Software Reuse Success Strategy Model: An Empirical Study of Factors Involved in the Success of Software Reuse

Completed Research Paper

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ABSTRACT

This study examined the relationship between information technology (IT) governance and software reuse success. Software reuse has been mostly an IT problem but rarely a business one. Studies in software reuse are abundant; however, to date, none has a deep appreciation of IT governance. This study demonstrates that IT governance has a positive influence on software reuse success. IT strategy and strategic decision-making process mediate the relationship between IT governance and software reuse success as mediators of the relationship. A sample of over 200 responses from IT professionals and business managers was used in this research. Data analysis was accomplished using confirmatory factor analysis (CFA) and structural equation model (SEM) with AMOS. The findings of this study supported the main causal relationship between effective IT governance and software reuse success. This study confirmed the need for effective IT governance in order to achieve success in software reuse initiatives.

Keywords

IT Strategy, IT Governance, Strategic Decision-Making Process, Software Reuse Success, Transaction Cost Economics, Business-IT Alignment.

INTRODUCTION

Software reuse is an information software development (ISD) practice that enables organizations the development of new software faster than implementing it from scratch. It has been argued that reuse improves software development productivity and quality while decreasing costs (Panagiotou & Mentzas, 2011). On the other hand, many reuse projects have failed due several reasons such as the lack of reusable assets, crude retrieval technologies, and overhead involvement in incorporating reusable assets among others (Viharana, et al., 2010). The purpose of this study is to develop and test a theoretical model to investigate the strategic factors that influence the success of software reuse projects. Specifically, this research study focuses on the impact of IT governance, IT strategy and strategic decision making practices that may impact the success of software reuse.

ISD project require the participation of multiple stakeholders including software engineers who write the source code, the developers that include the analysts, designers, testers and business managers (Wastell, 1999) as well as users. Conflicts of interest among stakeholders often exist throughout the duration of ISD projects. This is particularly true when it comes time to decide which software artifact is a candidate for reuse (Rothenberger & Dooley, 1999). It is difficult to reach the goals and objectives that the business expects and that satisfy all stakeholders across the business units. To accomplish this, a multilevel intention to adopt software reuse is crucial to an ISD group. It is important to explain the interdependency between business and IT strategies that would impact the success of a software reuse initiative. In this study, we propose that in order to succeed in a software reuse initiative, effective IT governance must first be properly implemented.

For a long time, business and IT professionals along with the business-IT alignment theorists have preached that effective business-IT alignment would result in success in IT (Henderson & Venkatraman, 1993; Luftman, 2003; Bergeron, Raymond, & Rivard, 2004; Chan, Sabherwal, & Thatcher, 2006; DeHaes & Van Grembergen, 2009). IT governance was mentioned numerous times as a major contributor to the success of business-IT alignment programs (Henderson & Venkatraman, 1993; Luftman, 2003; Chan, Sabherwal, & Thatcher, 2006). Knowing the importance of this strategic factors, the purpose of this study is to evaluate the need for effective IT governance in order to achieve success in software reuse initiatives and the role of IT strategy and Strategic Decision Making.

BACKGROUND OF THE STUDY

Software assets include architecture, design, test plan and source code (Han et al., 2008). These assets become the core business assets (Northrop, 2002). The consumption of the reusable artifacts is also costly and can be risky if it comes from an untrustworthy source. Both sides of the software reuse require effective knowledge management (KM) of the software assets. Thus, searching for knowledge about reusable assets can be expensive (Desouza, Awazu, & Tiwana, 2006; McCarey et al., 2008).

Organizations that succeed in software reuse produce good software more quickly and at lower cost. Thus, these software project teams enjoy increased productivity and better software process (Sherif et al., 2006). These benefits can be speculative, however, and depend upon the frequency of reuse by the consumers. In exchange, the reuse creators carry the cost in place of the benefits of the consumers. Whether the reusable asset is owned or acquired, the integration costs can be substantial; and these costs can be spread across involved departments. Thus, an effective reuse initiative requires strategic investment at the corporate level because the benefits can only be realized in the future (Rine & Sonnemann, 1998). As a result, top management uses these benefits to justify an investment and to establish and sustain a reuse program (Haefliger, von Krogh, & Spaeth, 2008). Furthermore, investment decisions in software reuse are ongoing because the need for reuse occurs in nearly every project (Kim & Stohr, 1998). It is difficult to predict future reuse because of the many variations in features and the uncertainties that exist in technological environments; however, the net present value (NPV) method can be used, even though it is speculative (Nazareth & Rothenberger, 2004).

The practice of software reuse can be opportunistic or planned (McCarey et al., 2008). Ad-hoc or opportunistic reuse is difficult to track because the results vary widely according to the perception and experience of the team members. On the other hand, systematic software reuse involves a process that requires a large investment from the company. Therefore, systematic software reuse is the focus of this study. These reuse activities incur additional expenses in exchange for substantial benefits in the future. Thus, management must set attainable goals and adopt effective strategies in order to achieve reuse success (Rothenberger et al., 2003).

Strong organizational support leads to the adaption of software reuse and makes required funding available for the effort (Kim & Stohr, 1998). A separate group may be funded to maintain a reuse knowledge repository and report the reuse results; however, creating and maintaining a knowledge management system can be cost-prohibitive. A good knowledge repository for the reusable assets is an important factor in the success of the reuse initiative.

Reusing an asset inside a company has fewer problems than when it is purchased (Frakes & Fox, 1995). Acquired assets can raise legal issues such as copyright, licensing and contractual disputes (Williamson, 2002). The copyrights and patent laws are intended to protect the reuse producers and consumer. The reuse consumer is not authorized to reverse-engineer the purchased software but is protected from hackers seeking to steal algorithms. On the other hand, the reuse creator is protected from the misuse of the software by the consumer (Samuelson, 1990). Software disputes can be costly and detrimental.

Deficiencies in prior research

In many past projects, the reuse of existing software assets has yielded shorter time to market, higher-quality software, and low maintenance costs. Very often, the reuse process has delivered good software solutions to customers (Rothenberger, 2004). Despite its success, though, software reuse continues to encounter many obstacles. In addition, even though software reuse is more than forty years old, a description of what factors reliably lead to its success remains elusive (Desouza, Awazu, & Tiwana, 2006). Recently, software reuse has received more attention from various software product line (SPL) practitioners (Bosch & Bosch-Sijtsema, 2009). However, many software developers continue to encounter difficulties in the reuse practice (Kishi & Noda, 2006). These difficulties stem from the four areas of the organizational study: intention to adopt software reuse addresses behavioral issues in the team; and structural issues are addressed in the areas of IT strategy, decision-making process, and governance. Although research in these four areas is abundant, to the best of our knowledge, no unified approach has been offered to help IT in practice.

IT strategy

The reuse process requires that investment decisions be made constantly, and these choices can be difficult. Should the project team develop a new software asset internally? Should the team purchase the asset elsewhere? How long will it take the team to search for a reusable asset? To find in-depth and valid answers to these questions, time and resources are needed. Furthermore, the investment of such resources may or may not yield fruitful results in the future. Consequently, the project may be delivered late and over-budget (Mohagheghi & Conradi, 2008). A project manager must make decisions on reuse issues in a spirit of collaboration with the business entities. Together, IT and business create a strong strategy that benefits the organization. In essence, a strategy is a set of long-term goals. These goals include a set of actions and resources needed to achieve the business objectives (Tallon, 2007).

Furthermore, decisions about the reuse initiative should be made strategically. In other words, they should be rational, economic and political (Boonstra, 2003). Therefore, the success of a software reuse initiative is beneficial to IT. In addition, a successful reuse program can benefit the overall strategy of the business. In the end, the success of reuse increases the business profits (Postmus & Meijler, 2008).

Strategic decision-making process

A number of factors make it difficult for IT executives to make effective business decisions, and these decisions affect the overall performance of the business (Benaroch, Jeffery, Kauffman, & Shah, 2007). A good decision, which takes time and effort to make, often yields a fruitful result for an investment opportunity. Time and money are two real and recognizable attributes in an investment. In finance, a project can be valued using the concept of a 'time value of money'. The discounted cash flow (DCF) analysis is one such method that can be used on a project, a company or an asset. 'Cash flow' is defined as the movement of the money into and out of a business. Positive cash flow is a desirable state because a company is always in need of money. Essentially, DCF determines the value of the project over time at a discounted rate using a time series of cash flows called net present value (NPV) (Benaroch et al., 2007).

Information system (IS) effectiveness is difficult to measure (Thong & Yapp, 1996). Therefore, the decisions that depend on these attributes are also difficult to recognize as good, and members in the team often challenge the effectiveness of these decisions. So, how do we know whether a strategic decision is effective? Strategic decision effectiveness is "the extent to which a decision achieves its objectives established by management at the time it was made" (Dean & Sharfman, 1996). The process of making strategic decisions is related to their effectiveness (Elbanna & Child, 2007). To achieve successful software reuse, it is essential to employ an effective process of making strategic decisions.

IT governance

In the field of IT, organizations differ in terms of structure and culture as well as history and technology use. Therefore, each IT organization must find its own unique reuse strategy; however, all strategies must lead to one result – success in their software reuse initiative. All must have strong support from management at multiple levels. In a study on software reuse, Rothenberger et al. (2003) found that supportive management leads to successful reuse programs. In ad-hoc reuse, the process is often disorganized and can frustrate the management and software developers; in the end, such reuse programs tend to become ineffective and costly (Postmus & Meijler, 2008). IT governance provides a structure for an effective IT strategy and a process for making strategic decisions.

Research questions

The study draws a parallel path between Enterprise Resource Planning (ERP) success and software reuse success. Similar to ERP, software reuse is both a technology and an innovation (Bueno & Salmeron, 2008). Both technologies require a strategic plan because they consist of long-term goals and objectives for business and IT. The plan provides a firm foundation of a structure for IT strategy and a strategic decision-making process (Xue et al., 2008).

The ERP system and software reuse are two critical areas of IT management; and in their implementation initiatives, they have both experienced similar failure rates (Mellarkod et al., 2007). ERP research has shown that IT governance is strongly related to ERP implementation success (Bernroider, 2008). As a consequence, this research proposes that IT governance is a predictor of software reuse success (Wang & Chen, 2006). To fill in the gap that exists between IT governance and software reuse, this study proposes the following research questions:

RQ1: Does IT governance influence the success of software reuse?

LITERATURE REVIEW AND RESEARCH MODEL

Transaction Cost Economics as the Theoretical Framework

The body of knowledge on transaction cost economics (TCE) is large because it is applied in a wide range of disciplines. The following section touches briefly on the taxonomies of TCE that are related to this study.

Williamson defines a 'transaction' as an event where a good or a service is exchanged via an interface; and he goes on to define an 'interface' as a technical separation between the two parties involved in the transaction (Williamson, 1981). Ideally, an interface is well designed and friction-free; thus, the cost of its transaction is negligible (Cordella, 2006). However, in the real world, this is seldom the case. The transaction cost involves the effort to smooth out the friction between two economic agents in a transaction. A rational person seeks an opportunity out of self-interest; he seeks a lower transaction cost in order to thereby maximize his profits (Simon, 1978). A transaction is usually complex and a function of three factors: uncertainty, frequency of exchange, and asset specificity (Williamson, 1981, 1983). TCE is a theory for explaining these three attributes of an economics exchange.

A TCE application can be a make-or-buy decision of an asset (Geyskens, Steenkamp, & Kumar, 2006); it can be the decision to outsource part of all IT activities from one company to another (Zeynep & Masini, 2008); or it can be the make-buy-or-ally decision in software reuse (Bosch, 2006).

In practice, any transaction that takes place with certainty is uneventful. Indeed, uncertainty arises in a transaction when the setting or the human behaviors are unpredictable. These conditions usually occur after the two parties have reached an agreement (Geyskens et al., 2006). Environmental uncertainty is the condition of lacking the relevant contingencies needed for a person to make a decision. Behavioral uncertainty, on the other hand, is the condition of lacking vision of foreseeable benefits. Practically speaking, in working with a transaction, a good organizational structure eases these conditions of uncertainty. In governance terms, an organizational structure can be hierarchical, market, or relational. When a company is facing a high level of uncertainty, the hierarchical structure model is superior to the market model. When a company is facing a medium level of uncertainty, however, the relational structure model seems to be the best fit (Geyskens et al., 2006). In general, though, researchers have recommended relational governance because it works with most business settings.

Asset specificity is the level of specialization of the product or a service involved in a transaction (Williamson, 1981). When a transaction is not of specificity, the cost is then competitive. In other words, non-specific products and services are abundant, which gives buyers the advantage since there is an abundance of choices. As a result, the market is efficient. Asset specificity is the most important attribute in TCE because it focuses on two-way relationships (Williamson, 1981). The relationship is unique in the sense that the same transaction is not repeatable elsewhere. In effect, a relationship with high asset specificity is tightly coupled. In software, a specific asset can be of a special algorithm that uniquely bonds two software components. Asset specificity can be of a few types: site, physical, and human (Williamson, 1981). Site specificity is location-specific, whereas physical specificity is specific to the material making up the final product. Human specificity, on the other hand, is about the skills of the people involved in the transaction.

In TCE, the dimension of frequency refers to the recurrence of a transaction (Williamson, 1981). When the same transaction recurs over time, a company may be better off using vertical integration (Geyskens et al., 2006). This dimension is seldom utilized in the literature because it is the least plausible.

TCE theory provides business and IT with a framework for making economics decisions with regard to available resources. The company exchanges the resources for the inputs of its operations and then transforms the inputs into products and services for survival and profits (Aubert, Rivard, & Patry, 2004). In other words, make-buy-ally decisions on any goods and services are fundamental to the business. On the demand side of software reuse, business and IT managers decide what assets to create, buy, and outsource. Thus, TCE theory provides the necessary processes and structures to achieve the objectives and goals of an organization. IT governance structure has a major impact on implementing an ERP initiative (Bernroider, 2008). Software reuse and ERP experience similar rates of success.

Business & IT alignment

IT, technologically speaking, does not benefit the business very much (Carr, 2003). In business, all units must work toward a single goal – i.e., contributing to the company's profitability. IT exists to satisfy the needs of the business that it supports (Moody, 2003). The business and IT strategies are the means by which the teams achieve company goals when these goals are aligned (Lee et al., 2008). In the past decade, business IT alignment has become one of the top ten concerns of executives (Luftmann & Kempaiah, 2008). IT alignment is an IT approach for ensuring that its strategy works in concert with the business strategy. Research has shown that IT alignment is strongly related to business performance (Chan & Reich, 2007). As a result, top executives demand that IT managers are well versed in business skills. Business and IT managers work together in controlling cost and quality (Luftmann & Kempaiah, 2008).

Luftman (2000) defines 'IT alignment' as the way in which businesses can apply IT to satisfy business needs, goals and strategies. IT alignment is nearly forty-years-old yet many are skeptical about its usefulness (Chan & Reich, 2007) and implementation failures (Luftman & Kempaiah, 2007). Today, IT alignment still experiences formidable challenges (Chan & Reich, 2007) that remain difficult to overcome. These challenges are weak IT, the lack of alignment knowledge, lack of business knowledge, and lack of a clear corporate strategy (Chan & Reich, 2007). Luftman and Kempaiah (2007) argue that

IT alignment often fails due to the lack of a clear definition. The practitioners are also looking for a perfect solution while the process lacks the instruments to measure maturity. IT alignment, therefore, presents a new opportunity to study areas where IT is a successful partner. Business and IT units can increase business performance and IT effectiveness (Chan & Reich, 2007).

IT alignment aims to help IT to support the business and helps share responsibility between IT and business (Luftman & Kempaiah, 2007). In practice, many factors and antecedents influence the success of IT alignment (Chan & Reich, 2007). Therefore, it is difficult to pinpoint those processes in which a company can excel in terms of IT alignment; in other words, the alignment processes vary from company to company. Largely, IT alignment is an industry-wide phenomenon, but its practice is not widespread. In addition, Chan and Reich (2007) found that academic and business environments differ in terms of their strategies and approaches. The size of the company (Gutierrez & Serrano, 2008) and the instrument for measuring the maturity (Luftman & Kempaiah, 2007) are the crucial success factors. An IT alignment framework proposes that IT and business are tightly coupled in strategies and infrastructures. Today, this proposed framework is classic and remains useful and applicable in the study of IT alignment.

This study relies on IT strategy from one of the dimensions used for determining IT alignment maturity by Luftman (2003). Thus, this section briefly describes the six dimensions of the IT alignment maturity. Communication is the extent to which business and IT exchange information that helps align their strategies. The competency or value is the level of business effectiveness where IT and business share the same core values. Governance is a structure for the decision-making authority that is shared between the business units and IT. Partnership is the willingness to collaborate and share risks between business and IT. Scope and architecture are the extent to which IT organization can quickly support business needs. Lastly, skill is the level of experience and knowledge of the IT workforce.

Strategic IT alignment posits that a company's success depends upon the collaboration between business and IT (Chan et al., 2006). Software reuse failure has contributed to the lack of organization and business support (Frakes & Kang, 2005). To succeed in implementing software reuse, the organization is required to place emphasis on large-grained reuse. This level of reuse invites the full participation of business units into the IT decision-making process Thus, in terms of investment strategy, IT alignment plays an important role in IT and software reuse (Rine & Sonnemann, 1998).

Research Model

Drawing on the previous research and the theoretical discourse delineated above, this study presents the following research model (Fig. 1). In this section, the discourse begins with the proposed research model.

In the research model, the IT strategy and strategic decision-making process are the two mediators. These two constructs mediate the main relationship whereby IT governance has a positive influence on reuse success. Thus, in this model, IT governance is the predictor, and software reuse success is the outcome variable. Lastly, the intention to adopt software reuse acts as the moderator for the two relationships. This model posits that the intention to adopt software reuse moderates the way in which IT strategy relates to the success of the software reuse. The intention to adopt software reuse also moderates the way in which the strategic decision-making process influences reuse success.

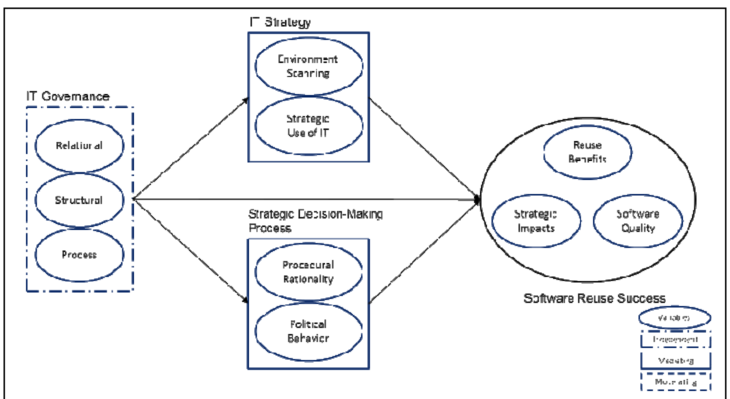

Figure 1. Software Reuse Success Strategy Model

Hypothesis 1: IT governance influences positively software reuse success.

Hypothesis 2: IT strategy explains the relationship between IT governance and the software reuse success.

Hypothesis 3: Strategic decision-making process explains the relationship between IT governance and the software reuse success.

This study consists of four (4) multidimentional constructs that were extracted from the extant literature. Software reuse success acts as a dependent variable that consists of three (3) dimensions. IT strategy and strategic-decision making process are two (2) mediators that consists of three (3) and two (2) dimensions, respectively. IT governance is the only independent variable and it consists of three (3) dimensions. These constructs are further analyzed in this section.

Dependent variable: software reuse success

Even though software reuse has gained ground in recent years, measuring reuse success in financial terms is a challenging and exhausting task (Shepperd, 2007). Software metrics can measure lines of code (LOC) or the number of components utilized for measuring the reuse success. This type of metric is important to IT, but business gains little by investing in software reuse. The success metric becomes a barrier for achieving the success of an overarching reuse initiative. Instead, the measure of success in software reuse initiatives in this study will be subjective. This study's measure focuses on the net benefits in terms of the impacts on the organizations and the individuals. The subjective measure will also consist of the information quality, system quality, and service quality derived from the DMISS model (DeLone & McLean, 2003). The organization's performance in this particular study is more concerned with the business level of reuse success. Objective measures may be in the dollar amounts for financial terms or in LOC for technical terms. Subjective measures, on the other hand, are more about a person's perception toward an event (Croteau & Bergeron, 2001). Dess (1984) conducted a study to determine the performance of a company that had several large business units, and found that a subjective measure has a positive influence on the related object measure. The core artifact on which this study focuses is software reuse assets. Thus, it is appropriate to use software quality as one of its determinants in measuring reuse success. Consequently, the software quality is concerned with the system, the information, and the service quality. Reuse success is concerned with three dimensions – the reuse benefits, the strategic impacts, and the software quality. The following sections consist of detailed discourses on these three dimensions.

Software reuse success, the dependent variable of this study, is based on the work of Rothenberger et al (2003). The researcher surveyed 77 ISD groups belonged to 67 organizations. Out of 77 responses, 71 were used in the final analysis. The study of software reuse proposed six reuse dimensions for reuse success – planning and improvement, the formalized process, the management support, the project similarity, the object technology, and the common architecture. The study concluded that organizations with high performance in all six dimensions are likely to realize reuse success (Rothenberger et al., 2003).

According to the preceding discourse, this study defines 'software reuse success' as the degree of success in technical, semantic and effectiveness aspects. These three aspects of success are articulated in terms of software quality, reuse benefits and strategic impacts (Rothenberger et al., 2003).

The proposed antecedents to software reuse success are IT governance, IT strategy, and strategic decision-making process. IT governance is the only independent variable. The IT strategy and strategic decision-making process are the antecedents of the mediation types. In other words, they are the mediators of the model.

Mediator: IT strategy

To explain a relationship between a predictor and an outcome, a mediator is used (Baron & Kenny, 1986). As the research model posits, IT governance and software reuse are positively related. The model also posits that IT strategy mediates the strength of this main relationship. Similarly, the strategic decision-making process explains why IT governance relates to reuse success.

Business strategy is a product of the decisions in relation to the environment, structure and processes (Croteau & Bergeron, 2001). A business strategy consists of long-term goals, actions and resources (Tallon, 2007). Moreover, business strategy must also consist of a set of activities that are unique in comparison to those of one's business rivals (Porter, 1996). Otherwise, the strategy is irrelevant or trivial, since there will be no real competition. At the corporate level, the shareholders hold the officers accountable for the resources in return for their investment. In financial terms, the higher the rate of return is, the better the company is perceived to perform. As a result, business strategy has a strong influence on business performance (Croteau & Bergeron, 2001). The business strategy is volatile because it must change constantly in order to stay competitive (Luftman, 2000). The strategy, therefore, must be flexible in order to react or even counter external threats.

IT plays a critical role in the area of competitive strategy (Bergeron et al., 2004). Business-IT alignment has remained one of the top ten concerns of many top executives in recent years (Luftman, 2000); these concerns arise from their fear of the inability of their company to compete with other enterprises. IT alignment relies on the business strategy, IT strategy, organizational infrastructure, and IT infrastructure. The connections of these components are important to the success in aligning IT strategy to business needs (Chan & Reich, 2007). As a result, misaligned business and IT strategies can cause a loss of opportunity (Chan, 2002). Ultimately, the IT strategy must connect with the business strategy in order to bring about IT effectiveness (Bergeron et al., 2004). IT alignment posits that strategy fit and infrastructure fit are two necessary components of enhancing business performance (Chan, 2002).

In this research, the term IT strategy implies the strength of IT strategy and is a quantitative variable. Researchers found that the strength of IT strategy is related to business performance (Bergeron et al., 2004). Success in software reuse, thus, is critical to IT management in determining its effectiveness in IT investment (DeLone & McLean, 2003). Organizational planning plays a role in software reuse initiative (Rothenberger et al., 2003). In this study, the strength of IT strategy is the ability of IT to defend its position and align with the business strategy. As such, the research model posits that IT strategy has a positive relation with software reuse success.

Mediator: Strategic decision-making process

Strategic decisions are long-term and involve a large amount of organizational resources. Researchers show that business performance relies on the quality of the decision on the allocation of resources for maximum return on investment. In addition, consensus and effective acceptance are important factors in how well one decides (Amason, 1996). Affective acceptance can be defined as the personal relationship of members in the decision team. The consensus dimension consists of the commitment to an implementation as well as cognition of the decision. The process by which one makes decisions also influences the decision outcome (Dean & Sharfman, 1996). Cognitive conflict has a positive effect on the quality of the decision, whereas affective conflicts have a negative impact on the effectiveness of the decision team.

A decision-making process can be either phase-based or attribute-based (Xue et al., 2008). A phase-based, or stage-based, approach is one that can be segregated into several phases. The phased-based approach is more complex and actor focused than the attribute-based process. On the other hand, the attribute-based process consists of several attributes that are used to decide (Dean & Sharfman, 1996). Each attribute-based process is different because the choice of attributes also differs (Maritan, 2001).

In this research, strategic decision-making process implies the strength of strategic decision-making process and is a quantitative variable. The strategic decision-making process consists of activities that lead up to the making of good decisions for long-term goals (Dean & Sharfman, 1996). In software reuse, one must decide on reusing or creating assets carefully because the decision influences the business strategically. The impact is significant because the resources dedicated for reuse can also be allocated for use in other activities.

Hypothesis Development

IT strategy has a positive influence on the success of software reuse. Researchers (Rothenberger et al, 2003) believe that strategies are necessary for a successful implementation of a software reuse initiative; however, no prior research has proposed a direct relationship between IT strategy and software reuse success. Poulin et al. (1993) states that better business strategies influence more investment in software reuse libraries that help to increase reuse success. Rothenberger et al. (2003) also agree that better strategic planning increases the success of a software reuse program.

In an ideal business–IT alignment scenario, the two entities synchronize their strategies; their strategies are complementary and well-coordinated (Luftman & Kempaiah, 2007). IT strategy is a product of the decision-making process and guides IT in terms of its environment, structure and processes (Croteau & Bergeron, 2001).

Strategic decision-making process has a positive influence on the software reuse success. Strategic decisions are long-term and involved large amount of organization resources. Researchers show that business performance relies on the quality of the decision on the allocation of resources for maximum return on investment. Software reuse is an IT investment because it requires a large amount of resources and planning efforts. Researchers found that reuse success rests upon the how business and IT cooperate in the decision-making process as what to develop for reuse (Ravichandran & Rothenberger, 2003).

When a software project adopts software reuse, a strategic decision-making process is crucial (Ravichandran & Rothenberger, 2003); however, management often makes poor decisions in adopting and implementing software reuse (Frakes & Kang, 2005). Project and business managers must work together to decide exactly what to reuse and what to create for reuse. In practice, these reuse decisions are not always systematic or business-oriented (Ben-Menachem & Gavious, 2007). The reuse decision often comes as an investment of the IT resources that belong to an organizational structure. To achieve a favorable outcome for a software reuse program, the decision-making process should be as rational and free of politics (Dean & Sharfman, 1996) as possible.

IT governance has a positive influence on a strategic decision-making process. Through the practice of IT governance, management ensures all IT investments yield desired return on investment for the shareholders. Successful investment requires an effective strategic decision-making process (Dean & Sharfman, 1996). The reuse decision often comes as an investment of the IT resources that belong to an organizational structure. IT governance is a decision right and an accountability of the IT stakeholders in implementing an IT strategy.

IT governance has a positive influence on software reuse success. An implementation of Enterprise Resource Planning (ERP) is an IT innovation that requires a careful planning, process, structures and a close business and IT inter-relationship to succeed. Bernoider (2008) found that effective IT governance leads to successful implementation of ERP. The central thesis of this study is the relationship between IT governance and software reuse success through the mediation of an IT strategy and strategic decision-making process.

Hypothesis 1 states that IT governance will mediate the relationship between IT governance and software reuse success. In addition, hypothesis 2 states that IT governance will mediate the relationship between IT governance and strategic decision-making process. As stated in the fifth and sixth hypotheses that IT strategy and strategic decision-making process are the two critical factors of software reuse success. However, effective IT governance is ultimately the driving force of any significant IT investment in a new technology or innovation such as software reuse initiative (Bernroider, 2008). As such, it is proposed that IT governance encourage software reuse success through an IT strategy and strategic decision-making process.

RESEARCH DESIGN

In this particular research, the four (4) major multidimensional theoretical concepts were IT governance, IT strategy, strategic decision-making process, intention to adopt, and software reuse success. These concepts were thoroughly studied in previous successful research projects and their possible usages were described in the literature review section. Each dimension of these concepts cannot be measured directly and is represented by a set of measurable scale items or indicators. The set of indicators that represent a dimension of the theoretical concept is called a construct. A second-order construct is a group of factors that represents a higher-level abstraction where Spearman two-factor model reaches its limitation of usefulness (Thurstone, 1931). A multivariate analysis technique enables the researchers to conduct data analysis using more than one variable simultaneously (Hair et al., 2006). Therefore, this study is a type of multivariate analysis. SEM was used in this research. This study has one independent variable (exogenous), two mediators (endogenous), and one dependent variable (endogenous).

This research will follow the two-step approach recommended by Hair, et al. (2006) to: 1) assess the measurement model validity and 2) assess the structural model validity. The measurement model shows how the constructs are operationalized by a set of measured variables. The structural model consists of a set of structural equations that can be depicted with a visual diagram.

The first step involves the confirmatory factor analysis (CFA) and the analysis of the goodness-of-fit (GOF). CFA is used to determine the item weights, factor loadings, and the dimensionality of each of the constructs in the model. In this research, the estimate technique for CFA will be a maximum likelihood estimates (MLE) because it is widely used and available. MLE, however, is sensitive to non-normality; thus, other techniques such as an ordinary least square (OLS), weighted least square (WLS), and asymptotically distribution free (ADF) have been used by other researchers.

In addition to assessing the model's GOF, the study will also compute these indices: 1) absolute fit index and 2) incremental fit index (Hair, et al., 2006). An absolute fit index is a direct measure of how well the theory fits the sample data. A root mean square approximation of error (RMSEA) value of less than 0.1 is considered a good fit. Incremental fit index helps determine how well the specified model in relation to an alternative baseline model such as the null model. Comparative fit index (CFI) that is among the most widely used index will be used as an incremental fit index for this study. CFI value is between zero and one. A model with a CFI value of greater than 0.90 is considered a good fit. As an alternative to CFI computation, Tucker Lewis Index (TLI) that is not normed will also be used to compare the model against the alternative baseline model. This study is seeking for a TLI value of close to 1.0 for a better fit.

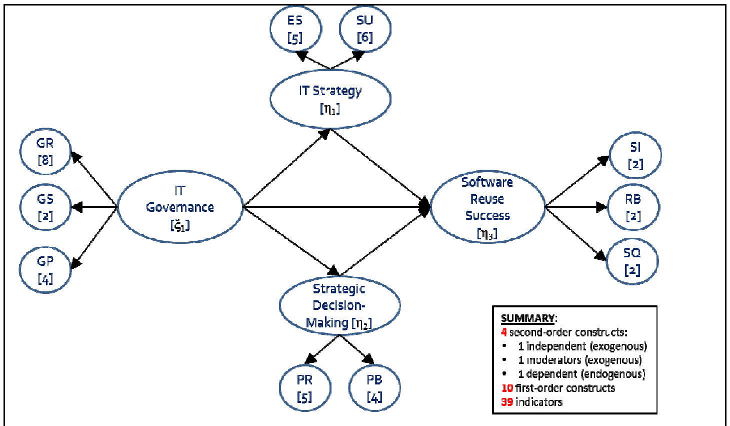

Figure 2. SEM model

The second step of the analysis is to assess the validity of the structural model. Even if the measurement model might have supported the proposed theory, the interrelationships between the constructs in the theory could be false. Thus, a reassess of the model is required to determine the overall fit and the individual estimates of the structural paths. A *p* value of less than 0.05 is considered statistically significant for path coefficients. The steps in assessing the validity of the structural model are similar to that of the measurement model; thus, values of the GOF and the indices are the same as mentioned above.

RESEARCH RESULTS

The survey questionnaire was conducted from the third week of September 2011 through the first week of November 2011. An invitation was posted to thirteen (13) online IT-focused groups within the Computer Science Corporation (CSC) collaboration network. These groups had 2,437 members. In addition, an invitation was sent to another 513 IT and business professionals outside of CSC. Nearly 3,000 IT and business professionals were invited to participate. When the survey was closed in early November 2011, 507 took the survey but only 292 surveys were completed without any missing values. The net response rate is 17.19%. The survey permitted the don't know (DK) responses. The 290 completed responses that included the DK responses. From the 507 responses, only the responses with 10% or less of missing values were selected for the research. Note that, at this point, the DK responses were considered missing. As a result, 202 cases were used for the analysis.

Confirmatory factor analysis (CFA) determines how well the scale items are suited for a construct of the study (Hair et al., 2006). On the other hand, exploratory factor analysis (EFA) determines the number of factors that a construct can have for the study. Unlike, EFA, CFA helps the researcher to either confirm or reject preconceived theory. Even though EFA was not required, this research used to shed insight into the interrelationship among the indicators prior to performing a multivariate technique. The study employed these two factor analysis techniques for the constructs of the model.

SEM will be used to determine the mediation effect of the model. Although, multiple regression method is commonly used for the mediation effect (MacKinnon, et al., 2000), the authors decide to use SEM instead because SEM is more flexible than regression (Frazier, et al., 2004). Both provide the same logic of analysis in the form of multiple regression method. SEM is useful when there are multiple predictors, multiple outcomes, and multiple mediators in the model. The model of this research consists of two mediators; thus, it is reasonable to use SEM for the analysis of the proposed mediation effects.

Table 1. Confirmatory Factor Loading

	Item	GS	GR	GP	SU	ES	SI	SQ	RB	PR	PB
Governance Structure	GS1	0.881	0.149	-0.100	0.021	0.060	-0.207	0.116	0.116	-0.017	-0.110
	GS2	0.881	-0.149	0.100	-0.021	-0.060	0.207	-0.116	-0.116	0.017	0.110
Governance Relational	GR1	-0.049	0.824	-0.104	-0.049	0.023	-0.243	-0.047	0.291	0.096	-0.135
	GR2	-0.226	0.861	0.014	-0.063	-0.024	-0.004	0.038	0.182	-0.020	-0.043
	GR3	0.001	0.831	0.000	-0.004	-0.114	-0.007	-0.044	-0.005	-0.020	-0.062
	GR4	-0.021	0.836	-0.011	-0.133	-0.094	0.122	0.055	-0.130	0.041	-0.013
	GR5	0.205	0.777	-0.023	0.108	-0.061	0.344	-0.115	-0.375	-0.028	0.098
	GR6	-0.076	0.736	0.000	0.006	0.135	0.025	0.032	-0.096	-0.179	-0.074
	GR7	0.042	0.721	0.074	0.115	0.116	0.064	0.102	-0.102	-0.010	0.260
	GR8	0.154	0.763	0.062	0.049	0.053	-0.294	-0.015	0.198	0.107	0.001
Governance Process	GP2	-0.112	-0.106	0.855	0.027	-0.127	-0.151	-0.120	0.279	0.158	-0.142
	GP3	0.056	0.140	0.847	-0.073	-0.001	0.120	0.232	-0.230	-0.055	0.070
	GP4	0.060	-0.035	0.802	0.048	0.136	0.034	-0.117	-0.054	-0.110	0.077
Strategic Use of IT	SU1	0.041	-0.005	-0.076	0.806	-0.016	0.074	0.131	-0.049	-0.121	-0.103
	SU2	0.050	-0.178	-0.042	0.820	0.012	0.115	-0.038	0.010	0.017	-0.186
	SU3	-0.118	-0.045	0.126	0.834	0.048	0.048	-0.007	-0.075	0.049	0.111
	SU4	-0.034	0.004	0.091	0.852	0.084	-0.036	-0.085	-0.037	-0.020	0.067
	SU5	0.036	0.032	-0.042	0.851	0.034	-0.045	0.119	-0.118	0.062	0.060
	SU6	0.030	0.203	-0.067	0.767	-0.179	-0.163	-0.126	0.295	0.010	0.045
Environ. Strategy	ES1	0.147	-0.106	0.187	-0.042	0.635	-0.168	0.045	-0.058	0.100	-0.152
	ES2	0.077	0.194	-0.136	0.029	0.746	0.172	-0.098	-0.176	-0.210	0.017
	ES3	-0.057	0.006	0.005	-0.017	0.835	-0.040	0.164	0.083	0.019	-0.089
	ES4	-0.067	-0.178	0.020	-0.002	0.786	0.032	-0.129	0.038	0.103	0.054
	ES5	-0.064	0.072	-0.047	0.027	0.793	-0.017	0.012	0.087	-0.005	0.147
Strategic Impact	SI1	0.173	-0.051	-0.012	-0.034	-0.001	0.895	0.010	-0.175	0.057	-0.057
	SI2	-0.173	0.051	0.012	0.034	0.001	0.895	-0.010	0.175	-0.057	0.057
Reuse Benefits	RB1	-0.108	0.142	0.081	-0.054	-0.091	-0.101	0.849	-0.160	0.071	-0.187
	RB2	0.108	-0.142	-0.081	0.054	0.091	0.101	0.849	0.160	-0.071	0.187
Software Quality	SQ1	-0.044	0.018	0.079	-0.021	-0.003	0.033	-0.002	0.942	-0.024	0.014
	SQ2	0.044	-0.018	-0.079	0.021	0.003	-0.033	0.002	0.942	0.024	-0.014
Process Rational	PR1	-0.079	0.047	0.110	-0.063	-0.033	0.080	0.006	-0.006	0.839	-0.201
	PR2	-0.006	0.030	0.009	-0.038	0.087	-0.207	0.083	0.002	0.874	-0.158
	PR5	0.089	-0.082	-0.125	0.109	-0.061	0.142	-0.098	0.004	0.795	0.386
Political Behavior	PB1	0.037	0.043	-0.074	-0.005	0.033	0.104	-0.106	-0.049	-0.139	0.889
	PB2	-0.037	-0.043	0.074	0.005	-0.033	-0.104	0.106	0.049	0.139	0.889

Table 2. Construct Validity and Reliability											
	Composite Reliability	GR	GP	GS	ES	SU	PR	PB	SI	RB	SQ
GR	0.932	0.795									
GP	0.874	0.627^{***}	0.835								
GS	0.873	0.372^{***}	0.408^{***}	0.881							
ES	0.873	0.569^{***}	0.506^{***}	0.288^{***}	0.762						
SU	0.775	0.607^{***}	0.564^{***}	0.313^{***}	0.587^{***}	0.822					
PR	0.875	0.590^{***}	0.547^{***}	0.250^{***}	0.419^{***}	0.527^{***}	0.772				
PB	0.883	0.435^{***}	0.531^{***}	0.258^{***}	0.323^{***}	0.488^{***}	0.635^{***}	0.782			
SI	0.890	0.403^{***}	0.469^{***}	0.507^{***}	0.414^{***}	0.316^{***}	0.394^{***}	0.353^{***}	0.895		
RB	0.940	0.384^{***}	0.457^{***}	0.496^{***}	0.447^{***}	0.364^{***}	0.396^{***}	0.408^{***}	0.690^{***}	0.942	
SQ	0.838	0.360^{***}	0.434^{***}	0.384^{***}	0.402^{***}	0.417^{***}	0.288^{***}	0.363^{***}	0.584^{***}	0.611^{***}	0.849

Square roots of average variances extracted (AVE's) are shown on diagonal and the correlations between first order factors off diagonal. ***: $p<0.001$.

Findings from the Measurement Models

The results from the measurement models provided four (4) new 2nd-order scales that went through rigorously analyzed CFA measurement models. These scales were multidimensional and from established peer-review management journals. These new scales are being discussed in this section.

First, the study found that two dimensions environmental scanning (ES) and strategic use of IT (SU) significantly loaded on the 2nd-order construct IT strategy ($p<0.001$). The model fit for the two-factor model was acceptable (χ^2/df=2.324, CFI=0.955, RMSEA=0.081, GFI=0.930, AGFI=0.884, NFI=0.925 and TLI=0.939). In addition, all observed indicators strongly loaded on the 1st-order constructs. The average variance extracted (AVE) values of the two dimensions of IT strategy were 0.581 (AVE_{ES}) and 0.676 (AVE_{SU}). The composite reliability (CR) values were 0.873 (CR_{ES}) and 0.885 (CR_{SU}). It was evident ($\sqrt{AVE}$ greater than correlation between the two constructs) that the model possessed discriminant validity. Thus, the two dimensions were empirically distinct and independently contributed to the 2nd-order construct IT strategy. This finding is consistent with previous study by Bergeron et al. (2004).

Second, the study found that two dimensions process rationality (PR) and political behavior (PB) significantly loaded on the 2nd-order strategic decision-making process ($p<0.001$). The model fit for the two-factor model had a good fit (χ^2/df=2.175, CFI=0.991, RMSEA=0.076, GFI=0.987, AGFI=0.936, NFI=0.983 and TLI=0.969). In addition, all observed indicators strongly loaded on the 1st-order constructs. The AVE values of the two dimensions of strategic decision-making process were 0.700 (AVE_{PR}) and 0.791 (AVE_{PB}). The CR values were 0.875 (CR_{PR}) and 0.883 (CR_{PB}). It was evident that the model possessed discriminant validity. Thus, the two dimensions were empirically distinct and independently contributed to the 2nd-order construct strategic decision-making process. This finding is also consistent with previous study by Dean & Sharfman (1996).

Third, the study found that three dimensions governance relational (GR), governance structural (GS), and governance process (GP) significantly loaded on 2nd-order IT governance (χ^2/df=1.143, CFI=0.995, RMSEA=0.027, GFI=0.964, AGFI=0.931, NFI=0.963 and TLI=0.992). In addition, all observed indicators strongly loaded on the 1st-order constructs. The AVE values of the three dimensions of IT governance were 0.632 (AVE_{GR}), 0.697 (AVE_{GP}), and 0.775 (AVE_{GS}). The CR values were 0.932 (CR_{GR}), 0.874 (CR_{GP}), and 0.873 (CR_{GS}). It was evident that the model possessed discriminant validity. Thus, the three dimensions were empirically distinct and independently contributed to the 2nd-order construct IT governance. This finding is consistent with previous study by Luftman (2000).

Fourth, consistent with previous research on software reuse success (Rothenberger et al., 2003 and Dan et al., 2008), the study found that the three (3) dimensions reuse benefits (RB), software quality (SQ), and strategic impact (SI) significantly loaded on the 2nd-order construct software reuse success. All observed indicators also loaded appropriate on the 1st-order constructs ($p<0.001$). The 2nd-order CFA model fits were (χ^2/df=1.697, CFI=0.993, RMSEA=0.059, GFI=0.985, AGFI=0.946, NFI=0.983 and TLI=0.982). The AVE values of the three (3) dimensions of software reuse success were 0.801

(AVE_{SI}), 0.887 (AVE_{RB}), and 0.720 (AVE_{SQ}). The CR values were 0.890 (CR_{SI}), 0.940 (CR_{RB}), and 0.838 (CR_{SQ}). It was evident that the model possessed discriminant validity. Thus, the three (3) dimensions were empirically distinct and independently contributed to the 2nd-order construct reuse success.

Findings from the Structural Models

The study proposed three (3) hypotheses: one (1) direct and two (2) mediation relationships. The findings supported all three (3) hypotheses.

First, the study found a strong and positive relationship (β=0.582, p<0.01, R^2=0.406) between IT governance and software reuse success. This finding is consistent with the study of IT governance and IS success by Bernroider (2008) and Hong & Kim (2002). Software reuse is an IT innovation that requires careful planning, structure, process, and strong relationship between business and IT to succeed (De Haes & Van Grembergen, 2009). This is where IT governance provides the foundations upon which IS success can be built (Luftman, 2003). IT governance allows IT to meet the business objectives and mitigates unnecessary risks (Bernroider, 2008). Two other findings of the study also supported the relationships of IT governance with IT strategy and strategic decision-making process. These findings were also consistent with IT governance as a decision right and accountability of IT stakeholders in implementing IT strategy (Peterson, 2004). IT governance was positively related to IT strategy (β=0.683, p<0.01, R^2=0.467). Similarly, IT governance is positively associated with strategic decision-making process (β=0.682, p<0.01, R^2=0.465).

Second, the study found that IT strategy and strategic decision-making process *partially* and positively mediated the effect of IT governance on software reuse success (β=0.582, p<0.01, R^2=0.406; χ^2/df=1.783, CFI=0.9, RMSEA=0.062). The results indicated that the total effect of IT governance on software reuse success comes from the indirect effects of [0.683^{**}: IT governance → IT strategy x 0.266^{**}: IT strategy → software reuse success + 0.682^{**}: IT governance → strategic decision-making process x 0.232^{**} strategic decision-making process → software reuse success] and the direct effect of [0.242**: IT governance → software reuse success]. The indirect effects of IT strategy and strategic decision-making process were 0.18 and 0.16, respectively. This meets the minimum value of 0.08 to consider worthwhile (Hair, et al., 2006). This new finding indicates that stronger IT governance leads to increases in software reuse success partially through stronger IT strategy and stronger strategic decision-making process. In other words, the finding empirically supported the importance of the presence of a strong IT strategy and a strong strategic decision-making process when an organization introduces IT governance as a framework to guide reuse activities within a software project.

DISCUSSION

The research question: "*Does IT governance influence software reuse success?*" was proposed because of a relationship extracted from previous research on IT innovation and IT governance (Bhattacharjya & Chang, 2007). IT governance strongly influences the success of IT innovation such as ERP implementation (Bernroider, 2008) and eventually in software reuse.

Hypothesis 1 was supported (β=0.582^{**}, p<0.01, R^2=0.406). IT governance, in this study, consists of three (3) dimensions governance structure, governance process, and governance relational. Governance structure enables the stakeholders to select skillful managers and make them accountable to the governance board (Tirole, 2001). Well-organized governance structures encourage information flows between IT and business units; thus, it prevents unwanted conflicts between groups. Most importantly, it increases business and IT alignment. The governance process provides a framework in assisting a decision-maker to identify, formulate, and rationalize business cases for an IT investment. Governance relational transcends the organization and technical boundaries and narrow the gap between business and IT. Thus, IT governance forms an alliance between IT and business to focus on the success of the implementation of an IT innovation: software reuse innovation. The finding is consistent with earlier findings (Bernroider, 2008).

The finding suggested that IT governance positively influences software reuse success (RQ1).

The study found that hypotheses 2 and 3 were supported. These findings are consistent with a study on strategy as a mediator the effect of resources on firm performance (Edelman, Brush, & Manolova, 2005). Furthermore, Tallon and Pinsonneault (2011) also found that firm agility fully mediates the effect of strategic IT alignment on firm performance. The study extended the work of Bernroider (2008) in employing IT governance effectiveness as a factor of the relationship between IT governance and software reuse success.

The findings suggested that IT strategy and strategic decision-making process mediate the effect of IT governance on software reuse success.

Limitation of the study

Even though the study findings indicated that the model fit indices of the measurement models were within the acceptable threshold levels, the study has several potential limitations. The most important limitation was that some 1st- and 2nd-order constructs might have suffered identification problems. Under-identified constructs are those with less than three indicators for the 1st-order constructs. Under-identified can also occur with the 2nd-order construct was represented by less than three 1st-order constructs. The study consisted of five (5) under-identified 1st-order constructs: governance structure (GS), political behavior (PB), reuse benefit (RB), strategic impact (SI), and software quality (SQ) and two (2) under-identified 2nd-order constructs: IT strategy (STR) and strategic decision-making process (DEC). On the other hands, over-identified constructs were those with more than three (3) indicators. Governance relational (GR), environmental scanning (ES), and strategic use of IT (SU) were over-identified 1st-order constructs. Ideal constructs are those with three (3) or four (4) indicators (Hair, et al., 2006).

CONCLUSION

Large-grain software reuse is on the rise as software product line engineering approach continues to thrive. Focusing on the non-technical side of software reuse has been rare even though the reuse idea has been around for over forty years. By introducing IT governance, IT strategy, and strategic decision-making process to a software projects, the reuse stakeholders removes the uncertainty of challenges in the areas of technology, economics, management, organization, and law. Management can use the strength of IT strategy to solve technological issues such as reuse repository, knowledge management, process and methodology, tools and techniques. The economics challenges of cost-and-benefit analysis and scarce resource allocation can be remedied via strategic decision-making process and IT governance. Strong IT governance can provide a framework to solve legal and organizational issues such as software protection, contractual disputes, software maturity, metrics and supporting roles. Lastly, IT governance can help management to fulfill its commitment to software reuse, motivate software professionals and managers through training and knowledge-based management system. These constructs, IT governance, IT strategy, and strategic decision-making process that are not new can be have a profound impact on how a software project should be managed. Success in software reuse initiatives contributes positively to the entire software project. Software reuse initiatives can span across multiple projects and organizations.

The study analyzed the proposed conceptual model that was grounded in theoretical framework. The measurement models of the higher-order constructs of IT governance, IT strategy, strategic decision-making process and software reuse success were found to have construct validity and good fits. The measurement models that were rigorously analyzed using CFA yields four new scales that can be candidate for future research. The study found that both IT strategy and strategic decision-making process mediate the effect of IT governance on software reuse success.

All causal relationships were supported in this study. Strong IT governance increases the effectiveness of IT strategy that, in turn, increases the chance of success for a software reuse initiative. In addition, strong IT governance improves the effectiveness of strategic decision-making process that, in turn, affects software reuse success. Overall, the findings suggest that IT governance affects software reuse success.

REFERENCES

1. Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams, *Academy of Management Journal*: Academy of Management.
2. Baron, B. M., & Kenny, D. A. (1986). The Moderator–Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.
3. Benaroch, M., Jeffery, M., Kauffman, R. J., & Shah, S. (2007). Option-Based Risk Management: A Field Study of Sequential Information Technology Investment Decisions, *Journal of Management Information Systems*: M.E. Sharpe Inc.
4. Ben-Menachem, M., & Gavious, I. (2007). Accounting Software Assets: A Valuation Model for Software, *Journal of Information Systems*: American Accounting Association.
5. Bergeron, F., Raymond, L., & Rivard, S. (2004). Ideal patterns of strategic alignment and business performance. *Information & Management, 41*(8), 1003-1020.
6. Bernroider, E. W. N. (2008). IT governance for enterprise resource planning supported by the DeLone-McLean model of information systems success. *Information & Management, 45*(5), 257-269.

7. Bhattacharjya, J., & Chang, V. (2007). Evolving IT Governance Practices for Aligning IT with Business – A Case Study in an Australian Institution of Higher Education, *Journal of Information Science & Technology*: Information Institute.
8. Boonstra, A. (2003). Structure and analysis of IS decision-making process. *European Journal of Information Systems, 12*(3), 195-209.
9. Bosch, J. (2006). The challenges of broadening the scope of software product families. *Communications of the ACM, 49*(12), 41-44.
10. Bosch, J., & Bosch-Sijtsema, P. (2009). From integration to composition: On the impact of software product lines, global development and ecosystems. *Journal of Systems and Software, 83*(1), 67-76.
11. Bueno, S., & Salmeron, J. L. (2008). TAM-based success modeling in ERP. *Interacting with Computers, 20*(6), 515-523.
12. Carr, N. G. (2003). IT Doesn't Matter, *Harvard Business Review*: Harvard Business School Publication Corp.
13. Chan, Y. E. (2002). Why haven't we mastered alignment? The importance of the informal organization structure. *MIS Quarterly Executive, 1*(2), 97-112.
14. Chan, Y. E., & Reich, B. H. (2007). IT alignment: what have we learned? *Journal of Information Technology (Palgrave Macmillan), 22*(4), 297-315.
15. Chan, Y. E., Sabherwal, R., & Thatcher, J. B. (2006). Antecedents and outcomes of strategic IS alignment: An emprical investigation. *IEEE Transactions on Engineering Management, 53*(1), 27-47.
16. Chapman, M., & Merwe, A. V. D. (2008). *Contemplating systematic software reuse in a project-centric company*. Paper presented at the Proceedings of the 2008 annual research conference of the South African Institute of Computer Scientists and Information Technologists on IT research in developing countries: Riding the Wave of Technology.
17. Cho, E. S., Kim, S. D., & Rhew, S. Y. (2004). A domain analysis and modeling methodology for component development, *International Journal of Software Engineering & Knowledge Engineering*: World Scientific Publishing Company.
18. Cordella, A. (2006). Transaction costs and information systems: Does IT add up? *Journal of Information Technology (Palgrave Macmillan), 26*(3), 195-202.
19. Croteau, A.-M., & Bergeron, F. (2001). An information technology trilogy: Business strategy, technological deployment and organizational performance. *The Journal of Strategic Information Systems, 10*(2), 77-99.
20. Dan, A., Johnson, R. D., & Carrato, T. (2008). *SOA service reuse by design.* Paper presented at the International Conference on Software Engineering, Leipzig, Germany.
21. Dean, J. W., & Sharfman, M. P. (1996). Does decision process matter? A study of strategic decision-making effectiveness, *Academy of Management Journal*: Academy of Management.
22. De Haes, S., & Van Grembergen, W. (2009). An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment. *Information Systems Management, 26*(2), 123-137.
23. DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update, *Journal of Management Information Systems*: M.E. Sharpe Inc.
24. Desouza, K. C., Awazu, Y., & Baloh, P. (2006). Managing Knowledge in Global Software Development Efforts: Issues and Practices. *IEEE Software, 23*(5), 30-37.
25. Dess, G. G., & Robinson Jr, R. B. (1984). Measuring Organizational Performance in the Absence of Objective Measures: The Case of the Privately-held Firm and Conglomerate Business Unit, *Strategic Management Journal*: John Wiley & Sons, Inc.
26. Edelman, L. F., Brush, C. G., & Manolova, T. (2005). Co-alignment in the resource-performance relationship: strategy as mediator. *Journal of Business Venturing, 20*(3), 359-383.
27. Elbanna, S., & Child, J. (2007). Influences on strategic decision effectiveness: Development and test of an integrative model, *Strategic Management Journal*: John Wiley & Sons, Inc.
28. Frakes, W., & Fox, C. (1995). Sixteen Questions About Software Reuse. *Communications of the ACM, 38*(6), 75-112.
29. Frakes, W. B., & Kang, K. (2005). Software Reuse Research: Status and Future. *IEEE Transactions on Software Engineering, 31*(7), 529-536.
30. Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing Moderator and Mediator Effects in Counseling Psychology Research. *Journal of Counseling Psychology, 51*(1), 115-134.

31. Geyskens, I., Steenkamp, J.-B. E. M., & Kumar, N. (2006). Make, buy or ally: A transaction cost theory meta-analysis. *Academy of Management Journal*: Academy of Management.
32. Haefliger, S., von Krogh, G., & Spaeth, S. (2008). Code Reuse in Open Source Software, *Management Science*.
33. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate Data Analysis* (6th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.
34. Han, T., Purao, S., & Storey, V. C. (2008). Generating large-scale repositories of reusable artifacts for conceptual design of information systems, *Decision Support Systems*.
35. Henderson, J. C., & Venkatraman, N. (1993). Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal, 38*(2/3), 472.
36. Hjorland, B. (2004). Domain analysis in information science. Eleven approaches – Traditional as well as innovative. *Journal of Documentation, 58*(4), 422-462.
37. Hong, K.-K., & Kim, Y.-G. (2002). The critical success factors of ERP implementation: An organizational fit perspective. *Information & Management, 40*(1), 25-40.
38. Khurum, M., & Gorschek, T. (2009). A systematic review of domain analysis solutions for product lines. *Journal of Systems and Software, 82*(12), 1982-2003.
39. Kishi, T., & Noda, N. (2006). Formal Verification and Software Product Lines. *Communications of the ACM, 49*(12), 73-77.
40. Kim, Y., & A.Stohr, E. (1998). Software Reuse: Survey and Research Directions, *Journal of Management Information Systems*: M.E. Sharpe Inc.
41. Lee, S. M., Kihyun, K., Paulson, P., & Hyesung, P. (2008). Developing a socio-technical framework for business-IT alignment, *Industrial Management & Data Systems*.
42. Lerner, J., & Tirole, J. (2002). Some simple economics of open source. *The Journal of Industrial Economics, L*(2), 197-234.
43. Lisboa, L. B., Garcia, V. C., Lucrédio, D., de Almeida, E. S., de Lemos Meira, S. R., & de Mattos Fortes, R. P. A systematic review of domain analysis tools. *Information and Software Technology, 52*(1), 1-13.
44. Luftman, J. (2000). Assessing Business–IT Alignment Maturity. *Communications of the AIS, 4*(14).
45. Luftman, J. (2003). Assessing IT/Business Alignment, *Information Systems Management*: Taylor & Francis Ltd.
46. Luftman, J., & Kempaiah, R. (2007). An update on business–IT alignment: "A line" has been drawn, *MIS Quarterly Executive*: MIS Quarterly Executive.
47. Mackinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the Mediation, Confounding, and Supporession Effect. *Prevention Science, 1*(4), 173-181.
48. Majchrzak, A., Neece, O. E., & Cooper, L. P. (2001, 2001). *Knowledge Reuse for Innovation – The Missing Focus in Knowledge Management: Results of a Case Analysis at the Jet Propulsion Laboratory.* Paper presented at the Academy of Management Proceedings.
49. Maritan, C. A. (2001). Capital investments as investing in organizational capabilities: An empirically grounded process model, *Academy of Management Journal*: Academy of Management.
50. Mellarkod, V., Appan, R., Jones, D. R., & Sherif, K. (2007). A multi-level analysis of factors affecting software developers' intention to reuse software assets: An empirical investigation. *Information & Management, 44*(7), 613-625.
51. Mohagheghi, P., & Conradi, R. (2008). An empirical investigation of software reuse benefits in a large telecom product. *ACM Trans. Softw. Eng. Methodol., 17*(3), 1-31.
52. Moody, K. W. (2003). New meaning to IT alignment. *Information Systems Management, 20*(4), 30-35.
53. Nazareth, D. L., & Rothenberger, M. A. (2004). Assessing the cost-effectiveness of software reuse: A model for planned reuse. *J. Syst. Softw., 73*(2), 245-255.
54. Neighbors, J. M. (1980). *Software construction using components.* University of California, Irvine.
55. Northrop, L. M. (2002). SEI's Software Product Line Tenets. *IEEE Softw., 19*(4), 32-40.
56. Panagiotou, D. & Mentzas, G. (2011). Leveraging Software Reuse with Knowledge Management in Software Development. *International Journal of Software Engineering and Knowledge Engineering. 21*(5), 693-723.

57. Peterson, R. (2004). Crafting information technology governance, *Information Systems Management*: Taylor & Francis Ltd.
58. Postmus, D., & Meijler, T. D. (2008). Aligning the economic modeling of software reuse with reuse practices. *Inf. Softw. Technol., 50*(7-8), 753-762.
59. Poulin, J. S., Caruso, J. M., & Hancock, D. M. (1993). The business case for software reuse. *IBM Systems Journal, 32*(4), 567-594.
60. Porter, M. E. (1996). What Is Strategy?, *Harvard Business Review*: Harvard Business School Publication Corp.
61. Prieto-Diaz, R. (1990). Domain analysis: An introduction. *SIGSOFT Softw. Eng. Notes, 15*(2), 47-54.
62. Ravichandran, T., & Rothenberger, M. A. (2003). Software reuse strategies and component markets. *Commun. ACM, 46*(8), 109-114.
63. Rine, D. C., & Sonnemann, R. M. (1998). Investments in reusable software. A study of software reuse investment success factors. *The Journal of Systems and Software, 41*(1), 17-32.
64. Rothenberger, M. A., Dooley, K. J., Kulkarni, U. R., & Nada, N. (2003). Strategies for Software Reuse: A Principal Component Analysis of Reuse Practices, *IEEE Transactions on Software Engineering*.
65. Rothenberger, M. A. (2004). Project-Level Reuse Factors: Drivers for Variation within Software Development Environments. *Decision Sciences, 34*(1), 24.
66. Samuelson, P. (1990). Reverse-Engineering Someone Else's Software: Is it legal? *IEEE Softw., 7*(1), 90-96.
67. Sen, A. (1997). The role of opportunism in the software design reuse process. *IEEE Trans. Softw. Eng., 23*(7), 418-436.
68. Shepperd, M. (2007). *Software project economics: A roadmap*. Paper presented at the 2007 Future of Software Engineering.
69. Sherif, K., Appan, R., & Lin, Z. (2006). Resources and incentives for the adoption of systematic software reuse, *International Journal of Information Management*.
70. Simon, H. A. (1978). Rationality as Process and as Product of Thought. *The American Economic Review, 68*(2), 1-16.
71. Tallon, P. P. (2007). A Process-Oriented Perspective on the Alignment of Information Technology and Business Strategy, *Journal of Management Information Systems*: M.E. Sharpe Inc.
72. Tallon, P. P., Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly*, Vol. 35 Issue 2, p463-486.
73. Taylor, R. N., Tracz, W., & Coglianese, L. (1995). Software development using domain-specific software architectures: CDRl A011\—a curriculum module in the SEI style. *SIGSOFT Softw. Eng. Notes, 20*(5), 27-38.
74. Tirole, J. (2001). Corporate Governance. *Econometrica, 69*(1), 1-35.
75. Wang, E. T. G., & Chen, J. H. F. (2006). The influence of governance equilibrium on ERP project success. *Decision Support Systems, 41*(4), 708-727.
76. Wastell, D. G. (1999). Learning Dysfunctions in Information Systems Development: Overcoming the Social Defenses with Transitional Objects, *MIS Quarterly*: MIS Quarterly & The Society for Information Management.
77. Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *The American Journal of Sociology, 87*(3), 548-577.
78. Williamson, O. E. (1983). Credible Commitments: Using Hostages to Support Exchange. *The American Economic Review, 73*(4), 519-540.
79. Williamson, O. E. (2002). The Theory of the Firms as Governance Structure: From Choice to Contract. *The Journal of Economic Perspectives, 16*(3), 171-195.
80. Xue, Y., Liang, H., & Boulton, W. R. (2008). Information technology governance in information technology investment decision process: The impact of investment characteristics, external environment, and internal context. *MIS Quarterly, 32*(1), 67-96.
81. Zeynep A., O., & Masini, A. (2008). Effective strategies for internal outsourcing and offshoring of business services: An empirical investigation. *Journal of Operations Management, 26*(2), 239-256.