December, 2011

Alignment within the Software Development Unit: Assessing Structural and Relational Dimensions between Testing and Development

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ALIGNMENT WITHIN THE IT UNIT: ASSESSING STRUCTURAL & RELATIONAL DIMENSIONS

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Abstract

As information technology (IT) management has become more strategic in orientation, the responsibility of IT managers has shifted from the internally-oriented role of managing IT assets to leveraging IT to create business value. In the literature, it is now largely taken for granted that all is well in the inner workings of the IT unit, however this is not always the case. For example, substantial tension may exist between developers and testers because developers create software functionality and testers point out the functionality flaws in the developers' work. To investigate how to resolve this tension within the IT unit, this paper argues for a refocus of empirical attention back on the core duties of corporate IT managers – that of efficiently and effectively managing across the sub-units within the IT unit. Unless this is done well, it will be difficult, if not impossible, for the IT unit to continue to add value in strategic ways. We apply theoretical concepts from the strategic business-IT alignment literature to the internal environment of the IT unit (i.e., comprising developers and testers in this study) in order to hypothesize and empirically test a research model through a survey of software professionals. Results suggest that relational dimensions (such as shared understanding, partnerships, and competencies) exert a more significant influence than structural dimensions (such as measurements/standards, governance, process/architecture) on the alignment of sub-units within the IT unit.

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Keywords: alignment within the IT unit, IT sub-units, developers and testers, survey research, structural and relational dimensions

Introduction

In the early days of corporate information technology (IT) management, the primary role of the IT manager was to effectively and efficiently manage the functional aspects of the IT unit. Using a traditional management-by-objectives perspective, this involved ensuring that the diverse internal sub-units of the IT unit were united in terms of goals and coordination of work processes. In these early days, the sub-units comprised teams of requirement analysts, programmers, testers, database designers and computer operators. In a prominent paper from this time period that identified success factors for IT unit management, Miller (1980) noted that: "*Information systems departments are becoming more difficult to manage, not easier.*" With the advent of personal computing, networks, and the internet, a new strategic imperative started

changing the role of IT management as it grew in importance within the corporate organization. This shift was marked by the advent of the chief information officer (CIO) role that has become diverse in scope and orientation. New responsibilities, beyond the internal management of the IT unit, have appeared including leading or participating in organizational strategic planning, process improvement, outsourcing management, innovation planning, knowledge management, and others (Chun and Mooney, 2009). This shift was also marked by a new focus on the CIO as a member of the top management team and on CIO relations and interactions with other business unit leaders in the organization (Armstrong and Sambamurthy, 1999). Much of the current research has followed this trend by focusing mainly on the strategic-level business-IT alignment challenges (e.g., De Haes and Van Grembergen, 2009; Hsiao and Ormerod, 1998; Kearns and Sabherwal, 2007; Newkirk et al., 2008; Tallon 2007/2008). It is our contention that while these newer strategic roles and responsibilities related to business-IT alignment are important, we cannot forget that a necessary prerequisite for CIO success is how well the internal workings of the IT unit are managed. A well aligned and functioning IT unit, whose sub-units (such as systems development, database management, network operations, architecture planning, etc.) are coherent, integrated, congruent, and in harmony, is essential for ensuring that the IT unit as a whole is able to meet all the new strategic responsibilities that have emerged. In essence, in order to achieve strategic business-IT alignment, and succeed at meeting the strategic goals of the organization it is critical for the CIO to get the basics right in terms of managing the inner workings of IT.

A recent report by CIO Magazine (2008) highlighted that CIOs are spending an average of 40% of their time with their IT staff, 22% with company executives, 18% with non-IT employees, 11% with IT vendors or service providers, and 9% of their time with external business partners or customers. In the same survey, three of the ten key leadership competencies for CIO success pertained to the inner workings of the IT function: expertise in running the IT function, team leadership, and people development. These findings suggest that while working with the business organization at a strategic level is essential, an equally important part of current CIO's responsibilities still deal with the internal management of the IT sub-units. To further illustrate the need for empirical research to re-examine the current inner workings of IT, one recent report from CIO magazine (2007) showed that 29% of CIOs say that they spend the most time on managing crises arising from internal IT sub-units.

In contrast to the above practitioner focus, the management information system (MIS) literature has been shifting away from examining issues pertaining to the internal management of the IT unit in order to focus on higher-level business-related topics. As an example, Appendix A offers select relevant research as found in two of the top-rated MIS journals. The appendix illustrates that prior to about 1985, most studies were internally focused on the factors and practices of successfully running the IT unit, followed by the 1990's where more studies were externally focused on interactions of IT with other components of the overall business environment. We propose, therefore, that there is a lack of current internally-focused studies, and this research addresses this issue by re-visiting the CIO's current role in managing the internal IT sub-units

given the dual role CIOs have in not only ensuring business-IT alignment but also establishing sub-unit alignment with the overall IT unit.

IT units typically spend a large portion of their budget on software development and testing which reflects the importance of these activities. Alignment of these two sub-units is critical for the success of the IT unit. For example, one report noted spending on software (20% of IT operating budget as a percentage of revenue) was behind the cost of personnel (44%), but greater than spending on hardware (10%), networking (10%), external service providers (4%), and other categories (12%) (Kelly and Siegel, 2008). Our research model focuses on the relational and structural fit between the sub-units within the larger IT unit, and empirically investigates specifically the alignment between the development and testing sub-units. To illustrate the challenges the CIO faces in managing internal IT sub-units, the relationship between the developer and the tester IT sub-units stand out as historically exhibiting substantial tension between these two groups (Barki and Hartwick, 2001; Cohen et al., 2004). Prior research has found that substantial disruptive relations tend to exist among these internal IT sub-units (Cohen et al., 2004; Ji et al., 2005; Pettichord, 2000, Zhang et al. 2009). The tension are likely to arise from developer and tester groups both working within the same IT unit and both striving to produce effective software solutions, yet both diverging in their approaches to reaching overall IT unit goals. More specifically, both groups play critical roles and their cooperation is important for IT units to successfully develop software solutions which support overall business strategies, yet developers create software functionality and testers point out the functionality flaws in the developers' work. These different roles often lead to antagonistic relationships and animosity between the members of these IT sub-units. To effectively manage the internal IT sub-units, this paper focuses on the alignment among diverse sub-units comprising developers and testers within the IT unit who have to work in tandem to create business value for the organization.

Our paper utilizes the salient constructs of the strategic business-IT alignment lens to investigate the inner workings of the corporate IT unit, as well as to provide managers with a tool to improve the management of the IT unit, by empirically testing the structural and relational dimensions of alignment through a survey of developer and tester software professionals. Prior research shows that business-IT alignment leads to tangible benefits for organizations in both cost reduction and revenue growth (Oh and Pinsonneault, 2007). Internal IT sub-unit alignment can facilitate business-IT alignment. Often IT sub-units are not in a natural state of alignment as shown by research on conflict between sub-units (Cohen et, 2004, Zhang et al. 2009). IT sub-units tend to be diverse and make differing contributions to overall IT unit performance, especially in the case of developers and testers, thus making sub-unit management a complex task.

Given the complexities of IT management, it is imperative that IT managers and academic researchers discern better ways to align the diverse and interrelated IT sub-units. The research question addressed in this study is: *how do the structural and relational dimensions of internal IT alignment influence overall sub-unit alignment?* Resource-based theoretical views of the firm in strategic management (Barney, 1991; Melville et al, 2004) suggests top management must put together (i.e., align) the appropriate resources that

can benefit the firm. This suggests the diversity of resources (i.e., sub-units) making up the IT unit have to be aligned together to achieve optimal benefits to the organization. It is argued that if the IT sub-units are not well aligned, the overall IT unit will have difficulty executing the higher-level strategic IT plans necessary for meeting the strategic goals of the organization. An IT unit characterized by sub-unit misalignment cannot support business strategies well. As we will argue in the next section, concepts from the strategic business-IT alignment literature can be usefully applied to study the inner workings of the IT unit itself. The strategic business-IT alignment literature has defined several relational dimensions (e.g., shared understating, partnerships, and competencies) as well as several structural dimensions (e.g., measurements/standards, governance, and process/architecture) needed to ensure proper overall alignment (Reich and Benbasat 2000, Preston and Karahanna 2007, Luftman and Kempaiah 2005).

The findings of this study contribute to the literature and managerial practice in several important ways. First, we show that strategic business-IT alignment concepts can be used to study alignment between internal sub-units within the IT unit, specifically between developer and tester groups. While much is known about the importance of business-IT alignment to company performance and the alignment dimensions involved, this study examines within IT unit alignment (i.e., sub-unit to sub-unit) needed to ensure a properly run overall IT organization. Prior business-IT alignment research lacks full consideration of the alignment of groups within the IT unit. Second, our study sheds light on the impact that relational and structural dimensions have on alignment between IT sub-units. This is done by undertaking a theoretically-driven empirical investigation of the dimensions of IT sub-unit alignment. Dimensions from the business-IT alignment literature are compiled, modified, and pilot tested for use in a sub-unit context. Then, survey data from developer and tester software professionals is used to validate these dimensions applied to the sub-unit level. These efforts provide researchers a lens with which future research can investigate the inner workings of the corporate IT unit, as well as, provide managers with a tool to improve the management of the IT unit.

The remainder of this article is organized as follows. The next section provides an overview of the alignment literature and discusses the unique nature of the alignment in the within-IT unit context. We then introduce an Integrated Model of Alignment Within the IT Unit (adapted from Luftman and Kempaiah, 2007), which serves as the theoretical underpinning of this study. Subsequently, we put forth an interrelated set of hypotheses designed to test the model. Next, the research methodology and results are presented. The article concludes with a discussion of the findings, as well as implications for theory and practice.

Hypothesis Development

IT Unit Management

Factors related to the internal management of IT have been studied since the 1970s. Research identified critical success factors for IT management (Henderson and Sifonis, 1988; Martin, 1982; Miller, 1980), governance structures for IT management (Brown, 1997; Sambamurthy and Zmud, 1999) and contingencies that influence the internal environment of IT (Lederer and Mendelow, 1999; Sambamurthy and Zmud, 1999; Wetherbe and Whitehead, 1977). As a result, this work suggests the inner workings of the IT unit merit scholarly attention, and this study seeks to extend these dialogs by applying theoretical concepts from the strategic business-IT alignment literature to the internal environment of the IT unit showing that the alignment lens can be a useful approach to the investigation of the internal dynamics of the IT unit. The paper builds on Segars and Grover's (1998) finding that alignment is an important antecedent of MIS success and examines internal IT management to investigate how alignment concepts can be applied to relations among sub-units of IT.

Strategic Business-IT Alignment

Strategic business-IT alignment arises when the business goals and activities of an organization are in harmony with the information systems that support them (McKeen and Smith, 2003). Business-IT alignment has been a top CIO interest for the past decade (Luftman and Kempaiah, 2007). This is not surprising as research finds that business-IT alignment leads to tangible benefits and superior corporate performance for organizations through achieving both cost reduction and revenue growth (Oh and Pinsonneault, 2007). High-level strategic alignment where a strong fit occurs between business and IT strategy leads to superior corporate performance compared to the case where there is a weak fit occurring between business and IT strategy (Oh and Pinsonneault, 2007). Alignment has been investigated along separate perspectives – intellectual, structural, social, or relational (Reich and Benbasat, 2000). The intellectual or structural perspective tends to focus on alignment between IT and business based on aspects such as alignment of infrastructures and processes (Henderson and Venkatraman, 1993), alignment of strategies (e.g., Chan et al. 1997; Henderson and Venkatraman, 1993; Luftman and Brier, 1999; Sabherwal and Chan, 2001; Sabherwal and Kirs, 1994; Tallon et al., 2000), alignment of skills (Bassellier and Benbasat, 2004; Roepke et al., 2000), and alignment of missions and plans (e.g., Hirschheim and Sabherwal, 2001; Lederer and Mendelow, 1987; Lyles, 1979; 1989; Reich and Benbasat 1996). The social or relational perspective tends to focus on the shared knowledge and understanding among the business and its IT partners (Nelson and Cooprider, 1996; Preston and Karahanna, 2008; Reich and Benbasat, 1996, 2000).

Empirical research indicates that both the structural and relational dimensions are important for achieving high levels of alignment (Luftman and Kempaiah, 2007; Reich and Benbasat, 2000) but does not indicate the relative contribution of each dimension to the level of alignment. The evolution of the strategic business-IT alignment research began with studies focused on the structural aspects of the phenomenon, and moved on in more recent studies to the relational or social aspects of alignment such as shared meaning

and understanding, demographic and experiential similarity, as well as partnership between units (Luftman and Kempaiah, 2007; Preston and Karahanna, 2008). Additionally, much of the early research in the area has been conceptual, with few empirical studies measuring alignment and the relationships among its components (Chan et al., 2006).

Literature on strategic business-IT alignment has identified a host of antecedents to alignment that can be related to the structural and relational dimensions. The relational antecedents include: shared understanding, shared learning, experiential and demographic similarity, and learning opportunities (Preston and Karahanna, 2008); as well as communication, value, and partnership (Luftman and Kempaiah, 2007). Structural antecedents that have been proposed include: governance structure; scope; processes; measurements and standards; and the architectures, tools and infrastructures that units employ to accomplishing their mission (Brown and Magill, 1994; Henderson and Venkatraman, 1993; Luftman and Kempaiah, 2007). Next we will apply facets of business-IT alignment to within IT sub-unit-sub-unit alignment.

Commented [A2]: Yuck? But it does map back to the equivalent at higher level….

Internal IT Sub-Unit Alignment

Prior research on strategic business-IT alignment lacks full consideration of the alignment of groups within the IT unit and often assumes that the various functional units that make up the total IT unit are appropriately aligned with each other. Internal alignment of IT sub-units is not always a given as research has found that substantial mis-alignments tend to exist among internal sub-units of IT (Cohen et al., 2004; Ji et al., 2005; Pettichord, 2000, Zhang et al. 2009). Business-IT alignment is founded on IT sub-unit alignment (see Figure 1), yet often IT sub-units are not in a natural state of alignment. Research studies examining sub-unit alignment find that conflict between sub-units has detrimental impacts on IT performance (Cohen et al., 2004; Zhang et al., 2009). As an example, consider the case of an IT unit that is responsible for business systems development. Several IT sub-units have to work cooperatively for overall success. These usually include requirements gathering, database design, architecture, programming, and testing sub-units. All these sub-units need aligned goals and operations to achieve smooth systems development lifecycle, in order to deliver software applications that meet business needs. Thus, in order to ensure business-IT alignment (Level 1 in Figure 1), IT managers and academic researchers need to find ways to improve IT sub-unit alignment (Level 2 in Figure 1).

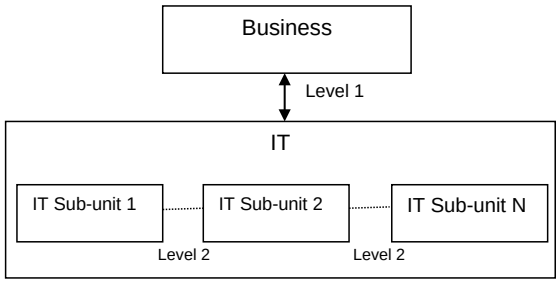

Figure 1: Levels of Alignment

Level 1 alignment has been the focus of much prior research (e.g., Brown and Magill 1994, Chan et al. 2006, Henderson and Venkatraman 1993, Luftman and Brier 1999, Luftman and Kempaiah, 2007, Preston and Karahanna 2007, Reich and Benbasat 2000, Saberhwal and Kirs 1994). Level 2 alignment has not received as much attention in recent years, even though it was the focus of many studies years ago (e.g., Miller, 1980; Martin, 1982; Pyburn, 1983; Wetherbe, et al. 1977). This study revisits the inner workings of the IT unit and provides a more granular view of the interaction between IT sub-units.

We define alignment among the IT sub-units as the congruence between the sub-unit functions along several relational and structural dimensions. Figure 2 illustrates a conceptual delineation of the specific relational and structural dimensions from the established literature on strategic business-IT alignment adapted to the IT sub-unit context (Luftman and Kempaiah, 2007). This model comprises relational and structural dimensions of alignment and serves as the basis for the hypotheses that were empirically tested.

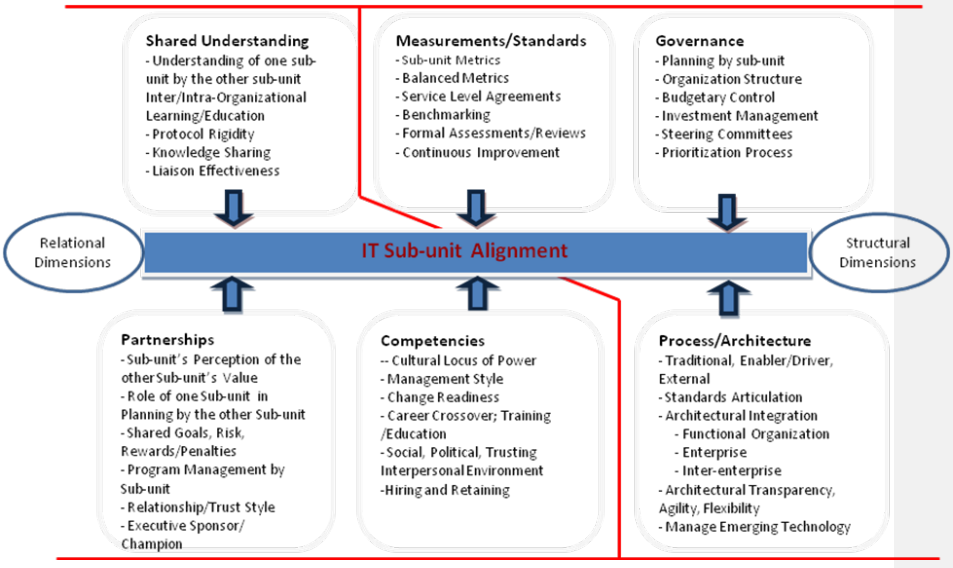

Figure 2: Integrated Model of Alignment Within the IT Unit (adapted from Luftman And Kempaiah, 2007)

Shared understanding, partnership, and competencies are considered relational dimensions and Preston and Karahanna (2008) and Luftman and Kempaiah (2007) consider them to be part of the social antecedents of alignment between the business and IT units. The antecedents of business-IT alignment may be used to measure the drivers of IT sub-unit alignment. For example, shared understanding includes the social aspects of employee relationships; partnership measures the rapport between sub-units and their interaction including issues of trust, shared goals, and values; while competencies measures ideas of management style, cultural locus of power, and the interpersonal environment which are all part of sub-unit relationships (Silva, 2007). Measurements/standards are considered a structural dimension as Luftman and Kempaiah (2007) use a similar construct labeled 'Value' as an antecedent to business-IT alignment. This antecedent applied to the IT sub-unit level would deal with the metrics used to quantify the performance output of a sub-unit and its relative contribution to the other sub-unit's output (Bannister, 2001). Henderson and Venkatraman (1993) and Reich and Benbasat (2000) consider governance and processes/architecture to be part of the structural dimension of strategic business-IT alignment. At the IT sub-unit level, governance refers to sub-unit organization of resources, plans, and processes while processes/architecture refers to structuring of the technical aspects of how the processes, standards, architectures, tools, and techniques are employed by the sub-units.

The early literature in strategic business-IT alignment focused on the structural components of alignment (e.g. Henderson and Venkatraman, 1993, Hirschheim and Sabherwal, 2001; Sabherwal and Chan, 2001; Sabherwal and Kirs, 1994; Tallon et al., 2000). Later the relational components of strategic business-IT alignment were also found to be important (Preston and Karahanna, 2008; Reich and Benbasat, 2000). Given this history, our research examines the relative balance and contribution of the two dimensions as they influence IT sub-unit alignment. We seek to understand if this profile of the dimensions of strategic business-IT alignment is also applicable to the internal dynamics of managing within the IT unit. The first three hypotheses presented below are related to the relational dimensions of sub-unit alignment while the last three are related to the structural dimensions of sub-unit alignment.

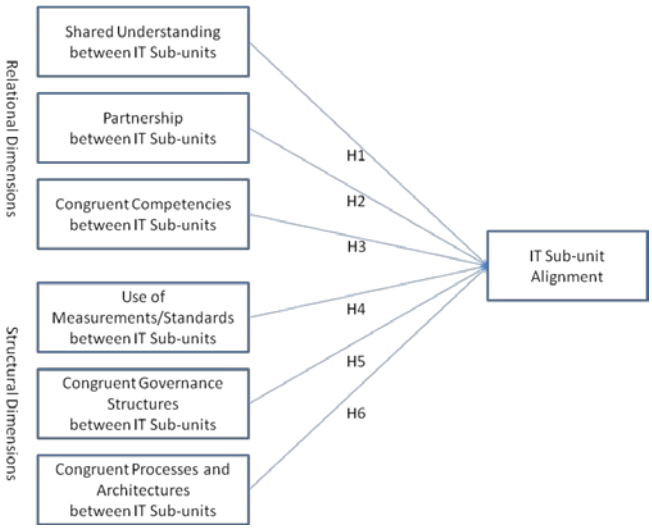

Figure 3: Research Model of Alignment Within the IT Unit

The first relational dimension of our Research Model of Alignment Within the IT Unit (see Figure 3) is shared understanding which is based on work performed by Preston and Karahanna (2008) at the business-IT level. In our model, shared understanding is the effectiveness in the exchange of ideas and knowledge among IT sub-units, enabling both to understand each other's strategies, plans, environments, risks, priorities, and how to achieve them. Shared understanding between groups or sub-units has been shown to facilitate the setting of common goals, improve communication, coherence, and coordination, and has also proven to be an important antecedent of business-IT alignment (Preston and Karahanna 2008; Chan, 2002; Reich and Benbasat 2000, Armstrong and Sambamurthy, 1999).

For example, to successfully develop software solutions that support business strategic goals, usually one IT sub-unit collects the business requirements and creates the use cases that delineate the features and functionality to be created; another IT sub-unit transforms those requirements and use cases into conceptual models such as entity-relationship diagrams, flow charts, and process configurations; and a different IT sub-unit converts the models into programmed software modules, which another IT sub-unit then validates and verifies. The overall software development process with its various hand-offs between IT sub-units runs better with a shared understanding among these groups as to sub-unit roles and responsibility as well as their goals and contributions to the overall software development project. For example, if those creating the requirements understand how the documents will be used later the process, then they can make sure to include vital contents that might be needed later in the software development process. Therefore we posit:

H1: Shared understanding between two sub-units of the IT unit will positively influence alignment between them.

Partnership is the sub-unit's role in defining the strategies of its partner sub-units, the degree of trust between the sub-units, and the degree of commonality between ~~the initiatives~~the initiatives of the two sub-units. When individual groups jointly work on defining their strategies, this fosters the building of shared goals and plans and helps develop an atmosphere of trust among the individuals of the respective sub-units. This means that ~~E~~everyone is pulling for the same outcomes. Trust between sub-units, as well as shared goals and plans have been shown to positively influence business-IT alignment (Chan 2002, Armstrong and Sambamurthy 1999; Nelson and Cooprider 1996), and it is anticipated that it will work at the IT sub-unit level in similar ways.

For example in the software development process, sub-units may consider simply finishing their activities within the ISD process then handing the output ~~it~~ off ~~to be~~as appropriate;~~, but~~ this practice may not lead to the highest quality outcomes. Sub-units need to consider how the product of their activity fits with other sub-units activities. Specifically, those creating system design specifications need to convey what information they need from the up-stream sub-units to know what is required in the designs, as well as know what downstream sub-units need later in the process in order to ensure the designs are complete and usable. The more sub-units are involved with each other in establishing their common strategies, goals, and objectives, the more they understand how their role fits within the entire process and create trust among the sub-units for gathering needed information. Close partnership and participation of one sub-unit in another sub-unit's activities can further foster a better understanding of each other's needs and operating procedures. This, in turn leads to better hand-off procedures between sub-nits and also to sub-unit output that is customized to another sub-unit's requirements.~~–~~Thus, ~~P~~partnership and participation of one unit in the other unit's decision making processes will positively influence the level of sub-unit alignment. Thus we posit:

H2: Partnership between two sub-units of the IT unit will positively influence the level of alignment between them.

Competencies comprise facets of human resources, e.g., hiring, retention, training, performance feedback, encouraging innovation and career opportunities, developing skills, etc.; which contribute to a readiness for change, capability for learning, and leveraging of new ideas (Peppard et al., 2000). Preston and Karahanna (2008) find that similar and complementary skill sets foster alignment. To build such similar and complementary skill sets, IT sub-units can employ mutually adjustable policies for hiring and cross-training. Roepke et al. (2000) show that management style and leadership in and human resource development can have a positive influence on alignment. Similarly, the management style and leadership of the IT sub-units that fosters a similar and complimentary sub-unit skill set will help strengthen the alignment between the two sub-units.

In the case of software development and testing, prior research has shown that ~~teseters~~testers tend ot have significantly lower skills and confidence that developers (CITE Jackson et al.). Very often this is a result of development being viewed as a creative endeavor while testing is considered a non-creative exercise. In many software –development organizations, less~~o~~er skilled developers are often sent to testing units. However, given the importantce ~~e~~of these two units ~~w~~having to work together, both groups have to have congruent competiencies~~it is important that the competencies of both groups be ocongurent~~. ~~Contrugent~~Congruent skills sets allow testers to improve and provide quality control for developed code. ~~If you are checking the technical work of the other person you have to be just as technically competent to do this adequately.~~ Testers need to be as technically proficient as developers (if not more) to be able to provide quality checking services for developers. In the case of any IT sub-unit, congruent skill-sets are necessary to ensure seamless integration of work throughout the ISD process. If one of the sub-units in an ISD chain lacks the necessary skills to ensure the quality of their work, then the entire ISD process will suffer. Given the importance of congruent skill-sets in an ISD process, we posit that having such congruent skills will increase the level of alignment between the sub-units of an IS unit.

~~Thus we posit:~~

H3: Congruent competencies between two sub-units of the IT unit will positively influence the level of alignment between them.

The first structural dimension of our Integrated Model of Alignment Within the IT Unit model is measurements/ standards. The availability of defined measures and standards facilitates alignment by clarifying the reciprocal value contribution of each sub-unit (Luftman and Kempaiah, 2007). Relative metrics that are clearly understood and accessible by the sub-units offer a better appreciation and understanding of the relative contribution of each sub-unit. Measurements/standards that emphasize metrics about different aspects of sub-unit performance help demonstrate the relative contributions of the IT sub-units. The use of metric-based processes such as benchmarking, formal assessments/reviews and continuous improvement, helps foster sub-unit alignment (Luftman and Kempaiah 2007, Tallon et al. 2000). Mutually accepted metrics regarding the level of services provided also support a better understanding of the mission of each group and of their responsibilities.

~~NEED MORE HERE. In software delveopment~~In an IT shop, it is important that the sub-units are functioning based on a common agreement on a common set of measurements and standards. If this is not the case, ~~it~~ the lack of common measurements/standards can lead to differences of opinion about scope, performance, and outcomes. Common ~~measures is~~measures are required to assess the relative contribution of each sub-unit. For example, in some organizations code written by developers has to meet specific coverage ratios before it can be passed on for integration testing by a testing group. These coverage ratios must be precisely specified and accepted by both sub-units to prevent breakdown in work flow processes. A ~~C~~common set of measurements/standards ensures alignment and visibility of relative performance for

each sub-group. Proper and commonly accepted measurements and standards act as quality gates between the sub-units, and foster adherence to strict quality standards that ensure that when hand-offs between sub-units occur, the product being transferred from one sub-unit to another meets the specifications needed by the next-in-line subunit to efficiently and effectively complete its processual task. Unless the when code goes between 2 units there are quality standards, it is a quality gate, these measuremens represent quality gates. Thus we posit:

H4: The use of measurements/standards between two sub-units of the IT unit will positively influence the level of alignment between them.

Governance reflects who has the authority to make IT decisions and what processes are used at strategic, tactical, and operational levels to set priorities and allocate resources. Governance also reflects the internal structure of the sub-units such as centralized versus decentralized or flat versus hierarchical reporting structures. The governance structure by which internal groups are organized should be congruent among the groups in order to achieve alignment (Chan et al. 2002, Brown and Magill 1994, Henderson and Venkatraman, 1993). Governance should provide adequate structures and processes that are used for organizing and controlling functional units in such a way that there is a harmonious interaction among them (Duane and Finnegan, 2003). As a result of congruent governance structures, sub-units are in a better position to share limited organizational resources and to allocate those resources in such a way that they support the mission of each unit and of the IT unit as a whole.

NEED MORE HERE. IT departments of large organizations are usually comprised of many smaller sub-units which are organized according to their local needs and environment. In such cases, some sub-units will be highly centralized and hierarchical, whereas others will be more decentralized and flat. The key is is centralized and decrentralized. In software development, for example, more often development groups are larger than testing groups. This often leads to development groups being more centralized and hierarchical than testing groups. This, in turn, leads to situations where lower level developers have to interact with higher level testers or vice-versa. Given that development groups have to communicate regularly with testers in sw dev it is important that governance structures of 2 units be congruent. For example, it may be difficult for very low level testers in a decentralized unit to be reporting defects found in code to senior managers of a centralized development tgroupgroup. Such mis-alignments can lead to poor communciaitonscommunications between the sub-units,, don't where the communicate seriousness of defects found is not properly communicated due to the , reluctance of testers to confront developers who are their seniorsshow the truth. It is therefore imprortnant for both groups to be either centralized or decrntralizeddecentralized so that the right level of personnel are talking to each other at all levels of collaboration. We found testing is fat vs. more hierarchical structure of development wehre low level testers were reporting to high level dev. testing groups tend to be smaller vs. dev groups they tend to be less hierarchical and flatter. This often leads to mis-match with more structured larger development groups. Thus we posit:

H5: Congruent governance structures between two sub-units of the IT unit will positively influence the level of alignment between them.

Process/architecture is the provision of flexible infrastructures, application of emerging technologies, enablement of process changes, and delivery of solutions to other units within the business or within IT. The tools, techniques, process and architectures used by the various groups that make up the IT unit have to be well integrated to allow the seamless and efficient activity of the IT unit to achieve its business goals (Luftman and Kempaiah 2007, Henderson and Venkatraman 1993, Slaughter et al. 2006, Tallon, 2007). The creation of a transparent and integrated infrastructure on which individual sub-units can build and use customized applications that work seamlessly with the applications of other sub-units will help foster better application integration between subunits and thus make their interaction activities more efficient and effective. Similar and complementary processes amongst the IT sub-units improve the shared mindset, shared knowledge and shared understanding of the individuals belonging to each sub-unit, which, in turn fosters alignment (Preston and Karahanna, 2008).

~~NEED MORE HERE.~~ A key issue facing software development in large scale enterprises today is the availability of common platforms and processes for undertaking code writing and ~~testing. Many~~testing. Many organizations are working towards securing an ~~E~~Enterprise Architectures that facilitates seemless integration ~~fo~~of the 2 functions. ~~w/o~~Without such an Enterprise Architecture ~~-~~there can be misalignment arising from disjointed workflow ~~process~~processes and formats between developers and testers. Automated processes can be ~~seemless~~seamless then and they can foster the efficient movement of activities along the ISD process. Congruent ~~-~~processes and architecture for an entire IT unit provides a foundation for the activities of all IT sub-units to take place. Since all sub-units would be using the same base process and architecture, with only customizations at higher levels, required by the sub-unit's individual type of work, the IT organization would be operating under the same constraints and assumptions. This increases the level of alignment between the IT sub-units Therefore we posit:

H6: Congruent processes and architectures between two sub-units of the IT unit will positively influence the level of alignment between them.

Research Methodology and Results

We empirically test our research model by investigating structural and relational factors of internal IT alignment as compared across development and testing sub-units. To achieve this purpose, the survey method presented the most effective approach. The sample, procedure, measures, and analysis are presented next.

Sample and Procedure

The survey consisted of questions capturing the seven constructs in the research model (Figure 2). A total of 1516 emails soliciting participation in the research were sent to software professionals primarily responsible for either testing or development-related activities who worked for U.S. corporations. This particular survey was administered as a nationally-available online survey using surveymonkey.com. A total of 152 usable responses were received, representing a response rate of 9.96%. Of the total respondents, 143 (94%) were full-time employees while 9 (6%) were contract employees. Table 1 provides the individual demographic profile of participants who participated in this survey. An important control variable that can potentially influence perceptions of alignment is the size of the IT organization that the respondent is a part of. We have conducted a $\chi 2$ difference test to investigate if the perceptions of alignment differ based on the size of the IT organization, and have found no significant difference between the organizational size categories presented in Table 1.

Table 1. Profile of Respondents

Demographic Variables	Category	Frequency (n=152) Test Sub-unit	Development Sub-unit
Number of Respondents		74	78
Total Employees in their Sub-unit at their Organization	0-10	80	68
	11-20	13	15
	21-40	15	15
	41-100	18	20
	101-200	11	9
	201+	15	25

Note: Table 1 shows the breakdown of test and development sub-unit employee respondents. A $\chi 2$ test revealed no significant difference between the groups regarding their perceptions of alignment ($\chi 2 = 2.4$, sig. = .88). Hence, the two groups will be combined for further analysis.

Measures

Special emphasis was placed on the operationalization of the constructs in the research model. A comprehensive review of the literature was undertaken to identify existing measures. Where validated scales did not exist, new items were created. All constructs were measured using multi-item scales. Appendix B provides the definition of each construct and the measures used grouped by construct. Most of the items were adapted from Luftman and Kempaiah (2007) and Preston and Karahanna (2008). The survey was validated as follows: first with semi-structured interviews with development and testing professionals to assess content validity, second with an item-sorting exercise to evaluate discriminant validity, and third with a statistical analysis of the psychometric properties.

Data Analysis

To establish the nomological validity of the research model, we chose partial least squares (PLS) (Barclay et al., 1995). The psychometric properties of all measures were assessed within the context of the structural model though the assessment of convergent and discriminant validity and reliability. In PLS, statistical

significance was determined using two-tailed tests based on the bootstrap re-sampling method with 500 samples.

To test the measurement model, the psychometric properties of the measurement model were confirmed prior to examining structural model parameters (Anderson and Gerbing, 1988). To confirm sound psychometric properties, the convergent and discriminant validity (via item loading), as well as the reliability and internal consistency (via Cronback's Alpha) of the measures were established (Gefen and Straub, 2005). All constructs were reflectively modeled. The psychometric properties of the measures were assessed in terms of item loadings, internal consistency and disciminant validity (Tables 2, 3, and 4). Item loadings and internal consistencies or reliabilities must be great than .70 to be considered acceptable (Fornell and Larker, 1981; Nunally, 1979). As can be observed from the factor loadings and cross-loadings in Table 3 and reliability scores in Table 2, measures used in this study meet the acceptable guidelines. Also as shown in Table 3, no undesirable cross-loadings emerged. Thus, the measures exhibit good internal consistency and reliability.

Convergent validity was examined at the individual measurement level as discussed above and also at the construct level. Average variance extracted (AVE) was utilized to assess convergent validity at the construct level (Fornell and Larker, 1981). Referring to Table 3, all AVEs surpassed the recommended .50 threshold (Nunally, 1979). Hence, each measure demonstrated convergent validity at the individual item and construct levels.

Table 2. Descriptive Statistics of Variables

Study Variables	Reliability (Number of Items)	Mean	Std. Dev.
Exogenous Constructs			
Competencies	0.86 (4)	3.96	1.02
Shared Understanding	0.93 (4)	3.61	1.17
Governance	0.85 (3)	3.52	1.01
Measurements/Standards	0.90 (5)	3.71	.87
Partnerships	0.87 (2)	3.42	1.06
Process/Architecture	0.89 (5)	3.49	1.15
Endogenous Constructs			
IT Sub-unit Alignment	0.90 (4)	3.70	1.21

Table 3. Factor Loadings and Cross-Loadings

	Governance	Partnership	IT Sub-unit Alignment	Process/ Architecture	Competencies	Shared Understanding	Measurements / Standards
Governance1	**0.89**	0.23	0.29	0.30	0.39	0.34	0.57
Governance2	**0.83**	0.29	0.37	0.37	0.36	0.29	0.49
Governance3	**0.66**	0.23	0.23	0.11	0.24	0.27	0.46
Partnership1	0.20	**0.89**	0.57	0.37	0.54	0.55	0.13
Partnership2	0.36	**0.86**	0.49	0.42	0.54	0.47	0.38
Internal Alignment1	0.27	0.46	**0.70**	0.40	0.42	0.62	0.34
Internal Alignment3	0.31	0.52	**0.89**	0.40	0.65	0.57	0.43
Internal Alignment3	0.32	0.56	**0.92**	0.44	0.58	0.56	0.36

Internal Alignment4	0.37	0.49	**0.85**	0.37	0.58	0.49	0.38
Process/Architecture1	0.26	0.37	0.35	**0.72**	0.37	0.23	0.27
Process/Architecture2	0.21	0.33	0.25	**0.76**	0.38	0.23	0.25
Process/Architecture3	0.25	0.39	0.39	**0.86**	0.46	0.34	0.31
Process/Architecture4	0.30	0.27	0.34	**0.80**	0.44	0.24	0.42
Process/Architecture5	0.30	0.38	0.48	**0.79**	0.40	0.34	0.34
Competencies1	0.39	0.65	0.64	0.39	**0.78**	0.58	0.39
Competencies2	0.35	0.49	0.54	0.40	**0.82**	0.40	0.47
Competencies3	0.34	0.27	0.43	0.41	**0.75**	0.25	0.38
Competencies4	0.16	0.45	0.41	0.46	**0.78**	0.37	0.22
SharedUnderstanding1	0.31	0.57	0.65	0.36	0.52	**0.90**	0.31
SharedUnderstanding2	0.27	0.48	0.53	0.23	0.42	**0.89**	0.28
SharedUnderstanding3	0.35	0.52	0.56	0.36	0.44	**0.90**	0.34
SharedUnderstanding4	0.37	0.48	0.58	0.32	0.49	**0.83**	0.40
Measurement/Standards1	0.51	0.24	0.41	0.25	0.33	0.36	**0.76**
Measurement/Standards2	0.56	0.32	0.46	0.32	0.47	0.40	**0.88**
Measurement/Standards3	0.47	0.24	0.35	0.37	0.42	0.30	**0.83**
Measurement/Standards3	0.49	0.14	0.30	0.37	0.39	0.19	**0.82**
Measurement/Standards4	0.48	0.09	0.20	0.42	0.25	0.19	**0.75**

Table 4. Intercorrelations Among Study Variables

	Competencies	IT Subunit Alignment	Governance	Measurements / Standards	Partnerships	Process / Architecture	Shared Understanding
Competencies	**0.78**						
IT Sub-unit Alignment	0.66	**0.84**					
Governance	0.41	0.37	**0.81**				
Measurement / Standards	0.47	0.45	0.62	**0.81**			
Partnerships	0.61	0.60	0.32	0.28	**0.87**		
Process / Architecture	0.52	0.48	0.34	0.41	0.45	**0.78**	
Shared Understanding	0.53	0.66	0.37	0.38	0.58	0.36	**0.88**

Notes. Pearson correlation coefficients are reported with coefficients > 0.20 significant at $p < 0.01$; > 0.15 significant at $p < 0.05$; The square root of the average variance extracted is in bold;

Discriminant validity was assessed by comparing the AVE associated with each construct to the correlations among constructs (Fornell and Larker, 1981). In order to claim discriminant validity, the square root of the AVE associated with a particular construct must be greater than its correlations with other constructs (Fornell and Larker, 1981). According to the estimates provided in Table 4, each construct, sufficiently differed from the other constructs and, therefore, the measures demonstrated discriminant validity. Combining the strong evidence for convergent and discriminant validity, the measurement model was deemed acceptable.

Structural Model Analysis

The results of the structural model analysis with path coefficients and explained variance are illustrated in Figure 3. The demographic variables from Table 1 were examined as potential control variables prior to testing the hypothesized relationships by regressing the IT sub-unit alignment construct on each demographic variable separately resulting in no significant relationships. Thus, none of the demographic variables will be included as control variables in all remaining analyses.

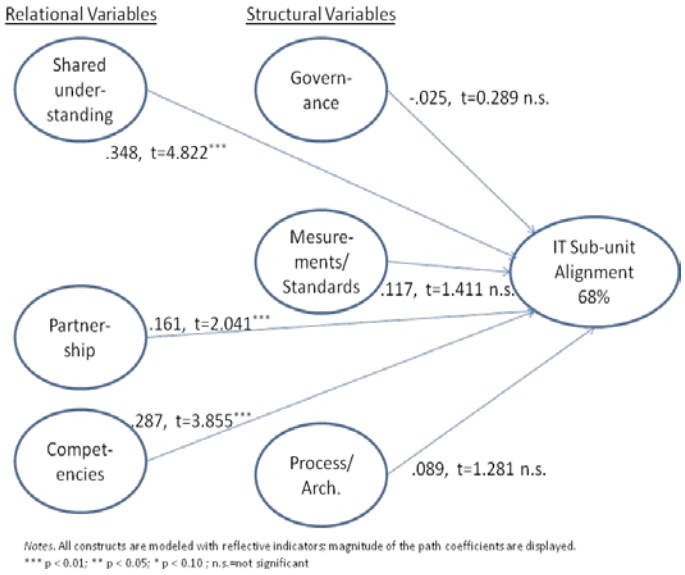

Figure 3: PLS Results

In terms of testing the research model, confirming expectations, the relational dimension constructs of shared understanding, partnerships, and competencies were all found to be significant predictors of IT sub-unit alignment ($\beta = .348$, $p < .01$; $\beta = .161$, $p < .01$; $\beta = .287$, $p < .01$; respectively), supporting hypotheses H1, H2, and H3.Unexpectedly, the structural dimension constructs of governance, measurements/standards, and process/architecture were not found to be significant predictors of IT sub-unit alignment ($\beta = -.025$, $p =$ n.s.; $\beta = .117$, $p =$ n.s., and $\beta = .089$, $p =$ n.s.; respectively), failing to support hypotheses H4, H5, and H6.The relational constructs of shared understanding, partnerships, and competencies explain 68% of the variance in IT sub-unit alignment. Table 5 summarizes these results.

Table 5. Summary of Findings

Significant Paths are:	*Statistics*
Shared Understanding → IT Sub-unit Alignment	$\beta = .348$, t = 4.822

Partnerships → IT Sub-unit Alignment	β = .161, t = 2.040
Competencies → IT Sub-unit Alignment	β = .287, t = 3.855
Non-Significant Paths are:	
Measurements/standards → IT Sub-unit Alignment	β = .117, t = 1.410
Governance → IT Sub-unit Alignment	β = -.025, t = 0.288
Process/Architecture → IT Sub-unit Alignment	β = .089, t = 1.281

Discussion

This study examined the perceptions of IT professionals about alignment between IT sub-units. It specifically focused on the alignment between the development and testing sub-units in software deployment which is a core responsibility of the IT organization. Most importantly, it examined relational and structural dimensions of sub-unit alignment. We used pertinent concepts from relevant research to develop and test a hypothesized research model based on prior theories of strategic business-IT alignment. The outcomes of this study are based on a national online survey of IT professionals primarily responsible for testing or development-related activities and who worked for U.S. corporations.

With respect to relational dimensions, the results of our study illustrate that shared understanding between IT sub-units is a strong predictor of sub-unit alignment. This suggests that managerial efforts designed to facilitate the exchange of ideas and knowledge between two IT sub-units will help foster congruence in relation to each sub-unit's strategies, plans, risks, and priorities. Lateral communication and liaison mechanisms for IT professionals working in diverse IT sub-units are important to ensure that they share a common view on how resources are allocated, overall IT priorities are established, and the relative roles of each sub-unit are communicated. This finding is consistent with prior studies of strategic business-IT alignment that also found shared understanding as an important predictor of alignment (Preston and Karahanna, 2008; Reich and Benbasat, 2000).

Our analysis also found that the partnerships between IT sub-units is a significant predictor of IT sub-unit alignment. This suggests that common participation in joint efforts fosters a strong sense of trust between IT sub-units which helps ensure that they are aligned. Also partnership between sub-units in areas of planning, goal setting and specific objectives allows the sub-units to better budget resources and to better schedule specific activities which brings a closer understanding between the units regarding resource base, specific capabilities, and impediments. Specific alignment mechanisms that foster perceptions of partnership plus a shared sense of goals and risks between IT sub-units can positively influence the perceptions of alignment between IT subunits.

Strong linkages in competencies pertaining to human resources and skills management between IT sub-units positively impacted IT sub-unit alignment. This suggests that there is value to ensuring that diverse IT sub-units are equally competent and share common hiring, retention, training and feedback criteria and practices. Misalignments caused by incompetence or an inability-to-execute of one IT sub-unit can

adversely impact the overall cohesiveness of the IT unit as it strives to meet its business and technology goals. This finding is consistent with prior studies of strategic business-IT alignment that also found competencies as an important predictor of alignment (Chen et al., 1997; Henderson and Venkatraman, 1993; Luftman and Kempaiah, 2007).

With respect to structural dimensions the use of measurement and standards for clarifying the contributions of distinct IT sub-units did not impact the overall alignment within the IT unit. This result differs from findings in the IT-Business alignment research. This suggests that taking a rigid "measure to manage" scientific approach towards interactions between IT sub-units may not be optimal if the goal is to have them aligned in terms of plans, priorities, and strategies. In our data collection context, which focused on testing and development sub-units, this finding suggests that the interaction and collaboration between them may be so complex that alignment cannot be facilitated by rigid measurement methods and precise service-level agreements (Li and Williams, 1999). This finding is in contrast to prior studies of strategic business-IT alignment that found measurement and standards to be an important predictor of alignment (Luftman and Kempaiah, 2007).

Our study also found that congruence in the governance structures of IT sub-units does not influence overall IT unit alignment. This is an interesting result suggesting that diverse IT sub-units can be governed differently and still be aligned in relation to the overall IT mission. For example, a sub-unit that utilizes centralized governance and decision making structures can still be aligned with others that are more decentralized in the governance and decision making orientation. This finding is in contrast to prior studies of strategic business-IT alignment that found governance to be an important predictor of alignment (Chen et al., 1997; Henderson and Venkatraman, 1993; Luftman and Kempaiah, 2007).

Our final hypothesis that focused on the influence of congruent processes and architectures of IT sub-units does not influence overall IT unit alignment. This suggests that enforcing common processes and the use of integrated development architectures on diverse IT sub-units will not impact the alignment between them. This directly challenges arguments often made by software vendors who seek to provide IT units with integrated tools and techniques for IT units. This finding is in contrast to prior studies of strategic business-IT alignment that also found processes and architectures as an important predictor of alignment (Brown and McGill, 1994; Henderson and Venkatraman, 1993; Luftman and Kempaiah, 2007).

Overall, our findings suggest that the relational dimensions of shared understanding, partnerships, and competencies are more important than the structural dimensions of governance, measurements/standards and process/architecture in determining the alignment among IT sub-units. Interestingly, prior research has stressed the importance of the structural dimensions for strategic business-IT alignment, however, our findings suggests that the relative importance of these dimensions may be different when examining alignment within the IT unit. An implication of this is that CIOs desiring a cohesive and well-aligned IT

unit, should not undervalue the contribution of relational dimensions such as partnerships, shared understanding, and congruent competencies among IT sub-units.

Implications & Directions for Future Research

Our work contributes to the IT management and alignment literatures in several important ways. IT contributes by: 1) showing the value of alignment as an appropriate lens for understanding IT management at the sub-unit level within the IT unit, 2) identifying salient dimensions of focus for the internal IT unit environment given that it has received comparatively less attention in the recent MIS research literature, 3) illustrating that relational dimensions may be more important than structural dimensions in certain contexts, and 4) assessing alignment using empirical analysis rather than conceptual modeling and framework designs. Most importantly, we illustrate that strategic business-IT alignment concepts can be usefully applied to how sub-units are managed within the IT unit. We show that relational dimensions tend to be are more important than structural dimensions for lower level sub-unit alignment. This finding is reflective of the strategic business-IT alignment literature that has seen the focus shift away from structural issues to relational issues in the last ten years.

Our study also makes a case for the need to refocus empirical attention back on the core duties of the corporate IT manager – that of efficiently and effectively managing the IT organization. This appears to be consistent with the notion that at the sub-unit level, structural dimensions are relatively stable, consistent, and standardized causing them to become less of an issues. This suggests that structural profiles (where strategic business-IT alignment is pertinent) may be different from those at the lower levels within the IT units. Strategic managerial notions of governance and integrated structures may not be as pertinent to the context of day-to-day management of the IT unit. Given the findings in this study, the importance of contextual factors needs to be considered. Future research is needed to tease out the specific contextual causes associated with the dimensions of alignment examined in this study.

While our study examined the testing and development sub-units, additional research is needed to extend our understanding of the dimensions relevant to other IT sub-unit interactions. Future research may want to replicate our study with other IT sub-units that have to be closely aligned for overall IT success. This includes: architecture/networking IT sub-units collaborating with software development IT sub-units; IT planning sub-units collaborating with IT operations sub-units; and geographically disparate IT sub-units collaborating on an overall IT mission. Another fruitful area of future research is to investigate if non-harmonious, misaligned, disruptive relations and structures at the internal sub-unit level can cause disruptions in strategic relations between the overall IT unit and other business units. The link between internal and internal alignment is thus another potential area of future research that can show the impact of internal IT unit alignment on the overall IT-Business alignment. These were labeled as Level 1 and Level 2 alignment in Figure 1.

It can be argued that pragmatic assessments of IT sub-unit alignment similar to that undertaken in our research can also provide a basis for strategic decisions pertaining to the organizational redesign of IT units. Future research can use the internal alignment framework provided by this study to assess managerial decisions pertaining to the outsourcing of distinct IT sub-functions. Constructs and concepts presented above can potentially be successfully employed to investigate the alignment between outsourcing vendors as well as the alignment between the vendors and the client company's IT units.

The value of the strategic business-IT alignment approach has recently been validated by Oh and Pinsonneault (2007) in relation to firm performance. They found that highly aligned firms with strong business-IT "fit" yielded superior firm performance. Similarly, future researchers may want to investigate the performance impacts of internal IT unit alignment. While this study uses IT sub-unit alignment as a dependent variable, future work may want to utilize a two-level model that considers the extended impacts of this construct that investigates the impacts of internal IT alignment on firm performance.

Limitations and Conclusion

Overall, the above considerations give testimony to the applicability and value of our research model's predictive potential in the context of managing IT sub-units. While providing a deeper understanding of the mechanisms facilitating alignment, it must be acknowledged that the study was limited in certain respects. This research has empirically clarified the balance between structural and relational dimensions that impact alignment within the IT unit by concentrating on alignment between two distinct sub-units in software deployment that have historically had a conflicted relationship and that has been a managerial challenge to CIOs (Cohen et al., 2004; Pettichord, 2000; Rothman, 2004). While it might seem intuitive that sampling employees among all IT sub-units would be a better choice than focusing on testing and development sub-units, we believe the chosen sample provided a solid foundation for testing the research model because of the known misalignment between these two units. The generalizability of findings from this context within software deployment to relations among other sub-units within the IT unit represents an important limitation that has to be recognized. We acknowledge that our respondents may differ from other IT professionals in other IT sub-units (requirements gathering, database design, etc.). This would be a fruitful area of focus for future research.

The sample enabled a rigorous test of the underlying theory. Utilizing a relatively homogeneous group of individuals minimized the variation within the units of observation. As a result, we can attribute significant effects to the variables in the research model rather than exogenous factors, increasing our confidence in the results. We tested several demographic variables and found no significant effects. Although sample homogeneity is appropriate when the goal involves theory building and testing, the next step would involve testing the model with more heterogeneous groups of individuals. Thus, we can probably generalize the

theoretical relationships among the variables to other IT sub-units involving misalignment. Nonetheless, future research needs to sample more heterogeneous sets of individuals to determine what boundary conditions exist.

In a similar vein, the survey asked participants about general perceptions. For instance, personal conflict can vary considerably in different contexts and affect alignment. Therefore, types of misalignment at more granular levels could affect misalignment of sub-units in distinct ways. Because the intention of this study was to gain a broad picture of the phenomenon, we chose to operationalize the variables at a more general level. This step, however, prevented us from determining how particular sub-unit technologies and individual social styles influence sub-unit misalignment. Consequently, whether important subtleties that would affect our research model exist remains an open empirical question.

Finally, the use of cross-sectional data cannot provide conclusive evidence of temporal precedence. Although the data collection procedure is consistent with other survey-type studies, future research should utilize alternative data collection methods, such as longitudinal and experimental designs, to address this issue. Moreover, common response bias could have surfaced given the exclusive use of survey data. Although the measures exhibited convergent and discriminant validity, the relationships among variables could have been inflated. Future studies are needed to validate these results using alternative research methods. Despite these limitations, it is our hope that this research demonstrates that the "alignment" lens can be a viable and valuable approach for the study of the internal dynamics of the IT unit and will motivate other investigations of this phenomenon.

References

Adomavicius, G., Bockstedt, J. C., Gupta, A. & Kauffman, R. J. (2008) Making sense of technological trends in the information technology landscape, a design science approach, MIS Quarterly 32(4) 779-809.

Ågerfalk, P. J. & Fitzgerald, B. (2008) Outsourcing to an unknown workforce: exploring opensourcing as a global sourcing strategy, MIS Quarterly 32(2) 385-409.

Alter, C. (1990) An exploratory study of conflict and coordination interorganizational service delivery systems, The Academy of Management Journal 33(3) 478-502.

Anderson, J.C., & Gerbing, D.W. (1988) Structural equation modeling in practice: a review and recommended two-step approach, Psychological Bulletin 103 411-427.

Armstrong, C.P. & Sambamurthy, V. (1999) Information technology assimilation in firms: The influence of senior leadership and it infrastructures, Information Systems Research 10(4) 304-327.

Bannister, F. (2001) Dismantling the silos: extracting new value from IT investments in public administration, Information Systems Journal 11(1) 65-84.
Barclay D., Higgins C., & Thompson R. (1995) The partial least squares approach to causal modeling: personal computer adoption and use as an illustration, Technology Studies 2 285-324.
Barki, H. & Hartwick, J. (2001) Interpersonal conflict and its management in information system development, MIS Quarterly 25(2) 195-228.
Barney J. (1991) Firm resources and sustained competitive advantage, Journal of Management 17(1) 99-120.
Bassellier, G. & Benbasat, I. (2004) Business competence of information technology professionals: conceptual development and influence on IT-Business partnership, MIS Quarterly 28(4) 673-694.
Beath, C.M. & Orlikowski, W.J. (1994) The contradictory structure of systems development methodologies: Deconstructing the IS-user relationship in information engineering, Information Systems Research 5(4) 350-370.
Brown C.L. & Magill S. (1994) Alignment of the IS functions with the enterprise: Toward a model of antecedents, MIS Quarterly 18(4) 371-403.
Brown, C.V. (1997) Examining the emergence of hybrid IS governance solutions: Evidence from a single case site, Information Systems Research 8(1) 69-91.
Chan, Y. E., Huff, S.L. Barclay, D.W. & Copeland, D.G. (1997) Business strategic orientation, information systems strategic orientation, and strategic alignment, Information Systems Research 8(2) 125-151.
Chan, Y., Sabherwal, R., Thatcher, J. B. (2006) Antecedents and outcomes of strategic IS alignment: An empirical investigation, IEEE Trans. Engrg. Management 53(1) 27–47.
Chun, M. and Mooney, J. (2009) CIO roles and responsibilities: Twenty-five years of evolution and change, Information & Management 46(6) 323-334.
CIO Executive Council, "State of the CIO 2007", CIO Magazine, 2007
CIO Executive Council, "State of the CIO 2008", CIO Magazine, 2008
Cohen, C.F., Birkin, S.J., Garfield, M.J. & Webb, H.W. (2004) Management conflict in software testing, Communications of the ACM 47(1) 76-81.
De Haes, S. and 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.
Duane, A. & Finnegan, P. (2003) Managing empowerment and control in an intranet environment, Information Systems Journal 13(2) 133-158.
Dyer, J.D. (2000) Collaborative Advantage: Winning Through Extended Enterprise Supplier Networks, Oxford University Press.
Ein-Dor, P. & Segev, E. (1982) Organizational context and MIS structure: Some empirical evidence, MIS Quarterly 6(3) 23-46.
Eisenhardt, M, K. (1989) Agency theory: An assessment and review, Academy of Management Review 14(1) 57-92.
Fornell, C., & Larker, D.F. (1981) Evaluating structural equation models with unobserved variables and measurement error, Journal of Marketing Research 18 39-50.
Gefen, D., & Straub, D.W. (2005) A practical guide to factorial validity using PLS-Graph: Tutorial and annotated example, Communications of the AIS 16 91-109.
Henderson J. & Venkatraman N. (1993) Strategic alignment: Leveraging information technology for transforming organizations, IBM Systems Journal 32(1) 472-484.
Henderson, J.C. & Sifonis, J.G. (1988) The Value of strategic IS planning: Understanding consistency, validity, and IS markets, MIS Quarterly 12(2) 187-200.
Hirschheim, R. & Sabherwal, R. (2001) Detours in the path toward strategic information systems alignment, California Management Review 44(1) 87-108.
Hsiao, R. L. & Ormerod, R. J. (1998) A new perspective on the dynamics of information technology-enabled strategic change, Information Systems Journal 8(1) 21-52.
Ji Y., Mookerjee V. & Sethi S. (2005) Optimal software development: A control theoretic approach, Information Systems Research 16(3) 292-306.
Kearns, G. S. & Sabherwal, R. (2007) Antecedents and consequences of information systems planning integration, IEEE Transactions on Engineering Management 54(4) 628-643
Kelly, S. & Siegel, R., (2008) Benchmarking IT Expenditures, Lodging Hospitability 646 95-98.
Lederer, A. L. & Mendelow, A. L. (1990) The impact of the environment on the management of information systems, Information Systems Research 1(2) 205-222.

Lederer, A.L. & Mendelow, A.L. (1987) Information resource planning: Overcoming difficulties in identifying top management's objectives, MIS Quarterly 11(3) 389-399.
Lee, A. S., Liebenau, J. and DeGross, J. I. (Eds.) Chapman and Hall, 466-480.
Li, F. & Williams, H. (1999) Interfirm collaboration through interfirm networks, Information Systems Journal 9(2) 103-115.
Lindgren, R., Andersson, M. & Henfridsson, O. (2008) Multi-contextuality in boundary-spanning practices, Information Systems Journal 18(6) 641-661.
Luftman J. & Kempaiah R. (2007) An update on business-IT alignment: A line has been drawn, MIS Quarterly Executive 6(3) 165-177.
Luftman, J. & Brier, T. (1999) Achieving and sustaining business-IT alignment, California Management Rev 42(1) 109–112.
Lyles, M. A. (1979) Making operational long-range planning for information systems, MIS Quarterly 3(2) 9-19.
Martin, E. W (1982) Critical success factors of chief MIS/DP executives, MIS Quarterly 6(2) 1-9.
Mckeen J.D. & Smith H. (2003) Making IT Happen: Critical Issues in IT Management, Wiley.
Melville, N., Kraemer K. & Gurbaxani, V. (2004) Review: Information technology and organizational performance: An integrative model of it business value, MIS Quarterly 28(2) 283-322.
Miller, W.B. (1980) Building an effective information systems function, MIS Quarterly 4(2) 21-30.
Nelson, K. M., & Cooprider J. G. (1996) The contribution of shared knowledge to is group performance, MIS Quarterly 20(4) 409–433.
Newkirk, H. E., Lederer, A. L., and Johnson, A. M. (2008) Rapid business and IT change: drivers for strategic information systems planning, European Journal of Information Systems 17(3) 198-218.
Nunally, J.C. (1979) Psychometric Theory, McGraw-Hill.
Oh, W. & Pinsonneault, A., (2007) On the assessment of the business value of information systems: Conceptual and measurement alternatives, MIS Quarterly 31(2) 239-265.
Olson, M. H. & Chervany, N. L. (1980) The relationship between organizational characteristics and the structure of the information services function, MIS Quarterly 4(2) 57-68.
Peppard, J, Lambert, R. & Edwards, C. (2000) Whose job is it anyway?: organizational information competencies for value creation, Information Systems Journal 10(4) 291-322.
Pettichord, B. (2000) Testers and developers think differently: Understanding and utilizing the diverse traits of key players on your team, Software Testing & Quality Engineering 2(1) 42-45.
Ping G., (2005) Using actor-network theory to analyse strategy formulation, Information Systems Journal 15(3) 255-275.
Preston, D.S. & Karahanna, E. (2008) Antecedents of IS strategic alignment: A nomological network, Information Systems Research 20(2) 159-179.
Pyburn, P. J. (1983) Linking the MIS Plan with Corporate Strategy: An Exploratory Study, MIS Quarterly 7(2) 1-14.
Reich, B. H. & Benbasat, I. (1996) Measuring the linkage between business and information technology objectives, MIS Quarterly 21(1) 55-81.
Reich, B. H. & Benbasat, I. (2000) Factors that influence the social dimensions of alignment between business and information technology, MIS Quarterly 24(1) 81-113.
Roepke, R., Agarwal, R. & Ferratt, T.W. (2000) Aligning the IT human resource with business vision: The leadership initiative at 3M, MIS Quarterly 24(2) 327-353.
Rothman, J. (2004) No more second-class testers! Better Software (January).
Sabherwal, R., & Chan Y. E. (2001) Alignment between business and IS strategies: A study of prospectors, analyzers, and defenders, Information Systems Research 12(1) 11–34.
Sabherwal, R., & Kirs. P. (1994) The alignment between organizational critical success factors and information technology capability in academic institutions, Decision Sciences 25(2) 301–330.
Sambamurthy, V. & Zmud, R.W. (1999) Arrangement for information technology governance: A theory of multiple contingencies, MIS Quarterly 23(2) 261-290.
Sawyer, S. (2001) Effects of intra-group conflict on packaged software development team performance, Information Systems Journal 11(2) 155-178.
Segars, A.H. & Grover, V. (1998) Strategic information systems planning success: An investigation of the construct and its measurement, MIS Quarterly 22(2) 139-163.
Silva, L. (2007) Epistemological and theoretical challenges for studying power and politics in information systems, Information Systems Journal 17(2) 165-183.

Simon, H. A. (1962) The architecture of complexity, Proceedings of the American Philosophical Society 106 467-482.
Slaughter, S. A., Levine, L., Ramesh, B., Pries-Heje, J. & Baskerville, R. (2006) Aligning software process with strategy, MIS Quarterly 30(4) 891-918.
Tallon P.P., Kraemer K.L. & Gurbaxani V. (2000) Executives' perceptions of the business value of information technology: A process-oriented approach, Journal of Management Information Systems 16(4) 145-173.
Tallon, P.P (2007/2008) A process-oriented perspective on the alignment of Information technology and business strategy, Journal of Management Information Systems 24(3) 227-268.
Walsham, G. (1997) Actor-Network theory and IS research: Current status and future prospects, Information systems and qualitative research.
Wang, E. T. G. & Barron, T. (1995) Controlling information system departments in the presence of cost information asymmetry, Information Systems Research 6(1) 24-42.
Wang, E.T.G., Chen, H.H.G., Jiang, J.J., & Klein, G. (2005) Interaction quality between IS professionals and users: Impacting conflict and project performance, Journal of Information Science 31(4) 273-282.
Weinberg G. M. (1975) An Introduction to General Systems Thinking, Wiley-Interscience.
Wetherbe, J. C. & Whitehead, C. J. (1977) A contingency view of managing the data processing organization, MIS Quarterly 1(1) 19-25
Yetton, P., Martin, A., Sharma, R. & Johnston, K. (2000) A model of information systems development project performance, Information Systems Journal 10(4) 263-289.
Zhang, X., Dhaliwal, J. Gillenson, M. Moiller, G. (2008) Sources of conflict between developers and testers in software development, in Proceedings of the 14th Americas Conference on Information Systems.

Appendix A. **Research on Information Technology (IT) Unit Management (in two MIS Journals)**	**Jour-nal**	**Unit of analysis**	**Method**	**Shared Under-standing**	**Meas urem ents/ Stand ards**	**Gov-ern-ance**	**Part-ner-ships**	**Pro-cess/ Archit ecture**	**Com-pete-ncies**	**Citation**
More internally focused (Level 2 in Figure 1)										
Framework of IT organization's position on a continuum ranging from closed/stable/mechanistic to open/adaptive/organic.	MISQ	IT Unit	Conceptual				√			Wetherbe, et al. 1977
Success factors for IT management including department's role and responsibilities, basic approach, management direction, plan, and development of good people.	MISQ	IT Unit	Conceptual/ Case study			√	√		√	Miller, 1980
Explores critical success factors for IT executives.	MISQ	IT Unit	Interview/ Survey			√				Martin, 1982
Planning managerial practices including the style of senior management decision making, the volatility of the business and application portfolio, the complexity of IT organization and management, and the status and physical location of IT management.	MISQ	IT Unit	Comparativ e Case Study			√	√		√	Pyburn, 1983
More externally focused (Level 1 in Figure 1)										
Strategic IT planning includes definition of key markets (within the firm) for IT, consistency between the strategic business and IT plan, and a means to assess the planning process.	MISQ	IT Unit	Conceptual/ Case study			√				Henderson and Sifonis, 1988
Alignment, analysis, cooperation, and improvement in capabilities influence strategic IT success.	MISQ	IT Unit	Key Informant Survey	√	√	√	√	√	√	Segars and Grover, 1998
Contingencies influence the mode of IT governance to amplify, dampen, or override their mutual influences on the IT governance mode. Three scenarios are identified: reinforcing, conflicting, and dominating.	MISQ	IT Unit	Multiple Case Studies			√				Sambamurt hy and Zmud, 1999
Model of the relationship between the IT department and its dynamic environment.	ISR	IT Unit	Structured Interview					√		Lederer and Mendelow, 1990
The control of IT departments when its managers have private information about the department's costs and have objectives which may differ from those of the organization.	ISR	IT Unit	Analytical/ Simulation		√	√				Wang and Barron, 1995
Context for decentralized systems development governance includes organic decision-making, business unit autonomy, a differentiation competitive strategy, and an unstable industry environment. Finds with perceived deficiencies in IT capabilities and a culture that supports structural changes, a different solution may be adopted.	ISR	Strategic business Unit/ IT Unit	Single Case Study			√				Brown, 1997

WE NEED TO TALK ABOUT THIS—WE NEED TO ADD A COLUMN THAT DESIGNATES WHERE EACH SET OF MEASURES COMES FROM (I.E., ADAPTED FROM …, OR IF WE CREATED THEM OK)

Appendix B. **Construct / Definition**	**Measures**	**Adapted from**
IT Sub-unit Alignment – the congruence of testing strategy and development strategy	• Align1. The software testing strategy is congruent with the software development strategy in your organization. • Align2. The scope of the development group is tightly linked with that of the testing group. • Align3. The governance of the development group is in harmony with that of the testing group. • Align4. The resources of the development group are aligned with those of the testing group.	Preston and Karahanna 2007
Shared understanding – effectiveness in exchange of ideas and knowledge between sub-units, enabling both to understand the company's strategies, plans, environments, risks, priorities, and how to achieve them.	• Comm1. There exist effective communication and liaison mechanisms between testers and developers. • Comm2. Testing and development members have shared understanding of the role of testing in our organization. • Comm3. Testing and development members have a shared view of the role of testing as a critical component in meeting the goals of the corporate IS unit. • Comm4. Testing and development members have a shared understanding of how testing can be used to increase the quality and productive of our software development operations.	Preston and Karahanna 2007; Luftman and Kepaiah 2005
Measurements/standards – uses balanced measurements to demonstrate contributions of the IT sub-units in terms both the business and IT can understand and accept.	• Value1. There are established development metrics to demonstrate the value of development to the organization. • Value2. The organization uses balanced measurements that are understood and accepted by both development and testing, to measure their relative contributions. • Value3. There are explicit service level agreements in place for assessing the contribution of testing to software development. • Value4. There are explicit benchmarking standards available for assessing the contribution of the testing group. • Value5. There are formal assessments and reviews conducted for evaluating the success of testing efforts.	Luftman and Kempaiah 2005
Governance –who has the authority to make IT decisions and what processes are used at strategic, tactical, and operational levels to set priorities and allocate resources.	• Govern1. The IS governance structure allows testing leadership plays a direct role in IS development planning. • Govern2. The development leadership plays a direct role in software testing planning. • Govern3. Steering committees involving testing and development personnel are used for IS governance.	Luftman and Kempaiah 2006; Henderson and Venkatraman 1993
Partnerships – sub-units roles in defining the business's strategies, the degree of trust between the two units and how each perceives the other's contribution.	• Ptnr1. There is a high level of trust between testing and development. • Ptnr2. Development and testing commonly partner to sponsor and champion IS initiatives.	Luftman and Kempaiah 2006
Process/Architecture – provision of a flexible infrastructures, application of emerging technology, enabling process changes, and delivery of solutions to business and partners.	• Scope1. The testing group uses cutting edge testing tools to provide quality assurance services. • Scope2. The testing provides leadership in relation to articulating standards for efficient and sound testing best practices. • Scope3. The testing group has put together a flexible testing infrastructure that supports the organization's software development goals. • Scope4. The testing group has a well-established process for evaluating and applying emerging technologies and best practices. • Scope5. The testing architecture is well integrated with that used for software development.	Luftman and Kempaiah 2006; Henderson and Venkatraman 1993
Competencies – human resources, e.g., hiring, retention, training, performance feedback, encouraging innovation and career opportunities, developing skills, etc. Readiness for change, capability for learning, and leveraging ideas.	• Skills1. The cultural locus of power of the testing group is in harmony with that of the development group. • Skills2. There are adequate training, education and career crossover opportunities for testing personnel. • Skills3. The testing group has hiring and retaining policies and procedures that are effective. • Skills4. The internal environment of the testing organization fosters trust and interpersonal collaboration.	Luftman and Kempaiah 2006; Henderson and Venkatraman

		1993