), we posit that the more the IS investment, the more the IS success in terms of system quality, information quality, and service quality (H1).

Second, as we mentioned earlier, both user satisfaction and usage are important criteria for measuring IS usage success (Mahmood and Mann 1993; DeLone and McLean 2003). Previous studies found a positive relationship between user satisfaction/usage and the outcomes of IS investment such as hardware/software accessibility and availability, and system utilisations (Igbaria, Pavri, and Huff 1989; Igbaria and Nachman 1990; Iivari and Ervasti 1994). We thus posit that in the presence of a high level of IS investment, system accessibility and availability of the system can be increased, resulting in system use such as the frequency of usage and user satisfaction. Therefore, an increase in IS investment should lead to a higher level of IS usage success so that the value of IS investment, in turn, will be reflected in the usage dimension of IS success (H2).

Finally, firms with greater IS investment are likely to have greater expectations of its benefits. Such benefits include, for example, lower cost of system maintenance, enhanced operational process, reduced IS-related costs, and shorter reaction times (Zviran and Erlich 2003). Since, in this study, IS benefit success is measured from the executives' perspective rather than the general end users' perspective, we can treat IS benefit success as both operational benefit and strategic positioning benefit based on previous studies (Stabell and Fjeldstad 1998; Tallon, Kraemer, and Gurbaxani 2000). Specifically, we posit that IS investment should lead to a higher level of IS benefit success by providing an excellent IS operation (e.g. excellent IS-enabled planning and management support, production and operations, and product and service enhancement) and helping to achieve the IS strategic positioning (e.g. excellent IS-enabled supplier relations, sales and marketing support, and customer relations) (H3).

In sum, combining the IS success model (DeLone and McLean 2003) and the empirical evidence on the business value of IS investments mentioned above, we argue that the value of IS investment will be reflected in the firm's IS success. Therefore, we have the three following hypotheses:

H1. IS investment is positively associated with IS quality success.

H2. IS investment is positively associated with IS usage success.

H3. IS investment is positively associated with IS benefit success.

3.2. Complementarity between IS investment and IS maturity

The previous IS literature has largely focused on the pathways through which IS investments create value, using the resource-based view to examine the direct impact of IT capabilities on firm performance and firm's IS success (Chircu and Kauffman 2000; Weill

and Aral 2006; Xue, Liang, and Boulton 2008; Kleis et al. 2012; Kohli, Devaraj, and Ow 2012). However, these studies largely ignore potential complementarities between IS investment and IS maturity and their joint effect on IS success (Krishnan and Teo 2012).

In this study, it is important to acknowledge that IS investment and IS maturity are not orthogonal, but rather interdependent because a firm should increase both IS investment as well as IS maturity to achieve IS success. Therefore, we posit that whether these two dimensions (i.e. IS investment and IS maturity) are substitutes or complements has important implications on firms' IS strategy. Given the fact that firms have limited resources, if the two dimensions are substitutes, firms would gain more benefits by focusing on the dimension that has a stronger association with IS success while minimising efforts in the less valuable dimension. In contrast, if they are complements, firms need to increase efforts in both dimensions, which would require additional resources or balancing two types of IS strategies, given the limited resources. Thus, we now focus on the moderating role of IS maturity in the relationship between IS investment and IS success.

The high level of IS maturity amplifies the degree of revolution in an IS project through significant information processing, data analysis, and solid infrastructure (Jokela et al. 2006; Ragowsky, Licker, and Gefen 2012). With such a high level of IS maturity which fosters a culture of innovation and an IS project where several ideas can be tested simultaneously, a firm that actively invests in its IS is more likely to achieve its goal in IS success. However, with a low level of IS maturity which implies the lack of sufficient firm's internal ability for IS planning and utilisation, it is more difficult to achieve IS success by IS investment. This implies that increasing the level of IS maturity can strengthen the positive association between a firm's IS investment and IS success. In other words, IS investment and IS maturity have complementarity to achieve IS success.

In the following sections, we hypothesise such complementarity by disaggregating IS success into three dimensions, extending DeLone and McLean's (2003) framework, examined as follows: (1) quality, (2) usage, (3) and benefit. In our framework, IS maturity moderates the effectiveness of IS investments by providing the solid infrastructure that allows better management of an IS project.

3.2.1. Role of IS maturity in the Quality dimension of IS success

According to the IS success model, DeLone and McLean (2003) suggested that system quality and information quality are the most important IS success factors when IS are evaluated individually, but when the overall IS department is evaluated, service quality could be the most important factor. Here, we focus on the moderating role of IS maturity in the relationship between IS investment and IS quality success.

Specifically, irrespective of the level of IS investment, it is important to acknowledge that IS maturity is not orthogonal, but rather interdependent because IS success would require both IS investment (quantity aspect) and IS maturity (quality aspect) (Karimi, Somers, and Gupta 2001). Whether IS investment and IS maturity are complements has important implications for achieving IS success. By having higher levels of IS maturity (in terms of the bases of maturity strengths), a firm is more likely to strengthen the link between IS investment (e.g. allocating more resources to its hardware, software, and manpower) and IS success in terms of enhancing system quality such as the response time, improved information and service quality which will be shown in the end user experience such as the accuracy of information (Raymond 1990; Mahmood and Mann 1993; Ortiz and Clancy 2003). However, since a firm could lose its ability and internal infrastructure for IS planning, implementation, and operation in the presence of lower levels of IS maturity, a firm's IS investment has more difficulty in achieving system, information, and service quality of its IS. Thus, we posit that there should be a complementarity between IS investment and IS maturity for the IS quality success.

> **H4**. The relationship between IS investment and IS quality success is positively moderated by the level of IS maturity.

3.2.2. Role of IS maturity in the Usage dimension of IS success

The IS success model's usage dimension regards use and user satisfaction as a success indicator (Seddon 1997; DeLone and McLean 2003; Heo and Han 2003). Therefore, we now focus on the moderating role of IS maturity in the relationship between IS investment and IS usage success. In other words, there should be a complementarity between IS investment and IS maturity for the IS usage success.

Specifically, when a firm has good abilities and internal infrastructure for IS planning, implementation, and operation (in the high level of maturity strengths), a firm's IS investment (e.g. allocating more resources to its hardware, software, and manpower) is more likely to achieve IS usage success such as IS usage level and IS user satisfaction. By having sound ability for IS planning, implementation, operation, and evaluation, a firm not only can increase the existing and future IS's extent, hours, voluntary, and anticipated use, but also can increase user

satisfaction on information and service (Karimi, Gupta, and Somers 1996; Kruger and Johnson 2010; Ply 2012). Therefore, increasing the level of IS maturity can intensify the direct relationship between IS investment and IS usage success. In sum, the positive impact of IS investment will be enhanced for those for whom the level of IS maturity is high (vs. low). However, it is still an open empirical question, thereby positing H5.

H5. The relationship between IS investment and IS usage success is positively moderated by the level of IS maturity.

3.2.3. Role of IS maturity in the Benefit dimension of IS success

Among our dimensions of IS success, the last dimension is the benefit dimension (Tallon, Kraemer, and Gurbaxani 2000; DeLone and McLean 2003). By having strong ability and internal infrastructure for IS planning, implementation, and operation (i.e. higher level of IS maturity), a firm that actively invests in its IS is more likely to increase operational efficiency in both the firm's primary activities and support activities (Clemons, Reddi, and Row 1993; Tallon, Kraemer, and Gurbaxani 2000), and increase the possibility that existing and future IS projects achieve success in strategic positioning such as reducing transaction costs, transaction risks, and distribution costs, and enhancing the customer-supplier relationship (Hoffman 1994; West and Pageau 1994; Bloch and Segev 1997; Chircu and Kauffman 2000; Petter and McLean 2009).

Therefore, increasing the level of IS maturity can strengthen the positive association between a firm's IS investment and IS benefit success. This argument indicates that organisations that have strong IS maturity are likely to enhance the IS benefit success. Given that IS investment leads to both high level of IS maturity and IS benefit, the positive influence of IS investment on IS benefit success could be strengthened for those for whom the level of IS maturity is high (vs. low). However, it is an open empirical question as to where IS maturity moderates the link between IS investment and IS benefit success, thereby positing H6.

H6. The relationship between IS investment and IS benefit success is positively moderated by the level of IS maturity.

4. Research methodology

In this section, we explain research methodology by using a group survey of firm executives. We then introduce research measurement and the procedure of structural equation modelling.

4.1. Sample and survey administration

In order to test these hypotheses, we conducted a group survey of about 300 business executives from mid-2008 to late 2009. This number represents companies that are in South Korea and other EU and US foreign companies based in Korea of similar size and operating characteristics. The survey targeted a range of business executives in these firms including, but not limited to, the CEO, CFO, COO, and CIO. We conducted both fax and e-mail surveys to cover data insufficiency from the group interviews and to increase the response rate. The data collection method was used for both group interviews and e-mail and fax questionnaire surveys in this research. The gang survey method was used for the group interviews whereby responses were taken immediately after explaining the purpose of this research to the respondents.

A group interview by the research team was conducted on the following groups: (1) firm's executives who had participated in the CIO academy courses at the Federation of Korean Information Industries (FKII) during 2008–2009, (2) firm's executives who had attended the Advanced Management Program (DAMP) courses at Seoul National University during 2008–2009, (3) the firm's CFO and CIO who had partaken in the breakfast IT forum at the Korea Foreign Company Association (FORCA) in 2009. For the information to be consistent for the goals of this research, we also included a number of companies in the target interview groups that are listed on the Korean stock market as well as EU and US foreign companies based in Korea, as they are secure and solid bases and environments of IS-oriented business.

A summary of the characteristics of the respondents is presented in Table 3. Since our sample represents a wide range of companies, we used a one-way analysis of variance to determine whether responses varied by geographic location, industry, and firm size. Firm size was measured using two variables: number of employees

Table 3. Characteristics of the sample.

Variable	Frequency (*n*)	Percent (%)
Firm's location		
Korea	213	78.0
The EU or the US	60	22.0
Industry types		
Construction/engineering	14	5.1
Finance	50	18.3
Business and professional services	52	19.0
Wholesale/retail	63	23.1
Manufacturing	83	30.4
Telecommunications	11	4.0
Firm size		
Large enterprise	134	49.1
SME	139	50.9

and annual sales (Karimi, Gupta, and Somers 1996). Common operationalisations of firm size include gross sales or gross value of assets (e.g. Kettinger et al. 1994). In this study, we categorised small-medium enterprise (SME) firms as those with 500 or fewer total employees and/or annual sales of $1 billion or less; large firms are those with more than 500 total employees and/or annual sales of over $1 billion. Initially, a total of 330 executives were recruited for the group survey, then final responses were received from 273 executives (one executive per firm), yielding an overall response rate of 82.6%.

5. Research results

We employed Partial Least Squares (PLS) analysis with SmartPLS (Ringle, Wende, and Will 2005) to test our structural model. PLS is appropriate for the structural model test in this study, because our model contains multi-paths and non-normal data (Chin 1998). We performed Kolmogorov–Smirnov and Shapiro–Wilk tests to examine the normality of distributions by using SPSS Version 20.0, and found that the sample distributions from our data did not obey the normal distribution. Also, PLS is appropriate to test the moderation effect by measuring the level of significance of the interaction terms and calculating the moderation effect size (Chin, Marcolin, and Newsted 2003).

5.1. Testing the measurement model

To build the measurement scale for the model constructs, we consulted prior literature and drew up a list of 58 items to measure these variables (for detail measurement items; see Appendix 1). All variables are measured via a 7-point Likert scale (1 = totally disagree, 7 = totally agree). We assumed that three latent constructs were the sub-dimensions of IS success. To determine whether our key constructs are formative or reflective, we reviewed decision rules from previous studies (Doll, Xia, and Torkzadeh 1994; Jarvis, MacKenzie, and Podsakoff 2003). Specifically, given that changes in IS quality success do not cause in the sub-dimensions of IS quality success (i.e. system quality, information quality, and service quality) while changes in the sub-dimensions of IS quality success should cause changes in IS quality success, the formative model is warranted. Further, conceptually, it is not necessary for both internal and external investment to co-vary with each other. Therefore, we employed a formative model for the second-order constructs (i.e. IS quality success, IS usage success, IS benefit success, and IS investment). The seven first-order factors were loaded onto one of the second-order factors while first-order factors were measured using their respective multiple indicator variables (see Appendix 1).

We conducted a confirmatory factor analysis to assess the reliability and validity of the measurement model. First, as shown in Table 4, the smallest value of Cronbach's α is 0.80, indicating a satisfactory level of internal reliability of the measurement item. Second, for convergent validity, item loadings exceed the recommended threshold of 0.6 (Hair et al. 2009). Third, for reliability, the composite reliability (CR) measures of all latent variables exceed the recommended threshold of 0.7, and the average variance extracted (AVE) values for each construct exceed 0.50 (Fornell and Larcker 1981). Fourth, for discriminant validity, the AVE for a construct should exceed the variance shared between the construct and other constructs in the model (Chin, Gopal, and Salisbury 1997). We also included the associated t-values and squared multiple correlations, or proportion of explained variance (R^2). Notably, the t-values were all significant and the R^2 values ranged from 0.45 to 0.77, indicating acceptable reliability for all factors. Table 5 shows the inter-construct correlations, with the square roots of the AVE of each construct in the diagonal elements. The square roots of the AVE exceed the inter-construct correlations, thereby satisfying the discriminant validity.

5.2. Testing the structured model

We measured the explained variance (R^2) of the dependent variables, path coefficients (β), and their levels of significance (t-values), which were obtained from a bootstrapping with re-sampling (546 re-samples, greater than 2 times our sample size = 273) to assess the significance of the hypothesised relationships. Figure 3 depicts the explained variances (R^2), the structural path-coefficient estimates on each path (β) and their levels of significance (based on t-values), along with the moderation effect sizes using Cohen's f^2. All hypotheses are supported at the $\alpha = 0.01$ levels of significance. Appendix 2 presents the entire structural model.

First, the *IS investment* is positively associated with the *Quality dimension of IS success* (H1: $\beta = 0.29$, $t = 7.48$) and is also positively associated with the *Usage dimension of IS success* (H2: $\beta = 0.35$, $t = 9.75$). Further, the *IS investment* is also positively associated with the *Benefit dimension of IS success* (H3: $\beta = 0.43$, $t = 12.23$). The results from the test of H1 indicate that, as hypothesised, if IS investment is at a high level, then a firm will achieve IS success in terms of quality. The results from the test of H2 indicate that a firm with a high level of IS investment will gain IS success in terms of usage. Finally, the results from testing H3 indicate that IS investment including internal

Table 4. Scales' reliabilities and convergent validity.

Observed variables					Latent variables					
Item	Mean	SD	Factor loading	R^2	Factor	Std. structure coefficient	R^2	Cronbach's α	CR	AVE
ISI 1	3.70	1.91	0.98[a]	0.59	Internal system investment	0.62 (7.38)	0.45	0.97	0.98	0.75
ISI 2	3.87	1.89	0.98	0.56						
ESI 1	4.33	2.11	0.98	0.57	External system investment	0.73 (7.63)	0.49	0.97	0.98	0.89
ESI 2	4.47	2.15	0.99	0.57						
ISM 1	3.78	1.55	0.94	0.68	IS maturity	0.82 (10.12)	0.44	0.96	0.97	0.84
ISM 2	4.36	1.73	0.95	0.70						
ISM 3	4.66	1.61	0.95	0.71						
ISM 4	3.91	1.89	0.91	0.64						
SYQ 1	2.95	1.29	0.94	0.88	System quality	0.90 (12.21)	0.59	0.98	0.99	0.89
SYQ 2	4.41	1.26	0.89	0.59						
SYQ 3	2.97	1.36	0.92	0.64						
SYQ 4	3.07	1.47	0.92	0.55						
SYQ 5	4.04	1.48	0.90	0.61						
INQ 1	3.44	1.19	0.79	0.63	Information quality	0.72 (7.61)	0.57	0.88	0.91	0.77
INQ 2	3.47	1.26	0.83	0.69						
INQ 3	4.52	1.38	0.82	0.67						
INQ 4	4.16	1.30	0.86	0.75						
SEQ 1	3.41	1.46	0.94	0.69	Service quality	0.75 (8.79)	0.41	0.91	0.93	0.81
SEQ 2	4.19	1.58	0.92	0.66						
SEQ 3	4.93	1.83	0.92	0.56						
SEQ 4	3.44	1.45	0.89	0.50						
SEQ5	3.49	1.69	0.92	0.66						
USE 1	2.95	1.30	0.69	0.69	Use	0.91 (12.30)	0.61	0.88	0.90	0.81
USE 2	4.41	1.26	0.82	0.79						
USE 3	4.93	1.83	0.87	0.77						
USE 4	3.48	1.27	0.75	0.73						
US 1	3.99	1.29	0.77	0.60	User satisfaction	0.83 (11.14)	0.40	0.82	0.84	0.70
US 2	4.13	1.13	0.97	0.95						
US 3	4.28	1.52	0.96	0.93						
OEB_PMS 1	3.48	1.75	0.84	0.71	Operational excellence benefit	0.81 (10.51)	0.64	0.96	0.97	0.64
OEB_PMS 2	2.99	1.89	0.92	0.65						
OEB_PMS 3	3.64	1.76	0.95	0.71						
OEB_PMS 4	3.76	1.62	0.93	0.57						
OEB_PMS 5	3.54	1.82	0.95	0.61						
OEB_PO 1	4.03	1.77	0.92	0.76						
OEB_PO 2	3.60	1.77	0.94	0.62						
OEB_PO 3	3.50	1.81	0.95	0.32						
OEB_PO 4	3.33	1.80	0.94	0.58						
OEB_PO 5	2.91	1.39	0.87	0.57						
OEB_SE 1	3.73	1.75	0.93	0.67						
OEB_SE 2	3.02	1.38	0.84	0.51						
OEB_SE 3	3.89	1.74	0.88	0.57						
OEB_SE 4	2.74	1.52	0.88	0.57						
OEB_SE 5	3.69	1.72	0.90	0.62						
SPB_SR 1	3.66	1.83	0.96	0.73	Strategic positioning benefit	0.77 (9.51)	0.56	0.95	0.96	0.66
SPB_SR 2	3.73	1.80	0.95	0.71						
SPB_SR 3	3.60	1.92	0.97	0.74						
SPB_SR 4	4.05	1.90	0.96	0.73						
SPB_SR 5	4.35	2.02	0.95	0.71						
SPB_SMS 1	3.39	1.55	0.92	0.74						
SPB_SMS 2	3.47	1.88	0.93	0.76						
SPB_SMS 3	3.34	1.78	0.95	0.71						
SPB_SMS 4	3.94	1.74	0.90	0.62						
SPB_SMS 5	2.94	1.50	0.89	0.60						
SPB_CR 1	3.55	1.84	0.94	0.68						
SPB_CR 2	3.77	1.93	0.95	0.70						
SPB_CR 3	2.71	1.64	0.93	0.68						
SPB_CR 4	4.21	1.88	0.95	0.71						

Note: *t*-values for factor structural coefficients are indicated in parentheses.
[a]Indicates a parameter fixed at 1.0 in the original solution.

and external investment will induce the benefit dimension of IS success.

Next, in order to test the moderation effects of *IS maturity* on the relationship between IS investment and IS quality success (H4), IS usage success (H5), and IS benefit success (H6), we adopted the procedure that Chin, Marcolin, and Newsted (2003) introduced: we measured the *t*-statistics of the interaction factors (moderator × main effect variable) and calculated the effect sizes using the R^2's of the two models: (1) the full model with both a moderating variable (as an independent variable) and an interaction term (moderator × main effect variable) on the predicted

Table 5. Correlations among research variables.

	1	2	3	4	5	6	7	8	9	10
(1) ISI	**0.864**									
(2) ESI	0.087	**0.945**								
(3) ISM	0.521	0.423	**0.914**							
(4) SYQ	0.789	0.063	0.738	**0.942**						
(5) INQ	0.134	0.817	0.688	0.363	**0.875**					
(6) SEQ	0.468	0.634	0.864	0.713	0.770	**0.898**				
(7) USE	0.492	0.575	0.871	0.776	0.790	0.750	**0.901**			
(8) US	0.555	0.523	0.883	0.822	0.771	0.829	0.863	**0.837**		
(9) OEB	0.855	−0.034	0.637	0.841	0.226	0.559	0.588	0.648	**0.802**	
(10) SPB	−0.004	0.905	0.545	0.185	0.885	0.684	0.653	0.620	0.104	**0.813**

Notes: ISI: internal system investment, ESI: external system investment, ISM: IS maturity, SYQ: system quality, INQ: information quality, SEQ: service quality, USE: usage of IS, US: user satisfaction, OEB: operational excellence benefit, SPB: strategic positioning benefit. The bold numbers on the diagonal are the square roots of the AVEs. The off-diagonal numbers are the intercorrelations among constructs.

variable; and (2) the partial model with only the moderating variable as an independent variable on the predicted variable in the PLS model (Chin, Marcolin, and Newsted 2003). By doing this, we calculated Cohen's f^2 defined as $R^2/(1-R^2)$ which is one of the effect size measures.

H4, the moderating effect of *IS maturity* on the relationship between *IS investment* and the *Quality dimension of IS success*, is supported at the $\alpha = 0.01$ level ($t = 2.24$), with a significant effect size of 2.1%. According to Henseler and Fassott (2010), in general, over 2.0% effect size is statistically significant. Next, H5, the moderating effect of *IS maturity* on the relationship between *IS investment* and the *Usage dimension of IS success*, is supported at the $\alpha = 0.01$ level ($t = 2.56$), with a significant effect size of 2.5%. Finally, H6, the moderating effect of *IS maturity* on the relationship between *IS investment* and the *Benefit dimension of IS success*, is supported at the $\alpha = 0.01$ level ($t = 3.14$), with a significant effect size of 3.0%.

The results from these moderating effect tests indicate that, even with the existence of the strong main effects of IS investment on IS quality success ($R^2 = 0.28$ means that approximately 28% of the variance in IS quality success is explained by the main effect), IS maturity significantly improves the impact of IS investment on IS success. These results also indicate that IS maturity moderates the impact of IS investment on IS benefit success more strongly than the impact of IS investment on both IS quality success and IS usage success.

6. Discussion and concluding remarks

6.1. Theoretical and managerial contributions

Our study makes several important contributions to the literature. First, the present study offers evidence of the moderating role played by IS maturity in the relationship between IS investment and IS success. Although considerable research has been conducted on the moderating factor such as R&D and industry environment (Xue, Ray, and Sambamurthy 2012; Bardhan, Krishnan, and Lin 2013), there has been little empirical research regarding the moderating effect of IS maturity. Also, while considerable research has been conducted on the antecedent of IS success (Petter and McLean 2009; Fearon, McLaughlin, and Jackson 2014), there has been little empirical research regarding the joint impact of IS investments and IS maturity on the success in IS operation. By linking technological performance and the maturity level of a firm about IS, this study proposes a comprehensive set of IS success measures that are presented with the contingency perspective, combined with IS maturity practice. This research offers a contribution by proving the contingency relationships between IS investment, IS maturity, and IS success (Chan and Reich 2007; Veldman and Klingenberg 2009; Kruger and Johnson 2010; Ragowsky, Licker, and Gefen 2012; Krishnan and Teo 2012; Serna 2012) and an understanding of the different dimensions of IS success.

Second, our study provides new insights into the relationship between IS investment, IS maturity, and IS success. To test our research model, we conducted group surveys on a random sample of business executives in approximately 300 global companies. Responses were received from 273 individual executives, one executive per firm. By doing this, our study focuses on the critical question: 'Do complementarities between IS investments and the level of IS maturity lead firms' IS success?'. By conceptualising IS maturity as a key contingent factor, this study validates the conjecture that IS maturity enhances the impact of IS investments on IS success. Using a complementarity view and extending previous literature on IS maturity (Karimi, Gupta, and Somers 1996; Jokela et al. 2006; Ply et al. 2012; Serna 2012), the findings of our study suggest that the level of IS maturity can play a critical enabling role in helping to increase the impact of IS investments and enhancing firms' IS success.

The findings of this study provide practical implications. Our findings can help managers gauge the impact of IS maturity in terms of their contribution to firms' IS success. In other words, an important implication of our

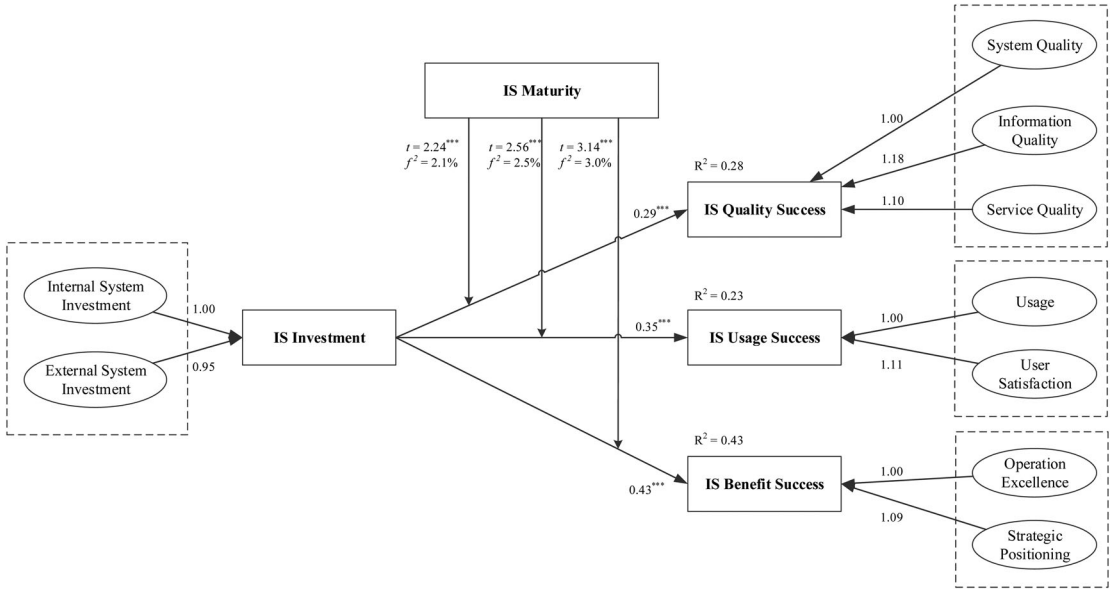

Figure 3. Research results.

study is to focus on coordinating IS investments and the maturity level of IS infrastructure and using IS maturity to improve IS project processes and outcomes. Our findings suggest that a firm's goal to realise an efficient and a high level of IS maturity is important. In our group interview, several executives have pointed out the right direction of IS life cycle. Thus, to achieve those goals of IS management, it is necessary to set up each of the following steps of the IS life cycle, from IS planning to the disposal of IS, as follows: pursue the necessary IS strategy, implement the IS strategy, work in the right manner, implement both the necessary methodology and a well-organised system. Our results could be applied to the success of an organisation's sub-domains such as CRM and business process management (Trkman 2010; Garrido-Moreno and Padilla-Meléndez 2011).

6.2. Limitations and future research avenues

This study does have several limitations. First, the research survey was conducted on listed local Korean firms and Korea-based European and US branch firms. Second, the instruments were applied in group interviews with executives; this could have been affected by the characteristics of the interviewer. Although we controlled this unobserved effect by setting up a formulaic interview procedure, it remains a limitation. Third, each respondent was an executive representing each firm. Thus we tried to solve the common method bias problem by asking the IS department or his/her secretary office to help to get a reply. Future research could examine several respondents from one firm. Finally, this study used a new instrument to measure IS maturity. While many sound research practices were followed in the development of the instrument (Kruger and Johnson 2010; Serna 2012), the instrument has only been tested on one sample of 273 firms. For example, when asking about IS maturity, some of the executives were aware of the general situation but tended to under- or overestimate their firm's level. Although this research deserves the assessment of enough discriminant validity and convergent validity, further improvement in measurement is required. A more practical research approach may be necessary by not only limiting it to a specific industry but also to the stage of a firm's globalisation, and also carrying out a case study of differences by targeting a firm's headquarters in Asia, the EU, and the US, respectively. Notwithstanding the limitations stated above, we hope that the contributions of our research in technology management, which integrated and extended the IS success model, are meaningful.

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References

Aral, S., and P. Weill. 2007. "IT Assets, Organizational Capabilities, and Firm Performance: How Resource Allocations and Organizational Differences Explain Performance Variation." *Organization Science* 18 (5): 763–780.

Bacon, C. J. 1992. "The Use of Decision Criteria in Selecting Information Systems and Technology Investments." *MIS Quarterly* 16 (3): 335–350.

Bardhan, I., V. Krishnan, and S. Lin. 2013. "Business Value of Information Technology: Testing the Interaction Effect of IT and R&D on Tobin's Q." *Information Systems Research* 24 (4): 1147–1161.

Barua, A., C. H. Kriebel, and T. Mukhopadhyay. 1995. "Information Technologies and Business Value: An Analytic and Empirical Investigation." *Information Systems Research* 6 (1): 3–23.

Bharadwaj, A. S., S. G. Bharadwaj, and B. R. Konsynski. 1999. "Information Technology Effects on Firm Performance as Measured by Tobin's Q." *Management Science* 45 (6): 1008–1024.

Bloch, M., and A. Segev. 1997. "The Impact of Electronic Commerce on the Travel Industry an Analysis Methodology and Case Study." Proceedings of the Thirtieth Hawaii international conference on System Sciences, Wailea, Hawaii, January 7–10, 48–58.

Bowena, P. L., M.-Y. D. Cheungb, and F. H. Rohde. 2007. "Enhancing IT Governance Practices: A Model and Case Study of an Organization's Efforts." *International Journal of Accounting Information Systems* 8 (3): 191–221.

Carr, N. G. 2004. *Do IT Matter? Information Technology and the Corrosion of Competitive Advantage*. Boston: Harvard Business Review Press.

Chan, Y. E., and B. H. Reich. 2007. "IT Alignment: What Have We Learned?" *Journal of Information Technology* 22: 297–315.

Chin, W. W. 1998. "Issues and Opinion on Structural Equation Modeling." *MIS Quarterly* 22 (1): 7–16.

Chin, W. W., A. Gopal, and D. W. Salisbury. 1997. "Advancing the Theory of Adaptive Structuration: The Development of a Scale to Measure Faithfulness of Appropriation." *Information Systems Research* 8 (4): 342–367.

Chin, W. W., B. L. Marcolin, and P. R. Newsted. 2003. "A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion Adoption Study." *Information Systems Research* 14 (2): 189–217.

Chircu, A. M., and R. J. Kauffman. 2000. "Limits to Value an Electronic Commerce-Related IS Investment." *Journal of Management Information Systems* 17 (2): 59–80.

Chung, S., K. Y. Lee, and J. Choi. 2015. "Exploring Digital Creativity in the Workspace: The Role of Enterprise Mobile Applications on Job Performance." *Computers in Human Behavior* 42 (2): 93–109.

Chung, S., K. Y. Lee, and K. Kim. 2014. "Job Performance Through Mobile Enterprise Systems: The Role of Organizational Agility, Location Independence, and Task Characteristics." *Information & Management* 51 (6): 605–617.

Clemons, E. K., S. P. Reddi, and M. C. Row. 1993. "The Impact of Information Technology on the Organization of Economic Activity: the 'Move to the Middle' Hypothesis." *Journal of Management Information Systems* 10 (2): 9–35.

Clemons, E. K., and M. C. Row. 1991. "Sustaining IT Advantage: The Role of Structural Differences." *MIS Quarterly* 15 (3): 275–292.

DeLone, W. H., and E. R. McLean. 1992. "Information Systems Success: The Quest for the Dependent Variable." *Information Systems Research* 3 (1): 60–95.

DeLone, W. H., and E. R. McLean. 2003. "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update." *Journal of Management Information Systems* 19 (4): 9–30.

Doll, W. J., W. Xia, and G. Torkzadeh. 1994. "A Confirmatory Factor Analysis of the End-User Computing Satisfaction Instrument." *MIS Quarterly* 18 (4): 453–461.

Earl, M. J. 1989. *Management Strategies for Information Technology*. Upper Saddle River, NJ: Prentice-Hall.

Ein-Dor, P., and E. Segev. 1982. "Organizational Context and MIS Structure: Some Empirical Evidence." *MIS Quarterly* 6 (3): 55–68.

Fearon, C., H. McLaughlin, and S. Jackson. 2014. "Measuring and Evaluating IS Expectations and Benefit Success from B2B Electronic Trading: A New Survey Approach." *Behaviour & Information Technology* 33 (4): 308–317.

Fornell, C., and D. F. Larcker. 1981. "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error." *Journal of Marketing Research* 18 (1): 39–50.

Galliers, R. D., and A. R. Sutherland. 1991. "Information Systems Management and Strategy Formulation: The 'stages of Growth' Model Revisited." *Information Systems Journal* 1 (2): 89–114.

GAO_US. 2004. *Information Technology Investment Management: A Framwork for Assessing and Improving Process Maturity*. Washington, DC: United States General Accounting Office.

Garrido-Moreno, A., and A. Padilla-Meléndez. 2011. "Analyzing the Impact of Knowledge Management on CRM Success: The Mediating Effects of Organizational Factors." *International Journal of Information Management* 31 (5): 437–444.

Gupta, Y. P., J. Karimi, and T. M. Somers. 1997. "Alignment of a Firm's Competitive Strategy and Information Technology Management Sophistication: the Missing Link." *IEEE Transactions on Engineering Management* 44 (4): 399–413.

Hair, J. F., W. C. Black, B. J. Babin, and R. E. Anderson. 2009. *Multivariate Data Analysis*. 7th ed. Upper Saddle River, NJ: Prentice Hall.

Henseler, J., and G. Fassott. 2010. "Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures." In *Handbook of Partial Least Squares*, edited by V. E. Vinzi, W. W. Chin, J. Henseler, and H. Wang, 713–735. Heidelberg: Springer.

Heo, J., and I. Han. 2003. "Performance Measures of Information Systems in Evolving Computing Environments: an Empirical Investigation." *Information & Management* 40 (4): 1–14.

Hitt, L. M., and E. Brynjolfsson. 1996. "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value." *MIS Quarterly* 20 (2): 121–142.

Hoffman, T. 1994. "Dannon Adds EDI to its Culture." *Computerworld* 28 (29): 64.

Igbaria, M., and S. A. Nachman. 1990. "Correlates of User Satisfaction with end User Computing: An Exploratory Study." *Information and Management* 19 (2): 73–82.

Igbaria, M., F. N. Pavri, and S. L. Huff. 1989. "Microcomputer Applications: An Empirical Look at Usage." *Information and Management* 16 (4): 187–196.

Iivari, J., and I. Ervasti. 1994. "User Information Satisfaction: IS Implementability and Effectiveness." *Information and Management* 27 (4): 205–220.

Jarvenpaa, S. L., and B. Ives. 1991. "Executive Involvement and Participation in the Management of Information Technology." *MIS Quarterly* 15 (2): 205–227.

Jarvis, C. B., S. B. MacKenzie, and P. M. Podsakoff. 2003. "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research." *Journal of Consumer Research* 30 (2): 199–218.

Johnston, H. R., and S. R. Carrico. 1988. "Developing Capabilities to use Information Strategically." *MIS Quarterly* 12 (1): 37–50.

Jokela, Timo, Mikko Siponen, Naotake Hirasawa, and Jonathan Earthy. 2006. "A Survey of Usability Capability Maturity Models: Implications for Practice and Research." *Behaviour & Information Technology* 25 (3): 263–282.

Karimi, J., Y. P. Gupta, and T. M. Somers. 1996. "Impact of Competitive Strategy and Information Technology Maturity on Firms' Strategic Response to Globalization." *Journal of Management Information Systems* 12 (4): 55–88.

Karimi, J., T. M. Somers, and Y. P. Gupta. 2001. "Impact of Information Technology Management Practices on Customer Service." *Journal of Management Information Systems* 17 (4): 125–158.

Kettinger, W. J., Varun Grover, Subashish Guha, and Albert H. Segars. 1994. "Strategic Information Systems Revisited: A Study in Sustainability and Performance." *MIS Quarterly* 18 (1): 31–58.

Kleis, L., P. Chwelos, R. V. Ramirez, and I. Cockburn. 2012. "Information Technology and Intagible Output: The Impact of IT Investment on Innovation Productivity." *Information Systems Research* 23 (1): 42–59.

Kohli, R., S. Devaraj, and T. T. Ow. 2012. "Does Information Technology Investment Influences Firm's Market Value? The Case of Non-Publicly Traded Healthcare Firms." *MIS Quarterly* 36 (4): 1145–1163.

Krishnan, S., and T. S. H. Teo. 2012. "Moderating Effects of Governance on Information Infrastructure and E-Government Development." *Journal of the American Society for Information Science and Technology* 63 (10): 1929–1946.

Kruger, C. J. N., and R. D. Johnson. 2010. "Information Management as an Enabler of Knowledge Management Maturity: A South African Perspective." *International Journal of Information Management* 30 (1): 57–67.

Kuo, Y.-K., and K.-D. Ye. 2010. "How Employees' Perception of Information Technology Application and Their Knowledge Management Capacity Influence Organisational Performance." *Behaviour & Information Technology* 29 (3): 287–303.

Lee, G. G., and J.-C. Pai. 2003. "Effects of Organizational Context and Inter-Group Behaviour on the Success of Strategic Information Systems Planning: An Empirical Study." *Behaviour & Information Technology* 22 (4): 263–280.

Luftman, J., and B. Derksen. 2012. "Key Issues for IT Executives 2012: Doing More with Less." *MIS Quarterly Executives* 11 (4): 207–218.

Mahmood, M. A., and G. J. Mann. 1993. "Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study." *Journal of Management Information Systems* 10 (1): 97–122.

McFarlan, F. W., J. L. McKenney, and P. Pyburn. 1983. "The Information Archipelago-Plotting a Course." *Harvard Business Review* 61 (1): 145–156.

Myers, B. L., L. A. Kappelman, and V. R. Prybutok. 1998. "A Comprehensive Model for Assessing the Quality and Productivity of the Information Systems Function: Toward a Theory for Information Systems Assessment." In *Information Systems Success Measurement*, edited by E. J. Garrity and G. L. Sanders, 94–121. Hershey, PA: Idea Group Publishing.

Nolan, R. L. 1979. "Managing the Crises in Data Processing." *Harvard Business Review* 57 (3): 115–126.

Norton, D. P., and R. S. Kaplan. 2001. *The Strategy-Focused Organization: How Balanced Scorecard Companies Thrive in the new Business Environment*. Boston, MA: Harvard Business Review Press.

Ortiz, E., and C. M. Clancy. 2003. "Use of Information Technology to Improve the Quality of Health Care in the United States." *Health Service Research* 38 (2): 11–22.

Peterson, R. R. 2003. *Information Strategies and Tactics for Information Technology Governance*. Hershey, PA: Idea Group.

Petter, S., and E. R. McLean. 2009. "A Meta-Analytic Assessment of the DeLone and McLean IS Success Model: An Examination of IS Success at the Individual Level." *Information & Management* 46 (3): 159–166.

Ply, J. K., J. E. Moore, C. K. Williams, and J. B. Thatcher. 2012. "IS Employee Attitudes and Perceptions at Varying Levels of Software Process Maturity." *MIS Quarterly* 36 (2): 601–624.

Ragowsky, A., P. S. Licker, and D. Gefen. 2012. "Organizational IT Maturity (OITM): A Measure of Organizational Readiness and Effectiveness to Obtain Value from its Information Technology." *Information Systems Management* 29 (2): 148–160.

Raymond, L. 1990. "Organizational Context and Information Systems Success: A Contingency Approach." *Journal of Management Information Systems* 6 (4): 5–20.

Ringle, C. M., S. Wende, and A. Will. 2005. SmartPLS. 2.0 (beta) ed. Hamburg, Germany.

Ross, J. W., and C. M. Beath. 2002. "Beyond the Business Case: New Approaches to IT Investment." *Sloan Management Review* 43 (2): 51–59.

Sabherwal, R., and W. R. King. 1992. "Decision Processes for Developing Strategic Applications of Information Systems: A Contingency Approach." *Decision Sciences* 23 (4): 917–943.

Saunders, C. S., and J. W. Jones. 1992. "Measuring Performance of the Information Systems Function." *Journal of Management Information Systems* 8 (4): 63–82.

Seddon, P. B. 1997. "A Respecification and Extension of the DeLone and McLean Model of IS Success." *Information Systems Research* 8 (3): 240–253.

Serna, E. 2012. "Maturity Model of Knowledge Management in the Interpretativist Perspective." *International Journal of Information Management* 32 (4): 365–371.

Stabell, C. B., and Ø. D. Fjeldstad. 1998. "Configuring Value for Competitive Advantage: on Chains, Shops, and Networks." *Strategic Management Journal* 19 (5): 413–437.
Suh, H., J. Van Hillegersberg, J. Choi, and S. Chung. 2013. "Effects of Strategic Alignment on IS Success: The Mediation Role of IS Investment in Korea." *Information Technology and Management* 14 (1): 7–27.
Tallon, P. P., K. L. Kraemer, and V. Gurbaxani. 2000. "Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach." *Journal of Management Information Systems* 16 (4): 145–173.
Teo, T. S., and P. K. Wong. 1998. "An Empirical Study of the Performance Impact of Computerization in the Retail Industry." *Omega* 26 (5): 611–621.
Trkman, P. 2010. "The Critical Success Factors of Business Process Management." *International Journal of Information Management* 30 (2): 125–134.
Varian, R. H. 2004. "Economic Scene; IT May or May not Matter; it Depends on How you Use IT." *New York Times*.
Veldman, J., and W. Klingenberg. 2009. "Applicability of the Capability Maturity Model for Engineer-to-Order Firms." *International Journal of Technology Management* 48 (2): 219–239.
Watson, R. T. 1990. "Influences on the IS Manager's Perceptions of Key Issues: Information Scanning and the Relationship with the CEO." *MIS Quarterly* 14 (2): 217–231.
Weill, P. 1992. "The Relationship Between Investments in Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector." *Information Systems Research* 3 (4): 307–333.
Weill, P., and S. Aral. 2006. "Generating Premium Returns on Your IT Investments." *Sloan Management Review* 47 (2): 39–48.
Weill, P., and M. H. Olson. 1989. "Managing Investment in Information Technology: Mini Case Examples and Implications." *MIS Quarterly* 13 (1): 3–17.
West, L. J., and R. W. Pageau. 1994. "Completing the EDI Circuit: Electronic Communications Plugs in Power for New England Electric." *Corporate Cashflow*.
Xue, Y., H. Liang, and W. R. Boulton. 2008. "Information Technology Governance in Information Technology Investment Decision Processes: The Impact of Investment Characteristics, External Environment, and Internal Context." *MIS Quarterly* 32 (1): 67–96.
Xue, L., G. Ray, and V. Sambamurthy. 2012. "Efficiency or Innovation: How Do Industry Environments Moderate the Effects of Firms' IT Asset Portfolios?" *MIS Quarterly* 36 (2): 509–528.
Zephir, O., S. Minel, and E. Chapotot. 2011. "A Maturity Model to Assess Organisational Readiness for Change." *International Journal of Technology Management* 55 (3/4): 286–296.
Zviran, M., and Z. Erlich. 2003. "Measuring IS User Satisfaction: Review and Implications." *Communications of the Association for Information Systems* 12 (1): 81–103.

Appendices

Appendix 1. Measurement items

IS investment: The degree to which an executive perceives that his or her company invests on the following IS (Johnston and Carrico 1988; Earl 1989; Weill and Aral 2006). To measure IS investment in this research, we use the objective indicators approach, whereby the firm's executives assess their IS investment characteristics (i.e. objective indicator) using the descriptions of their internal and external system investments. The above four IS investments are characterised by combining the two IS investment goals, and are illustrated by using four sub-property systems (i.e. operation, management, strategic relations, and sales).

Indicate the extent to which you agree with the following statements regarding your organisation's IS investment (from 'strongly disagree' 1 to 'strongly agree' 7).

Internal system investment
ISI1: operation system (e.g. ERP, MES, PDM)
ISI2: management system (e.g. KM, EP, DSS)
External system investment
ESI1: strategic relation system (e.g. CRM, SCM)
ESI2: sales system (e.g. CLAS/EC, EDI)

IS maturity: The degree to which an executive perceives that his or her company can manage their IS overall in terms of the following stages (Karimi, Gupta, and Somers 1996; Karimi, Somers, and Gupta 2001).

Indicate the extent to which you agree with the following statements regarding your organisation's IS maturity level (from 'strongly disagree' 1 to 'strongly agree' 7).

ISM1: *in terms of IS planning*
In our firm, to align business and IS, an IS investment roadmap is set up together with IS planning (ISP) or enterprise architecture planning (EAP), and is reflected in the review of the business plan regarding investment.
ISM2: *in terms of IS implementation*
In our firm, throughout the request for proposal (RFP), the system building company is selected in a detached way. The range of IS and collaboration is sorted and classified for mutual and concurrent project commitment and follows the standard criterion of quality and output control.
ISM3: *in terms of IS operation*
In our firm, receipt of service problem and its handling is centred on the service desk and treated under regulatory processes. Overall operation services guarantee optimised operation, which is supported by the service level agreement (SLA). The service level agreement is then evaluated.
ISM4: *in terms of IS evaluation*
In our firm, both general ratings of usage and satisfaction to the system are regularly evaluated. Measure of business value to the investment is executed. Then, feedback and improvement are reflected in IS planning.

IS success (*quality/usage dimension*): The degree to which an executive perceives that his or her company accomplishes its high quality/usage of IS in terms of the following statements (DeLone and McLean 1992; Myers, Kappelman, and Prybutok 1998; DeLone and McLean 2003; Heo and Han 2003).

Indicate the extent to which you agree with the following statements regarding your organisation's IS (from 'strongly disagree' 1 to 'strongly agree' 7).

System quality
- SYS1: adaptability of IS
- SYS2: availability of IS
- SYS3: reliability of IS
- SYS4: response time of IS
- SYS5: usability of IS

Information quality
- INQ1: completeness of information
- INQ2: relevance of information
- INQ3: reliability of information
- INQ4: timeliness of information

Service quality
- SEQ1: assurance of service
- SEQ2: competence of service
- SEQ3: empathy of service
- SEQ4: reliability of service
- SEQ5: responsiveness of service

Use
- USE1: extent of use
- USE2: hours of use
- USE3: voluntary use
- USE4: anticipated use

User satisfaction
- US1: information satisfaction
- US2: service satisfaction
- US3: overall satisfaction

IS success (*benefit dimension*): The degree to which an executive perceives that his or her company boosts its benefit from the IS in the following areas (Stabell and Fjeldstad 1998; Tallon, Kraemer, and Gurbaxani 2000)

Indicate the extent to which you agree with the following statements regarding how IS boost your organisation benefit in the following areas (from 'low realised benefits' 1 to 'high realised benefits' 7).

Planning and management support
- OEB_PMS l: Improve internal communication and coordination
- OEB_PMS 2: Strengthen strategic planning
- OEB_PMS 3: Enable your company to adopt business standardisation processes
- OEB_PMS 4: Improve management decision-making
- OEB_PMS 5: Reduce management cost

Production and operations
- OEB_PO l: Improve production throughput or service volumes
- OEB_PO 2: Enhance operating flexibility
- OEB_PO 3: Improve the productivity of labour
- OEB_PO 4: Enhance utilisation of equipment
- OEB_PO 5: Reduce the cost of tailoring products or services

Product and service enhancement
- OEB_SE l: Improve control and coordination ability of products/services
- OEB_SE 2: Decrease the cost of designing new products/services
- OEB_SE 3: Reduce the time to market for new products/services
- OEB_SE 4: Enhance product/service quality
- OEB_SE 5: Support product/service innovation

Supplier relations (*inbound logistics*)
- SPB_SR 1: Help your corporation gain leverage over its suppliers
- SPB_SR 2: Help reduce variance in supplier lead times
- SPB_SR 3: Help develop close relationships with suppliers
- SPB_SR 4: Improve monitoring the quality of products/services from suppliers
- SPB_SR 5: Enable electronic transactions with suppliers

Sales and marketing support
- SPB_SMS l: Enable the identification of market trends
- SPB_SMS 2: Increase the ability to anticipate customer needs
- SPB_SMS 3: Enable sales people to increase sales per customer
- SPB_SMS 4: Improve the accuracy of sales forecasts
- SPB_SMS 5: Help track market response to pricing strategies

Customer relations (*outbound logistics*)
- SPB_CR 1: Enhance the flexibility and responsiveness to customer needs
- SPB_CR 2: Improve the distribution of goods and services
- SPB_CR 3: Enhance the ability to attract and retain customers
- SPB_CR 4: Enable you to support customers during the sales process

Appendix 2. The entire structural model