THE VALUE OF IT–INSTITUTION ALIGNMENT: A MANAGERIAL PERSPECTIVE OF IT–BUSINESS ALIGNMENT

Completed Research Paper

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Abstract

Present commercial software packages (such as ERP) have incorporated management insights, industry solutions, and best-practices to facilitate IT-business alignment. However, poor alignment of IT-business still exists on a large scale in practice. In this study, we investigate the notion of IT-business alignment from a managerial perspective and argue that, in addition to the four well-studied dimensions of IT-business alignment (i.e., knowledge, structure, society and culture), IT should also be aligned with institution to control opportunistic behaviors in administrative practices. Our study shows that: 1) IT exhibits a function of sensing to detect problems promptly, whereas institution exhibits a function of responding to solve problems effectively. From the perspective of governance, IT-business alignment refers to technology efficiency achieved by the coordination between IT and institution; 2) The alignment process undergoes three major stages: at the first stage, alignment is achieved between institution and IT but not between business process and IT; at the second stage, with the embedded management insights and best-practice solutions, IT integration succeeds in aligning with the business process but not with the original institution; at the third stage, the organization further develops integrated IT into customized IT and adapts the existing institution to achieve both IT-institution alignment and IT-business process alignment. A decline in the managerial performance of IT systems can be expected during this process; 3) It is not always wise to improve IT systems and revise original institution to pursue a higher level in IT-institution alignment. Practitioners should take the three-stage framework into account and fully examine the required effort before they start the process of IT-institution alignment.

Keywords: IT-business alignment, institution, governance, private information, incomplete contract

Introduction

IT–business alignment is not only a lasting topic in IS academy research, but also a significant managerial issue in practice (Luftman et al. 1993; Reich & Benbasat 1996, 2000; Huang & Hu 2007; Pinsonneault 2007; Ravishankar et al. 2011; Tallon 2012). Although researchers and practitioners have known the significance of IT–business alignment and endeavored to achieve higher levels of alignment, organizations still encounter serious problems and obstacles in IT–business alignment practice (Ravishankar et al. 2011; Guillemette & Pare 2012). For example, Luftman & Kempaiah (2007) investigated 1000 managers about the status of the alignment in their firms only to find that merely half of the firms could align IT with business to some extent. As a result, scholars have been asking why we have not revealed the true nature of alignment (Chan 2002). Given the rich research findings and abundant managerial implications proposed in academic studies, it is even more intriguing for researchers. Is the research on IT–business alignment not sufficient? Or have the scholars omitted important components of the alignment to which we should pay specific attention?

In addition, since enterprise software packages such as ERP and CRM systems become more mature and comprehensive when software vendors start to incorporate management insights, optimal solution scheme, and best practices into their software products, the fact that many organizations still suffer from misalignment between IT and business seems more puzzling (Soh et al. 2000). Moreover, the firms that prefer develop ERP systems by themselves have also absorbed enough knowledge in designing proper IT systems and coordinating IT and business processes over the long run, foreshadowing almost a guaranteed high level of alignment between IT and business (Bharadwaj 2000). As the functionality and capability of commercial software packages continue to improve and increasingly benefit IT–business alignment practices, why do the firms still struggle in the pursuit of IT–business alignment? We argue that a major reason is the negligence of the final phase of IT–business alignment—IT–institution alignment. In this study, we define institution as the regulative and institutional environment in which the focal firm operates).

Prior studies have provided detailed knowledge and specific recommendations at both the strategic and operational levels about how to achieve IT–business alignment(e.g., Henderson & Venkatraman, 1993; Reich & Benbasat, 1996; Sabherwal & Chan 2001; Chan et al. 2006; Huang & Hu 2007; Ravishankar et al., 2011). Although these findings establish a form foundation for research and practice of IT–business alignment, we argue that strategy and processes do not cover the entire administrative spectrum in the alignment process. In fact, we argue that alignment strategy and processes could not be effective without the support from the intangible institution within the organization (Alvesson & Willmott, 2002). Organizational institutions define all kinds of legitimate behaviors in the organization and regulate the managerial practices that could be applied when rules and procedures are violated (Zucker 1987; Nee, 1998). Since it is the institution that warrants smooth and effective operations of the organization, the alignment between IT and institution should be a major concern of researchers and practitioners. As a result, how to align institution and IT should be an emerging problem in IT–business research and has the potential to provide novel insights for improving the level of IT–business alignment.

In one of the seminal works in IT–business alignment, Henderson & Venkatraman (1993) proposed the Strategic Alignment Model (SAM) which focuses on the strategic and operational levels of IT–business alignment and establishes a comprehensive framework for follow-up studies (. Based on the four typical alignment procedures proposed in SAM, a number of studies investigated the logic and the result of different patterns of alignment between IT strategy and business strategy or the alignment between IT functions and business processes, covering the major issues in strategy alignment and process alignment (Chan et al. 1997; Luftman et al. 1999; Kearns 2000; Shanks et al. 2012). A fundamental assumption in these studies is that IT will benefit the organization once it is well designed, properly developed, successfully implemented, and appropriately aligned with business strategy and operations in the organization. However, this is not necessarily the case based on our anecdotal experience. We investigated several firms with strong IT capabilities and clear IT strategies, and most of them built their IT systems according to business strategies and operational requirements. However, few of them had really made the IT systems work at the anticipated levels. Exploring for the reasons, we found that there were lack of regulations to assure the quality of input and flow of information, and no specific institutions dealing with emerging and integrated data coming from the IT systems. These observations made us to realize that IT

– institution alignment is an indispensable practice which could highly influence the degree of IT – business alignment and the value of IT, and deserves specific attentions from researchers and practitioners. In fact, the institutional and structural impacts of IT have been recognized by IS researchers (Orlikowski & Robey, 1991; Orlikowski, 1992; DeSanctis & Poole, 1994). However, these studies concentrate on the direct relationship between IT and institution rather than the alignment between them, and how they influence each other rather than how they act as a whole. Above all, the issue of IT and institution alignment is under-researched in the IS literature, which provides the primary motivation for this study.

Considering that the major effect of institution is on governance, we choose governance theory, especially incomplete contract theory (Spier, 1992; Hart & Moore, 1999; Tirole, 1999), as our theoretical lens for investigation. What distinguishes this study from IT governance research stream is the fact that we view the topic of our study as an intermediate-level managerial issue. Instead of investigating who are in charge of IT strategy or who are responsible for IT investment, we focus on some practical issues, namely institutions and regulations associated with IT systems, the IT managers or business managers. More specifically, we investigate three research questions in this study: (1) what are some of the under-researched issues within IT – business alignment process; (2) what is the function of institution in IT – business alignment; (3) when and how could firms improve the level of IT-institution alignment.

Briefly, we find the following results: 1) Alignment between IT and institution could help improve the managerial performance of IT systems. Institutions could utilize specific information to response to problems while IT could provide detailed and integrated information for the execution of institutions; 2) IT-institution alignment is likely to undergo a three-stage process, from low-level alignment to misalignment then to high-level alignment. A decline in the managerial performance of IT systems can be expected during the process; 3) It is not always wise to improve IT systems and revise original institution. Practitioners should take the three-stage framework into account and fully examine the required effort before they start the project of IT-institution alignment.

Literature Review and Theoretical Foundation

IT-Business Alignment

The problem of IT–business alignment was identified in the early 1970s, mainly focusing on the "the optimized synchronization between dynamic business objectives/processes and respective technological services provided by IT" (Ullah & Lai, 2013, p. 1). To distinguish between the actions for achieving alignment by design and actions for maintaining alignment by management, we divide alignment studies into two categories: pre-implementation alignment and post-implementation alignment. While the pre-implementation alignment research stream mainly concentrates on the actions in IT design and investigates how top management reaches a shared vision on the identity of IT as well as the alignment procedure (Henderson & Venkatraman, 1993; Sabherwal & Chan 2001), the post-implementation alignment research stream mainly focuses on the communications and interactions between IT and business managers and studies how IT department shares professional knowledge with the business department as well as how business department conveys operational demand to IT staffs (Reich & Benbasat, 1996, 2000; Huang & Hu 2007). Although both strategic alignment and process alignment do show significant impacts on the level of IT–business alignment in these studies, none of the two research streams have taken the role of institution into account.

Prior studies have enlightened us from multiple perspectives; most illuminating are the four dimensions, namely knowledge, social, structure, and culture, in understanding and managing IT–business alignment. Alignment research in knowledge dimension measures the congruency between IT strategy and process and business strategy and process, as typified by Henderson & Venkatraman's (1993) SAM. Many empirical studies, directly or indirectly, extended the four alignment procedures identified in SAM to explain the problem in IT–business alignment, and identified different IT strategies according to various business strategies (Luftman et al., 1999；Sabherwal & Chan, 2001；Sabherwal et al. 2001; Pinsonneault, 2007). For instance, Sabherwal & Chan（2001), drawing on the definitions of business strategies from Miles et al.（1978), identified three kinds of IT strategies to align with three corresponding business strategies: effective IS to explorative strategy, flexible IS to defendant strategy, and comprehensive IS to

analytic strategy.

Alignment research in social dimension focuses on shared cognition between IT managers and business managers on IT vision, IT target, and IT plan, as well as commitment of IT staff and business staff to develop and use IT in business processes (Reich & Benbasat 1996, 2000; Huang & Hu 2007). Shared language and shared knowledge between CIO and CEO are two critical success factors for social alignment and are well formed when the strong ties are present (Campell et al. 2005; Feeny et al. 1992). Holding a position in the top management team is beneficial for CIO to establish a more frequent interaction with other top managers, receive more business insights, and promote more IT knowledge (Preston et al. 2009). In addition, both the connection between IT plan and business plan and the communication between IT managers and business managers influence the social dimension of alignment (Reich & Benbasat 2000). The more CIO participates in the business plan and the more CEO participates in the IT plan, the better result would be achieved in the alignment because of the closer connection of IT plan and business plan (Kearns & Lederer 2003；Kearns 2006; Huang & Hu 2007).

Alignment research in structural dimension focuses the way and the extent of alignment between IT structure and business structure, including such topics as the power of CIO, the position of CIO, the distribution of IT proficiency, centralization or decentralization of IT governance, and decision right of IT program (Brown & Magill 1994; Kane & Borgatti 2011). First, the CIO's position plays an important role in signaling the commitment from the top management. If the hierarchies between CEO and CIO are few, IT is more likely to be viewed as an essential part of the business (Pyburn 1983; Schult & Wolff 2012); at the same time, the CIO would have more chances to participate in business strategic planning and form a comprehensive understanding of business needs, which will in turn help the CIO design a more appropriate IT strategy for business. Second, the report structure also influences the alignment between IT and business. If the firm uses a low-cost strategy, it is better for CIO to report directly to CFO; if the firm conducts a differentiation strategy, it is better for CIO to report directly to CEO (Banker et al. 2011). Last, IT governance structure should be aligned with the competitive strategy of the firm. Centralized IT structure matches well with conservative competitive strategies while decentralized IT structure fits entrepreneurial firms that are not risk-averse (Tavakolian 1989).

Alignment research in cultural dimension focuses on the effect of organizational culture and emphasizes building a culture which is conducive to knowledge sharing among organizational members to act as a soft infrastructure for IT–business alignment (Chan 2002). Empirical studies show that the extent managers respect for and commit to the prevailing culture in the organization will impact the level of IT–business alignment (Nickels & Janz 2010) and that certain types of subcultures could harm the alignment (Ravishankar et al. 2011).

In general, the alignment literature suggests that knowledge alignment mainly happens in the pre-implementation stage and instructs the direction of IT planning and IT implementation. Social alignment and structure alignment mainly happen in the post-implementation stage and significantly determine the level of IT usage. Culture alignment is most likely on-going and happens from pre- to post-implementation phases. Although these different alignment research streams have developed connections between knowledge, structural, social, and cultural factors and IT–business alignment, the administrative practice element, that is, the institution that keeps IT and business aligned in post-implementation and beyond, has not been explored and understood. In the same line with previous studies, as knowledge alignment borrows from strategy theory, culture alignment is based on organizational culture theory, and social alignment refers to organizational learning theory, we build our institutional perspective from governance theory, more specifically, the theory of incomplete contract, to investigate how IT and institution align with each other.

Theory of Incomplete Contract

Classical contract theory premises that a contract could fully predict future possibilities and accordingly articulate detailed and comprehensive items to specify the right and liability of contractor, thus avoiding potential opportunistic behaviors (Lyons 1996; Schwartz & Scott 2003). Different from classical contract, incomplete contract theory argues that it is of huge cost and even impossible for a contract to fully reflect the future, involve all possible problems, inspect all violations, or punish all mistakes in practice (Spier, 1992; Hart & Moore, 1999; Tirole, 1999). To prevent the drawback of incomplete contract, scholars

propose two respective approaches. One deals with the causes of incomplete contract, such as information asymmetry, and the other seeks to design an optimal contract which could not only bring enough motivation but also restrict the potential moral hazard (Spence, 1973；Rothschild & Stiglitz, 1976). In general, costs coming from three different sources result in an incomplete contract: (1) High future-predicting cost. Because the contractors are not always prophets or foreseers, it is costly or even impossible to envision all possibilities in the future and involve them in the contract; (2) High contract-building cost. The contractors have to bargain and negotiate back and forth in order to design a contract accepted by both parties, especially when some situations are hard to describe in explicit language; (3) High violation-substantiating cost. Maybe the principal is convinced that the agent has done something wrong intentionally, it is still hard for the principal to provide sufficient evidence to support his/her judgment and to convince third parties, such as the court, to believe it is the agent's fault. According to these reasons, a complete contract is hard to design, hard to write, and hard to enforce, thus hard to fully motivate the parties involved and effectively extinguish all kinds of opportunistic behaviors (Tirole, 1999; Maskin, 2002).

The incomplete contract theory doesn't restrict itself in the discipline of economics. It also sheds light on the interval governance and administration of firms. Since formal institutions in an organization always exist in the form of contract or regulation and regulate legitimate and inhibited behaviors as a contract does, institutions are also vulnerable to the problem of incomplete contract (Zucker 1987; Nee, 1998). In an organization, the most important governance targets, especially those related with opportunistic behaviors, are cost and efficiency; however, an incomplete institution can't guarantee that these targets are maintained or enforced. Lacking enough information, it is difficult for an organization to find the operational problems promptly, highly undermining the effect of the institution. In addition, due to asymmetry and incomplete information, managers could not really find the underlying opportunistic reason for a problem to prove that the problem is a result of opportunism rather than capability. Therefore, many institutions frequently become dead letters or battlefield of wrangles.

In fact, many researchers have noted the impact of IT on information sharing and information transparency (Clemons et al., 1993; Karimi, 2001; Lin et al., 2005; Xiao et al. 2011). Banker et al. (2006) pointed out that the major function of IT system is to integrate the processes in the organization and share information and knowledge in the entire organization. Studies focusing on DSS or BI also indicate that the value of IT system lies in the accurate and timely information collecting, information storing, information screening and information mining (Shim et al. 2002; Chien & Chen 2008). Given that information is one of the core components in incomplete contract theory, IT is bound to influence the completeness of contract and the effect of contract (Hobbs, 2004; Zhu, 2004; Kelepouris et al., 2007). Bakos and Brynjyolfsson (1993) distinguished non-contractible factors from contractible factors and identified innovation, speed, flexibility, and responsiveness as non-contractible factors. All these factors are closely associated with opportunistic behaviors which could be governed by a complete contract. A significant similarity among these studies is the focus on information, more specifically, asymmetry and incomplete information. Since asymmetry and incomplete information is the unique assumption as well as the major concern in incomplete contract theory, any tools dealing with asymmetry and incomplete information could influence the form of contract and the effect of governance.

To sum up, based on the theory of incomplete contract and the previous findings on IT value, it is reasonable to anticipate that IT would have some impact on organizational institution and should be aligned with organizational institution.

A Basic Model of IT-Institution Alignment

Overview of the Process of IT-Institution Alignment

Before we discuss different modes in IT-institution alignment, it is necessary to introduce the inner logic of this study and the framework of IT-institution alignment. Instead of suggesting a universal model, what we want to describe is a typical dynamic process many firms may follow. To the best of our best knowledge, the majority of the firms that we have investigated in field studies exhibit a similar painstaking process for the alignment. It is not necessary for all the firms to follow exactly same process to achieve the alignment, but the underlying motivations and rationales of alignment do share some similarities.

First we have to identify some IT modes. Although many organizations can develop or implement ERP systems to manage their daily operations, a great portion of them still suffer from isolated IT systems. At this stage, the business process is not aligned with IT systems. Constrained by the discrete IT systems, organizations have to sustain the lack of integrated information and design an original institution without some specific or detailed requirements. However, this misalignment between process and IT will motivate the organization to integrate the discrete IT systems and implement a more mature and integrated IT architecture. At this stage, IT aligns with the process, but the new capability brought by IT doesn't necessarily align with the original institution. This misalignment will evoke a customized development on the ERP software package to align with the unique institutions of the organization, which are normally different from the processes and best practices embedded in the commercial ERP software package. Only after this stage can IT align with both the process and the institution in an organization. Figure 1 illustrates this three-stage model and reflects the main idea of our study. We will then build an analytical model to show how alignment or misalignment is formed and what performances various alignment modes can achieve. Although the framework seems sort of arbitrary, the central idea, the dynamic alignment process, in fact comes from previous studies. In respect to IT resource management, Nolan's (1973) stage hypothesis describes the dynamic essence of IT use and management, which is supported in following empirical studies (e.g., King & Teo 1997). Within the IT alignment literature, both the theories of punctuated equilibrium and co-evolution describe a dynamic process of IT alignment firms are likely to undertake (Sabherwal et al. 2001; Benbya and McKelvey 2006).

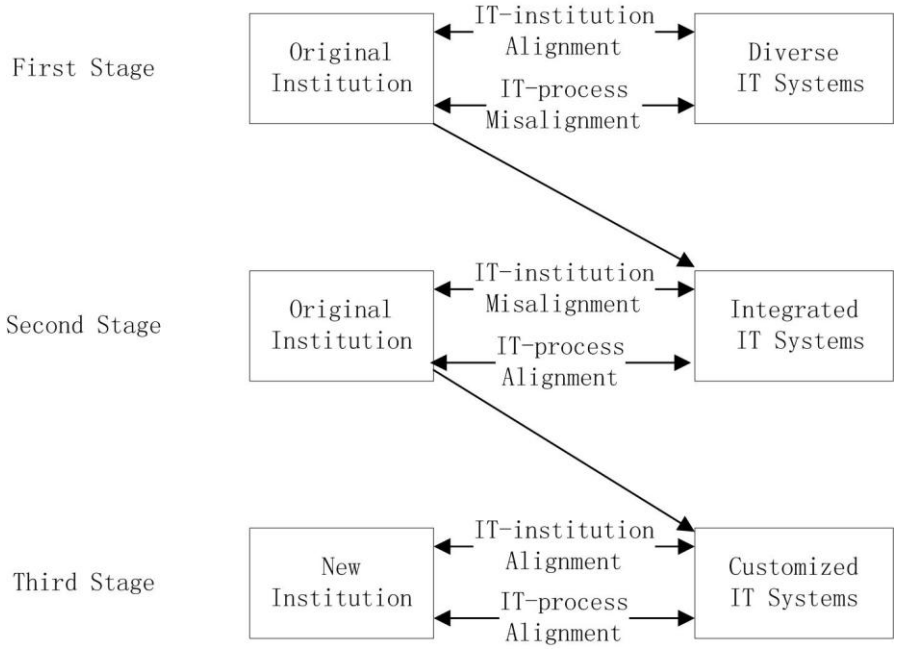

Figure 1. Three-stage alignment in IT-institution and IT-process

In Figure 1, we don't intent to argue that there is only one way for IT-institution alignment. Instead, we draw this figure to help explain the motivation of IT–institution alignment. IT-institution alignment also could follow some distinct alignment approaches, including revising institution to align with IT, developing IT to align with institution, or coevolving both institution and IT.

Alignment between Discrete IT Systems and the Original Institution

Organizational institutions can be either explicit or implicit. Explicit institutions always exist in the form of formal contract, clearly regulating both the rights and responsibilities of staffs and the methods to punish those who violate the regulations (Mustakallio et al. 2002; Carson et al. 2006). Implicit institutions always exist in the form of culture, informal norms, or shared psychological expectation.

Maybe there are no written regulations to cite or follow when staffs are doing their work, they agree on intangible laws and form coherence on the possible results of unwelcomed behaviors (Russel and Russel 1992). Out of two reasons, we won't distinguish explicit and implicit institutions in this paper: (1) Both explicit and implicit institutions share the same mechanism when they are used to deal with opportunistic behaviors; (2) Their performances could be expressed in the same way, an expression of responsive timeliness and problem coverage rate, when institutions are violated.

IT could benefit the conduction of institution in three aspects, including finding problems, providing evidence for solving problems and exhibiting how problems are solved (Clemons et al., 1993; Karimi, 2001; Lin et al., 2005). If the cost of searching information is low while the speed of searching is high, the time required to find an operational or managerial problem will also be short; if the information is sufficient and accurate, it will be easy to find the person who is responsible for the problems and to convince him/her that it is indeed his/her fault; if the cost of sharing information is low, much information could be shared and many people will be notified when a problem is solved according to the institutions. Based on this logic, we identify these three cost factors associated with the implementation of institution, namely, the cost of searching information, the cost of utilizing information, and the cost of exhibiting information. Thus the performance of IT-institution alignment is viewed from three dimensions: the hysteresis of detecting problems, the coverage of problems, and the effectiveness of management. Figure 2 shows the theoretical logic underlying our analytical model.

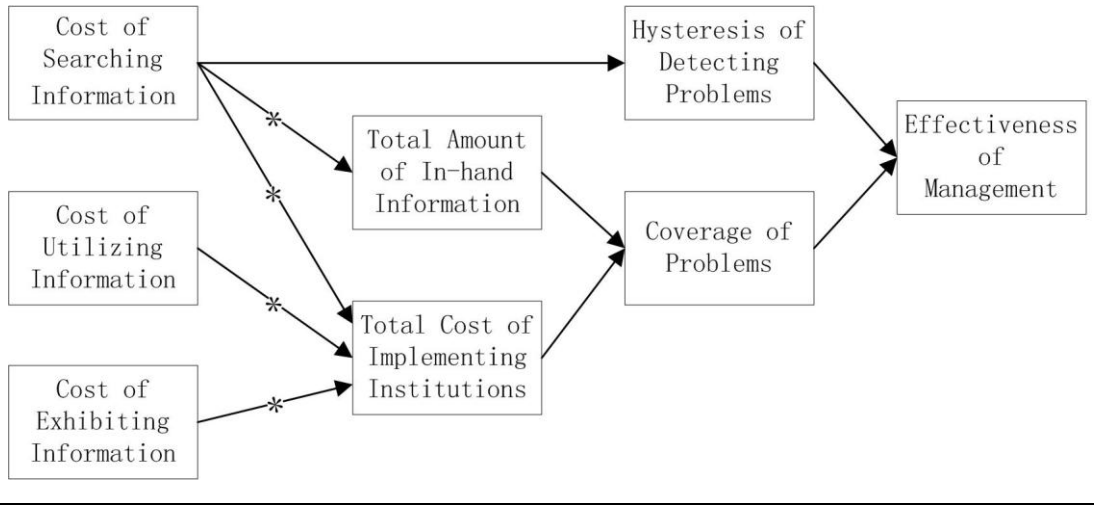

Figure 2. Logical Framework of IT-institution Alignment

Note:"*" denotes a relationship of alignment

In this framework, we intentionally ignore the principle-agent structure in classical incomplete contract theory. It is indeed one of the kernels in incomplete contract theory, but the interest of this study doesn't lie there. The employers or stakeholders are the principles while the employees or staffs are agents in our context. The relationship serves as a background rather than the skeleton of our model. The problems faced by top management or stakeholders in our model are consistent with the ones suggested in classical models. But the unique aspect of this model is that the principles seek for IT systems to solve the problem of asymmetry information and opportunistic behaviors rather than the optimal coefficient to share revenue or control right. What the principles need to do in our context is combining IT systems and institutions to restrain or encourage their agents. Before starting the model, we would clarify some parameters and assumptions (See Table 1).

At stage 1, the alignment is between original institution and discrete IT systems. Assume that the organization applies the following search strategy to find operational problems: the organization searches the managerial areas one by one to make sure whether there is a problem in this area. And assume that the problems could only happen in the first cycle and the organization will only search all these areas two times. Therefore, we know that no problem will be missed and the only uncertain thing is when a problem is detected. Imagining a problem in a certain area, the possibility for its happening is the same for the

situation that the search has not detected this area as the situation that the search has already went through the area. Thus it is easy to deduct that the hysteresis of detecting a problem is $t_o=\frac{N}{2}$.

Table 1. Parameters and Assumptions

Parameters	Definition	Interpretation
$[\underline{\theta}, \overline{\theta}]$	Range of acceptable performance	This is a range of individual or group performance which is accepted or set by the institutions. All the performances under the lowest level would be punished.
N	Types of operational areas	Assume that the organization faces N types of managerial areas, and each kind of area has a range of acceptable performance. Although in practice the range can't be the same, we use one range to simplify the analysis.
ρ	The possibility of a problem	The possibility of a problem happening in a certain kind of managerial area. We assume that up to one problem could happen in any managerial area and the possibilities are independent among the areas.
t	Hysteresis of detecting problems	It reflects the delay between the time when the problem happens and the time when the problem is detected. We assume $t\in [1, N]$, in which1 denotes the shortest delay and N denotes the longest delay. We further set t_o to represent the delay at stage 1, t_N for stage 2 and t_A for stage 3.
S	Cost coefficient of searching information	The cost required to search one problem in all the managerial areas. Set S_o for discrete IT systems and S_N for both integrated IT systems and customized IT systems. Assume $S_o > S_N$ considering the systems are integrated.
A	Cost coefficient of utilizing information	The cost required to find the responsible person and punish him/her in one case. Set A_o for discrete IT systems and A_N for both integrated IT systems and customized IT systems. Assume $A_o > A_N$ considering the technology is developed.
E	Cost coefficient of exhibiting information	The cost required to exhibit how one problem is solved and how one institution is carried out. Set E_o for discrete IT systems, E_N for integrated IT systems, and E_A for customized IT systems. Assume $E_o > E_N$ considering the information is transparency in integrated infrastructure.
σ	Amount of at-hand information	The amount of information gained during the inspection of one problem. Set σ_o for discrete IT systems and σ_N for both integrated IT systems and customized IT systems.
I	Total cost of implementing institutions	The total cost of implementing one institution is influenced by the total amount of searching information, the total cost of utilizing information and the total cost of exhibiting information. Set I_o for stage 1, I_N for stage 2 and I_A for stage 3.
π	Coverage of problems	It is the rate of the number of solved problems to the number of the amount of all coming out problems. Set π_o for stage 1, π_N for stage 2 and π_A for stage 3.
C	Effectiveness of management	It reflects the effect of the institution but relates to it in a reversed logic. C measures how much loses are caused by the problems before the organization having found and solved them. Set C_o for stage 1, C_N for stage 2 and C_A for stage 3.

At stage 1, the alignment is between original institution and discrete IT systems. Since the IT systems are not seamlessly connected, the organization still needs manual labors to collect and summary the information and data provided by each single IT system. Assume that the organization applies the

following search strategy to find operational problems: the organization searches the managerial areas one by one to make sure whether there is a problem in this area. And assume that the problems could only happen in the first cycle and the organization will only search all these areas two times. Therefore, we know no problem will be missed and the only uncertain thing is when a problem is detected. Imagining a problem in a certain area, the possibility for its happening is the same for the situation that the search has not detected this area as the situation that the search has already went through the area. Thus it is easy to deduct that the hysteresis of detecting a problem is $t_o=\frac{N}{2}$.

Because stage 1 serves as a foundation for the entire analytical model, we define the coverage of problems in this stage as π_o. And π_o is mainly influenced by total amount of at-hand information, which is $2N\sigma_o$ in this stage and the total cost of implementing institutions I_o. Logically, π_o is positively related with $2N\sigma_o$ while negatively related with I_o. And by definition:

$$I_o = f\left(2NS_o \text{ , } 2N\sigma_o A_o \text{ , } 2N\sigma_o E_o\right) \quad (1)$$

in which equation $\frac{\partial f}{\partial S_o} > 0$, $\frac{\partial f}{\partial A_o} > 0$, $\frac{\partial f}{\partial E_o} > 0$, meaning that the total cost of implementing institutions will increase with any of these costs of searching information, implementing information, or exhibiting information.

In terms of management efficiency, the original institution can't cover all the problems with the poor support from discrete IT systems. Therefore, some problems are detected and solved while the others are found out but left there without any execution. Among the solved problems, since not all of them are detected timely, even if solving a problem might be by no means time consuming, the problem have been hampering the profit of the organization until it is detected and solved. Thus, we can deduct that:

$$C_o = N\rho\pi_o * \left(\underline{\theta} - \theta\right) * \frac{N}{2} + N\rho(1-\pi_o) * \left(\underline{\theta} - \theta\right) * \frac{3N}{2} \quad (2)$$

Considering that the original institution is subject to the poor IT technology and is seriously constrained by the capacity of discrete IT systems, it is wise to compromise institution to IT. IT is so poor that it could not support the automatic problem-detecting process while the requirement of institution could be slightly relaxed considering the underdeveloped IT capacity.

Extended Model on IT-Institution Alignment

Alignment between the Integrated IT Systems and the Original Institution

The misalignment between IT and business process at stage 1 is likely to motivate the CIO and IT department to develop or implement a better IT system. To bridge the gaps among the isolated IT systems, the best way is establishing an integrated IT infrastructure or implementing mature integrated IT systems. The newly developed IT systems could reduce the cost of information storage, processing, integration, and screening, thus improving the information flow within the organization and providing more information for the execution of institutions. First, the change in the cost of searching information will impact the hysteresis of detecting problems. To better compare the different stages, we assume that the budget for searching information is $2NS_o$, which is the cost of searching information at stage 1. Since the integrated IT systems can automatically collect, integrate and screen information, the cost will be definitely reduced. Under the budget, organization with integrated IT systems can search $\frac{2NS_o}{NS_N}$ times, denoting that the time required to search all the managerial areas is $\frac{S_N}{S_o}$ times the time required at stage 1. Since the searching mechanism itself is not changed and where the problem happens is not influenced by the search method, the hysteresis of detecting problems at stage 2 satisfies $t_N = \frac{N}{2} * \frac{S_N}{S_o}$. Hereby we get lemma 1 ("Sensing" means the capabilities to sense operational or transactional problems within or associated with a firm. Sensing includes collecting information, tracking the operation process, and scanning for problems and exceptions. (Adapted from Overby et al. 2006)):

Lemma 1: IT exhibits the function of "sensing" in an organization, helping reduce the cost of searching information and the time of finding a problem, and thus promoting the timeliness of detecting problems and providing an information foundation for solving the problems.

In the same line with equation (1), the total cost of implementing institutions is:

$$I_N = f\left(2NS_o \text{ , } 2N\frac{S_o}{S_N}\sigma_o A_N \text{ , } 2N\frac{S_o}{S_N}\sigma_o E_N\right) \quad (3)$$

Compared with equation (1) $I_o = f(2NS_o \text{ , } 2N\sigma_o A_o \text{ , } 2N\sigma_o E_o)$, I_N and I_o have the same cost of searching information. In terms of the cost of implementing information, since institutions don't change during this process, the integrated IT systems just provide the information required by original institutions rather than new information which could be obtained via the new IT technology. Therefore, the amount of information used by institutions increases at stage 2 but the species of information don't change. While the coefficient of the utilizing information cost decreases, the product of information amount and cost coefficient is somehow hard to predict and the relationship between $2N\frac{S_o}{S_N}\sigma_o A_N$ and $2N\sigma_o A_o$ is uncertain. In the same logic, whether $2N\frac{S_o}{S_N}\sigma_o E_N$ is smaller than $2N\sigma_o E_o$ also depends on the parameters in the expressions. Because of this uncertainty, it is entirely possible that I_N is bigger than I_o, or vice versa. Thus we get lemma 2 (see proof in Appendix 1):

Lemma 2: There exist a set of critical values of the cost of searching information and exhibiting information, under which integrated IT systems could help reduce the total cost of implementing institutions and improve the coverage of problems while above which integrated IT systems could induce an information overload problem, increase the total cost of implementing institutions, and reduce the coverage of problems.

In the same line with equation (2), the management efficiency at stage 2 is:

$$C_N = N\rho\pi_N * \left(\underline{\theta} - \theta\right) * \frac{N}{2} * \frac{S_N}{S_o} + N\rho(1-\pi_N) * \left(\underline{\theta} - \theta\right) * \frac{3N}{2} \quad (4)$$

Compared with equation (2) $C_o = N\rho\pi_o * \left(\underline{\theta} - \theta\right) * \frac{N}{2} + N\rho(1-\pi_o) * \left(\underline{\theta} - \theta\right) * \frac{3N}{2}$, at stage 2 the coverage of problems could be bigger or smaller, the hysteresis of detecting problems is reduced, and the loss from unsolved problems is unchanged. Therefore, we get lemma 3(see proof in Appendix 2):

Lemma 3: Even if the coverage of problems is reduced by integrated IT systems, the upgraded IT could still improve the management efficiency of institutions in the end.

From lemma2 we can see that integrated IT systems could be a double-edged sword for detecting and solving operational and managerial problems. On one hand integrated IT systems enhance the speed to find a problem. But on the other hand, they also provide excessive and redundant information associated with a simple problem. Therefore, we know the effect of original institution depends on the coherence between the original institution and integrated IT systems. The positive aspect and the negative aspect of integrated IT systems may offset each other if the institutions are not properly aligned with the IT systems. Every organization has some unique institutions, even though the best practice and most leading management insights are embedded in integrated IT systems, the function of the IT systems may still not be able to satisfy the demand of the organization. Therefore, at stage 2, institution is only partially aligned with IT but process is fully aligned with IT. When this partial alignment is observed by top management, they will try to revise the original institution and further develop the integrated IT systems to customized IT systems.

Alignment between the Customized IT Systems and the New Institution

Based on the integrated IT systems, many organizations will further develop some function to satisfy its unique demand and maintain its core competitiveness. But with the development of IT technology, the top management will always find that the original institution wastes the valuable information and versatile functions of customized IT systems and therefore no longer consider it the best one for the organization. At this point, top management will revise the original institution or even redesign some new ones to fully take advantage of customized IT systems. In this paper we will focus on what the approach is for the third-stage alignment and what results are brought by the perfect alignment between IT and institution.

Although institutions have been changed at stage 3 and some functions have been added into integrated IT systems, the basic function of integrated IT systems—reducing the cost of searching information—

remains the same. In the same logic of the previous subsection, at stage 3 the hysteresis of detecting problems is $t_A = t_N = \frac{N}{2} * \frac{S_N}{S_o}$.

Different from the original institution, the new institution sets new items to regulate the behaviors of staffs just because it now involves new information provided by customized IT systems. Some uncontractible factors are no longer uncontractible, and some private information is no longer private as well. If the new information compensates the information required by the original institution, there is no doubt that the new institution will have more methods to govern the operational problem and exhibit the execution process. Moreover, because of the seriously information asymmetry, the original institution has to share some profit with the staffs to motivate them to disclose their private information. However, with more information, the new institution can directly observe and constrain the behaviors of staffs rather than sacrifice the profit. Thus how to design the institution and how to utilize the advantage of IT systems become major concerns in IT-institution alignment.

Once the new institutions ask for new types of operational information within IT systems, customized IT systems can develop a certain function and provide the required information. It does not necessarily mean that integrated IT systems can't find the right information to provide> Instead, the original institution doesn't require IT to do that. Since customized IT systems get not only the traditional information σ_o but also the supplemental information σ_N, the total amount of at-hand information is $2N\frac{S_N}{S_o}(\sigma_o + \sigma_N)$. In the same logic with equation (3), the total cost of implementing institutions is:

$$I_A = f(2NS_o, 2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)A_N, 2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)E_A) \quad (5)$$

Comparing with equation (3) $I_N = f(2NS_o, 2N\frac{S_o}{S_N}\sigma_o A_N, 2N\frac{S_o}{S_N}\sigma_o E_N)$ we can find that the three cost coefficients don't change but the total amount of at-hand information is increased, so the total cost of implementing institutions is also increased. But the change in the coverage of problems is uncertain because of the competing effects of $2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)$ and I_A. Thus we get lemma 4 and proposition 1 (see proof in Appendix 3):

Lemma 4: The extent of alignment between customized IT systems and new institution depends on the usage of supplemental information. If new institution involves new information and new methods of exhibiting information, the coverage of problems can be improved. If new institution fails to do that, the coverage of problems may decrease.

Proposition 1: Alignment between IT and institution in its nature is a problem of technological efficiency. If institution fully takes advantage of IT and utilizes the information provided by IT, alignment is achieved. In this alignment, IT acts as a "sensing" device and reinforces the effect of institution through prompt information searching and screening. Institution acts as a "responding" device and solves the operational and managerial problems by formal contract or implicit regulations.

By using "sensing" here, we want to emphasize the capability to sense the problems in a firm; by using "responding" here, we want to emphasize the capability to effectively and timely response to the uncovered problems.

In the same line with equation (4), the management efficiency is:

$$C_A = N\rho\pi_A * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{S_N}{S_o} + N\rho(1 - \pi_A) * (\underline{\theta} - \theta) * \frac{3N}{2} \quad (6)$$

Compared with equation (2) $C_N = N\rho\pi_N * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{S_N}{S_o} + N\rho(1 - \pi_N) * (\underline{\theta} - \theta) * \frac{3N}{2}$ and equation (4) $C_o = N\rho\pi_o * (\underline{\theta} - \theta) * \frac{N}{2} + N\rho(1 - \pi_o) * (\underline{\theta} - \theta) * \frac{3N}{2}$, the coverage of problems in equation (6) is the biggest and the timeliness of searching problems is the best at stage 3 when new institution cooperates with customized IT systems. At this point, the management efficiency is also the best. Hereby we get lemma 5 and proposition 2 (see proof in Appendix 4):

Lemma 5: When new institution is aligned with customized IT systems, both the timeliness of searching problems and the coverage of problems become the optimal solution, thus bringing the best management effect. Both the original institution-discrete IT systems alignment and original institution-

integrated IT systems alignment embed some disadvantages compared with new institution-customized IT systems alignment.

Proposition 2: During the process of IT-institution alignment, if IT doesn't support institution, institution will suffer from serious hysteresis of detecting problems and low coverage of problems. If institution doesn't align with IT, IT will find too many problems and brings too much information for institution to deal with. Only when IT satisfies the unique requirement of institution and institution utilizes the unique function of IT, can firms achieve a high-level IT-institution alignment.

From lemma 4 and lemma 5 we can conclude that the informational function of IT, which is critical for the alignment between IT and institution, partially substantiates the managerial function of institution. At stage 1 IT and institution achieve a low-level alignment; at stage 2 they achieve a misalignment; and finally at stage 3 they achieve a reasonable alignment. Meanwhile, the IT-process alignment transits from the misalignment status at stage 1 to the alignment status at stage 2 and 3. Combining the two procedures, the organization achieves ambi-alignment at stage 3.

A Summary of Three-stage IT-Institution Alignment

Now we have investigated all the performance in three stages. To compare the effect of different alignment modes, we introduce table 2 to exhibit the algebraic results of our model. Some expressions are not listed in the table for limited space. Please refer to equations (1)-(6) to find them.

Table 2. Comparison Among Three Stages

	Original institution with Discrete IT systems	Original Institution with Integrated IT systems	New Institution with Customized IT systems
Hysteresis of detecting problems	$t_o=\frac{N}{2}$ Serious	$t_N = \frac{N}{2} * \frac{S_N}{S_o}$ Not Serious	$t_A = \frac{N}{2} * \frac{S_N}{S_o}$ Not Serious
Total amount of at-hand information	$2N\sigma_o$ Scarce	$2N\frac{S_o}{S_N}\sigma_o$ Medium	$2N\frac{S_o}{S_N}$ （$\sigma_o + \sigma_N$） Abundant
Total cost of implementing institutions	I_o Low, Medium or High	I_N Low or Medium	I_A Medium or High
Coverage of problems	π_o Medium or Low	π_N Low or Medium	π_A High
Effectiveness of management	C_o Low or Medium	C_N Medium or Low	C_A High

In terms of hysteresis of detecting problems, integrated IT and customized IT do better than discrete IT no matter what the institution is. In terms of total amount of at-hand information, IT forms a technical foundation for more information; however, how much information is obtained depends on the content of institution. In general, integrated IT and customized IT acquire more information than discrete IT; original institution acquires less information than new institution does. In terms of total cost of implementing institutions, new institution always cost more than original institution ($I_N < I_A$) because it requires more information. However, the cost coefficient brought by integrated IT may compensate the increased cost of at-hand information amount, thus making the relationships among I_o, I_N, and I_A uncertain: $I_N < I_A < I_o$, $I_N < I_o < I_A$, and $I_o < I_N < I_A$ are all possible. In terms of problem coverage, new

institution performs the best because it fully utilizes new information and new functions of customized IT. The comparison between the values under stage 1 and stage 2 depends on the coefficients of information-implementing cost and information-exhibiting cost. The smaller the cost, the high possibility for institution at stage 2 has to cover more problems. Finally, in terms of management efficiency, the alignment between customized IT and new institution outperforms among other two modes thanks to the support from the most prompt searching of problems and the biggest coverage of problems. Since the cost of searching information is negatively correlated with management efficiency, the management efficiency under stage 2 is more likely to surpass the one under stage 1 if the cost is small.

A Dynamic Analysis of Three-stage IT-Institution Alignment

In the previous sections, we described a three-stage framework and pointed out the static features of each stage. But what is the motivation to go through the three-stage procedure? Whether the motivation is enough for different firms?

Table 3 shows the payoffs in each stage. The bolded expression shows the comparative advantage in each mode.

Table 3. Tradeoffs of Three Modes

	Original Institution	New institution
Discrete IT Systems	$N\rho\boldsymbol{\pi_o} * (\underline{\theta} - \theta) * \frac{N}{2} + N\rho(1-\pi_o) * (\underline{\theta} - \theta) * \frac{3N}{2}$	
Integrated IT Systems	$N\rho\pi_N * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{\boldsymbol{S_N}}{\boldsymbol{S_o}} + N\rho(1-\pi_N) * (\underline{\theta} - \theta) * \frac{3N}{2}$	
Customized IT Systems		$N\rho\boldsymbol{\pi_A} * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{\boldsymbol{S_N}}{\boldsymbol{S_o}} + N\rho(1-\pi_A) * (\underline{\theta} - \theta) * \frac{3N}{2}$

As is shown in previous sections, the advantage of original institution is simplicity. It focuses on a small but essential partition of performance information to improve the management efficiency—spending limited effort on essential problems. Different from original institution, new institution extends the scope of management and requires more related information. New institution is ambitious in governing all aspects of operation and involving as much as decision information, thus making the management more delicate.

Discrete IT systems lags in collecting information and detecting information, but when they are aligned with original institution, the institution works well because the institution does need too much information. Integrated IT systems provide more information than discrete IT systems, but when they are aligned with original institution, the increased information overwhelms the managers because there are no structured routines and regulations to deal with the emerging problems or the redundant decision information. Customized IT systems could help organize and exhibit newly collected information and thus partially overcome the issue of excessive information. At the same time, new institution concerns the new information and regulates a routine to deal with the information. Combined with each other, customized IT systems satisfy the ambition of new institution while new institution exploits the new information brought by IT. As a result, in terms of the level of IT-institution alignment, we name the stage 1 low-level alignment, the stage 2 misalignment, and stage 3 high-level alignment. And in terms of the level of IT-process alignment, it is misalignment at stage 1, high-level alignment at stage 2 and 3. Therefore, it is not the low-level IT-institution alignment motivating the firms to improve their IT systems, but the

misalignment between IT and process serves as the trigger. However, the unexpected misalignment between IT and institution could happen if firms have no sense to adapt original institution to integrated IT systems. As a result, the performance of IT systems maybe surprisingly reduced even after an improvement in the technology. Thus, we have lemma 6 and proposition 3 (see proof in Appendix 5):

Lemma 6: The managerial performance of IT systems at stage 2 may be smaller than that at stage 1 if the negative effect of expanded information outweighs the positive effect of swift searching.

Proposition 3: The misalignment between IT and process at stage 1 motivates firms to improve their discrete IT systems, but the unexpected misalignment between IT and institution makes the firms worse off. What the firms intend to achieve is the ambi-alignment at stage 3, and stage 2 is the low point they have to overcome.

If all the firms are wise enough to foresee the full procedure of IT – business alignment, they can decide whether they should go through the process to achieve a higher level of alignment. Staying in a low-level alignment is not always a bad idea especially when the cost to improve is tremendous. Compared stage 1 and stage 3, we know a firm has to both improve IT systems and revise institutions to achieve an ambi-alignment. Let us assume the cost of improving IT is C_{1-2} while the cost of revising institutions is C_{2-3}. Thus we can have proposition 4 (see proof in Appendix 6):

Proposition 4: It is not always wise to improve IT systems and revise institutions to achieve ambi-alignment. When the cost of improving IT systems and revising institutions is smaller than the enhanced performance of IT systems, it is beneficial to do that; otherwise it is better to stick to stage 1.

Discussion

In this study we extend the content of IT – business research and begin to focus on the issue of IT-institution alignment. We argue that the low-level IT-institution alignment is responsible for the overall misalignment between IT and business when mature ERP software packages are implemented in organizations. From the governance perspective, the analytical results show the process of IT–business alignment: a three-stage framework.

At stage 1, IT aligns with institution in a low efficiency because discrete IT systems restrict the productivity of the firm and original institution could not require or regulate so much. However, the function of discrete IT systems is at least consistent with the aim of original institution. But IT and process are misaligned at the same time, motivating the firm to further develop its IT systems. At stage 2, the firm would introduce some commercial software packages, such as ERP, OA, which embed management thought, industrial solutions, and the best practice schemes. Such software can get a relatively high rate to successfully align with firm's process. However, the firm's institution has not been updated with integrated IT systems. Therefore, the firm achieves the alignment between IT and process but unfortunately evoke the misalignment between IT and institution. Such misalignment calls for the improvement from integrated IT systems to customized IT systems and the change from original institution to new institution. At stage 3, firms still need to conduct secondary development to fully satisfy the unique features of each firm's business process. Meanwhile, the original institution will be revised to be a more comprehensive and detailed one. Thus, the firms could achieve ambi-alignment—IT-institution alignment and IT-process alignment. From the perspective of technical efficiency, stage 3 realizes the incentive compatibility between managers and staffs and thus achieves the high–level alignment between IT and institution.

Considering that we mainly draw on incomplete contract theory in this study, we illustrate the three-stage alignment process under a principle-agent context in previous three subsections. At stage 1 and 2, as the agent owns the private information, the principal has to sacrifice some revenues to motivate the agent. At stage 3, IT systems make the information transparent and traceable, helping to reduce the extent of information asymmetry in principal-agent relationship. Thus, IT systems enable the principal to take back some benefit which is originally appreciated to the agent. The changing in information structure serves as the basis for IT-institution alignment and provides an important insight for IT – business alignment research.

In terms of the function of IT, our model shows that IT itself can only help to find the operational and

managerial problem. But it cannot effectively solve these problems on its own. Previous studies suggest that IT can improve the level of communication efficiency and information transparency, thus helping firms improve their performance (Pentland 1995; Zhu 2004). However, our research reveals that without the support from institutions, IT itself cannot significantly enhance firms' performance. Although IT provides more information and detects more problems, it is institution that forms the legitimate foundation for IT or human to deal with the uncovered problems. Considering the present governance theories, such as contract, relational governance, and power, none of them has mentioned that information or technology itself can play the role of governance.. Because firms that are strong in IT always also do well in establishing institutions or cultures, it is easy to understand the results of those empirical studies. However, the complementary, or even the determining, role of institutions should never be ignored when firms are ambiguous to build their advanced IT systems.

In terms of the function of institutions, the effect of it could be highly undermined if no timely and accurate information is supplied. Although institutions could response to the problems, without a keen sense of the problems, the effect of institution is still limited. Our research draws on governance theory to investigate the issue of IT–business alignment, adding new perspective to IT – business research. Since strategic alignment research borrows the concept of strategy from strategic management area while process alignment borrows the concept of process from enterprise production and operation area, we borrow the concept of institution from the governance theory. We hope that various theoretical views can help to explore a deeper understanding of IT–business alignment.

The theoretical implication of this study is two-fold. Previous studies on IT – business alignment mainly emphasize the strategic level of alignment, but in fact without the support of proper institutions the effect of advanced IT systems could not be fully exploited. We involve a sort of operational level factor, institution, to extend the content of IT – business alignment and further link academic research to practice. Since we draw on a governance theory, incomplete contract theory to explain our idea and build our model, we hope this new theoretical perspective could enlighten alignment scholars. In fact, the relationship between IT and institution has been discussed by considerable studies. Scholars have found that IT can restructure institution and institution can influence the level of IT usage (Orlikowski, 1992; DeSanctis & Poole, 1994; Jones & Karsten 2008). These studies mainly focus on mutual influence between IT and institution, however, our research focus on the effect of the interaction between IT and institution. We further explain the issue of IT-institution alignment as a problem of technical efficiency and investigate how firms could achieve the alignment between IT and institution to improve the performance of IT systems. We find that only when institutions fully use the information provided by IT, the institution can effectively take advantage of IT. One of the major theoretical contributions of this research lies in that the utilizing of IT needs the support—the function of responding-- from institutions and the utilizing of institutions need the support—the function of sensing—from IT. Hopefully these findings could inspire the research of IT-institution alignment and the understanding of the complex relationship between IT and institution.

The practical implication of this study lies in that we indentify the condition in which firms should pursue the high-level IT-institution alignment and in which they should not. Firms are highly possible to encounter a decline of the performance of IT systems if when they improve the function of IT systems. The instant gain is lower than what the firms expected when they decided to improve their IT systems. In fact, although process is misaligned with IT at stage 1, it is still reasonable to stay in this stage if the total cost of simultaneously improving IT and institution is higher than the benefit brought by enriched information and increased speed of detecting problems. Managers are encouraged to take the three-stage process into account and estimate the potential benefit before beginning their IT – business alignment project.

Conclusion

To present an overall picture of the issue of IT – business alignment, we investigate the problem of IT-institution alignment and focus on how IT cooperates with institution when IT is well designed and successfully implemented. Since the major function of institution is to solve opportunistic behaviors, we draw on the lens of governance theory and build an analytical model to show how IT aligns with institution and what the effects of institution are under different alignment stages. The contribution of

this study is three-fold:

First, we find that the function of IT is more "sensing" while the function of institution is more "responding" when they cooperate to solve the operational and managerial problems in a firm. If IT is not aligned with institution, it is able to find problems but not able to solve them. Meanwhile, if institution is not aligned with IT, it is not able to find problems though it is capable to solve them. Once IT is aligned with institution, IT will search problems in the organization and provide necessary information for institution. Institution then can use the information provided by IT to solve the problem and make the result circulated among all the staffs as a warning of similar opportunistic behaviors. When IT is aligned with institution, the organization can fully take advantage of IT to back up the execution of institution and maximize the value of IT. Therefore, in the perspective of management and governance, alignment between IT and institution is a problem of technology efficiency.

Second, by combining IT-institution alignment and IT-process alignment, we create a dynamic picture of IT – business alignment. In general, the alignment process undergoes three stages. At stage 1, discrete IT systems and original institution form a low-level alignment but meanwhile discrete IT and process don't align with each other. At stage 2, integrated IT systems and original institution become misaligned with each other but meanwhile integrated IT and process become aligned with each other. At stage 3 customized IT systems and new institution are aligned while customized IT and process are also aligned. It is the misalignment between discrete IT systems and process at stage 1 that urges an organization to develop discrete IT into integrated IT. Likewise it is the misalignment between integrated IT systems and original institution in stage 2 that triggers the co-evolution of new institution and customized IT. The managerial performance of IT systems at stage 2 is probably worse than at stage 1, indicating that firms would undergo a descending path before they come to the final high-level alignment. In addition, it is not always necessary and beneficial for firms to complete the three-stage process. Staying in stage 1 is the optimal choice when the cost of improving IT systems and institutions is comparatively high. Under original institution, a firm has to share some profits with the staffs so that they are willing to disclose their private information and work hard for the strategic goal of the firm. With the help of integrated IT systems, the extent of information asymmetry between the firm and the staffs is reduced. As a result, the firm can partially withdraw the profits that are surrendered to the staffs when it could not collect enough information. The changes in the extent of information asymmetry and institution settings serve as a basis for the alignment between customized IT and new institution.

To sum up, in this paper we focus on a new area of IT – business alignment, IT-institution alignment, and investigate the managerial performance of IT systems from the management perspective. Although we neither identify specific type of institution nor show how to align IT with institution, we do articulate the inner logic underlying the alignment process and propose a three-stage model for IT-institution alignment. For future research, survey studies are welcomed to test the antecedents of IT-institution alignment. But due to the fact that the study of IT-institution alignment is at its early stage, case studies investigating how IT is aligned with institution and how institution is developed to take advantage of IT are more practical and beneficial at this point.

Appendix

A1

Let us compare $I_N = f(2NS_o, 2N\frac{S_o}{S_N}\sigma_o A_N, 2N\frac{S_o}{S_N}\sigma_o E_N)$ with $I_o = f(2NS_o, 2N\sigma_o A_o, 2N\sigma_o E_o)$. To make $2N\frac{S_o}{S_N}\sigma_o A_N = 2N\sigma_o A_o$, A_N has to satisfy $A_N^* = \frac{S_N}{S_o}A_o$. In the same logic, when $E_N^* = \frac{S_N}{S_o}E_o$, $2N\frac{S_o}{S_N}\sigma_o E_N = 2N\sigma_o E_o$. Apparently, if $A_N < A_N^*$ and $E_N < E_N^*$, then I_N will be smaller than I_o. If $A_N > A_N^*$ and $E_N > E_N^*$, I_N will be greater than I_o. Since I is negatively related with the coverage of problems, a bigger I always indicates a smaller π. Thus lemma 2 is supported .

A2

Let us compare $C_N = N\rho\pi_N * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{S_N}{S_o} + N\rho(1-\pi_N) * (\underline{\theta} - \theta) * \frac{3N}{2}$ and $C_o = N\rho\pi_o * (\underline{\theta} - \theta) * \frac{N}{2} + N\rho(1-\pi_o) * (\underline{\theta} - \theta) * \frac{3N}{2}$. Set $C_N = C_o$, then $N\rho(\pi_o - \pi_N) * (\underline{\theta} - \theta) * \frac{3N}{2} = N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * (\pi_o - \frac{S_N}{S_o} * \pi_N)$. We get $3(\pi_o - \pi_N) = (\pi_o - \frac{S_N}{S_o} * \pi_N)$, which is simplified as $\pi_N^* = \frac{2S_o}{3S_o - S_N} * \pi_o$. If we know $\pi_N < \pi_o$, and we

want to make $\pi_N^* = \pi_o$, then $S_N = S_o$. But normally $S_N < S_o$, thus $\pi_N^* < \pi_o$. So when $\pi_N < \pi_N^* < \pi_o$, the low coverage of problems overweighs the benefit of timely information searching and leads to a low management efficiency. But when $\pi_N^* < \pi_N < \pi_o$, although the coverage is still smaller at stage 2 than at stage 1, the final management efficiency is greater at stage 2 than at stage 1.

A3

Let us compare $I_A = f(2NS_o, 2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)A_N, 2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)E_A)$ and $I_N = f(2NS_o, 2N\frac{S_o}{S_N}\sigma_o A_N, 2N\frac{S_o}{S_N}\sigma_o E_N)$. Obviously, $2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)A_N > 2N\frac{S_o}{S_N}\sigma_o A_N$. Only when $2N\frac{S_o}{S_N}(\sigma_o + \sigma_N)E_A < 2N\frac{S_o}{S_N}\sigma_o E_N$, I_A may be smaller than I_N. Otherwise, I_A is definitely bigger than I_N. Since π is negatively related with I and positively related with σ, for π_A to be bigger than π_N, the new institution has to involve a great amount of information in its execution and exhibition. But as our definition, new institution makes a progression in utilizing new information and exploring new information exhibition method, it is reasonable to assume the positive effect of increased information outweighs the negative effect of increased information. Thus the coverage of problems is also increased.

A4

$C_A - C_N = N\rho(\pi_A - \pi_N) * (\underline{\theta} - \theta) * \frac{N}{2} * \frac{S_N}{S_o} + N\rho(\pi_N - \pi_A) * (\underline{\theta} - \theta) * \frac{3N}{2} = N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * (\pi_A - \pi_N) * (\frac{S_N}{S_o} - 3)$. Since $\frac{S_N}{S_o} < 1$, then $C_A < C_N$. In other words, the management efficiency at stage 3 is better than that at stage 2. In the same logic, $C_A - C_o = N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * (\frac{S_N}{S_o}\pi_A - 3\pi_A + 2\pi_o)$. $\frac{S_N}{S_o}\pi_A - 3\pi_A + 2\pi_o = \pi_A(\frac{S_N}{S_o} - 1) + 2(\pi_o - \pi_A)$. Since $\frac{S_N}{S_o} < 1$ and $\pi_o < \pi_A$, $C_A < C_o$.

A5

Since $C_N - C_o = N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * (\pi_N \frac{S_N}{S_o} - \pi_o) + N\rho * (\underline{\theta} - \theta) * \frac{3N}{2} * (\pi_o - \pi_N)$, if $C_N - C_O = 0$, $\pi_N^* = \frac{2S_o}{3S_o - S_N} * \pi_o$ can be deducted. If $\pi_N < \pi_N^*$, C_N will be smaller than C_o; if $\pi_N > \pi_N^*$, C_N will be bigger than C_o. Since $\pi\_$ is negatively influenced by I_ and positively influenced by σ, we have to compare the difference between I_N and I_o. Let us compare $I_N = f(2NS_o, 2N\frac{S_o}{S_N}\sigma_o A_N, 2N\frac{S_o}{S_N}\sigma_o E_N)$ with $I_o = f(2NS_o, 2N\sigma_o A_o, 2N\sigma_o E_o)$. To make $2N\frac{S_o}{S_N}\sigma_o A_N = 2N\sigma_o A_o$, A_N has to satisfy $A_N^* = \frac{S_N}{S_o}A_o$. In the same logic, when $E_N^* = \frac{S_N}{S_o}E_o$, $2N\frac{S_o}{S_N}\sigma_o E_N = 2N\sigma_o E_o$. Apparently, if $A_N < A_N^*$ and $E_N < E_N^*$, then I_N will be smaller than I_o. If $A_N > A_N^*$ and $E_N > E_N^*$, I_N will be greater than I_o.

A6

$C_A - C_o = N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * (\frac{S_N}{S_o}\pi_A - 3\pi_A + 2\pi_o)$. $\frac{S_N}{S_o}\pi_A - 3\pi_A + 2\pi_o = \pi_A(\frac{S_N}{S_o} - 1) + 2(\pi_o - \pi_A)$. Since $\frac{S_N}{S_o} < 1$ and $\pi_o < \pi_A$, $C_A < C_o$. In addition, the difference between C_N and C_o is positively influenced by the difference between S_N and S_o as well as the difference between π_N and π_o. The investment on IT could improve S_o to S_N, and the cost is C_{1-2}. If C_{1-2} is smaller than $N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * \pi_A(1 - \frac{S_N}{S_o})$, it is beneficial to improve the IT systems. The investment on institutions could revise institutions and thus improve π_o to π_A, and the cost is C_{2-3}. If C_{2-3} is smaller than $N\rho * (\underline{\theta} - \theta) * \frac{N}{2} * 2(\pi_A - \pi_o)$, it is beneficial to revise original institution. Combining the two conditions, we know it is better to improve IT systems and institutions only when the cost is comparatively smaller than the expected gain of the improvement. Otherwise, it is wise to stay in stage 1 and wait until the conditions are satisfied.

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