IT Governance: Incentives - the Missing Link in Alignment?

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Abstract

Information Technology (IT) has emerged as the fastest growing asset class within firms and is ubiquitous. While literature as well as industry has focused on the importance of alignment of business and IT as key to firm performance, surveys have consistently reported widespread mis-alignment. This paper proposes that lack of incentives is the missing link in non realization of much talked and valued alignment. The paper offers expands the definition of IT governance and is the first to develop a model of IT governance based on incentives where unobservable effort is expended has two dimensions; core-effort and informational-effort. and analyzes the feasibility and generation of optimal incentive contracts for both IT and business managers for improved IT governance. We identify the properties of optimal wage contracts that induce both business manager and IT manager to self select optimal efforts.
1. Introduction

Information Technology (IT) has emerged as the fastest growing asset class within firms and is ubiquitous. IT forms increasingly higher proportion in capital investments and literature has identified IT capabilities as key driver of growth and competitive advantage (Bharadwaj et al. 1999). As business processes get embedded in technology mediated tools (Hewitt, 2003), IT is increasingly being integrated into business operations. Alignment between business and IT has emerged as a key area for industry attention, and extant research in IS has also highlighted such alignment as a key to firm performance (Henderson and Venkatraman, 1993). On the other hand industry surveys have consistently found that misalignment is a key component of under achievement in business performance and/or underutilization of IT resources. A recent study, Gu et al (2008) show that IT governance misalignment adversely affects firm performance.

IT governance has been broadly studied in the IS literature in two streams (i) structure oriented location of decision rights and, (ii) contingency interactions to explain determinants of IT governance. The first approach considers organizational structures in terms of attributes such as centralization and decentralization and focuses on decision making rights within the organization (Boynton & Zmud 1987; Weill 2004; Weill & Ross 2004; Weill & Woodham 2002). This approach posits that there is no ideal governance structure for all firms and the appropriate structure depends on corporate structure IT organization within the firm and contingencies. The second approach, pioneered by Sambamurthy & Zmud (1999), considers interactions of contingencies such as organizational structure, competition, business strategy, industry and firm size, to explain determinants of IT governance adoption. With in this approach Samabmurthy and Zmud (2000) call for a break from tightly linking IT governance architectures to organizational structure, and taking into consideration other factors.

Though IT governance literature has not specifically focused on alignment issues, some recent papers (Preston and Karahana, 2002; Sabherwal & Chan, 2001) have studied the factors leading to such alignment. One of the key finding of this stream of literature is that business knowledge of the CIO and IT knowledge of the CEO and top management teams is relevant to alignment. Further, an earlier study by Armstrong and Sambamurthy (1996) demonstrates that CIOs with high strategic IT and business knowledge had a larger impact on the firm’s IT deployment and success with IT use.

While the extant research in IT governance has focused above mentioned three broad streams, Ba, Stallaert and Whinston (2001) in their research commentary work, have called for research in exploring the incentives issues within IT teams, the cross-functional incentives are equally important in aligning business and IT. In economics literature has studied the incentives in team extensively in moral hazard setting (Che and Yoo, 2001; Grossman and Hart,1983; Holmstrom,1979; Holmstrom,1982; Itoh, 1991) and show that incentive alignment is key to optimal team effort.

Within this back drop, our research focuses on incentives with in cross functional teams in business IT, wherein, on one hand successful implementation of business project requires knowledge of IT capabilities by business manager, success of IT project is contingent on understanding of business environment by IT manager. This research proposes that incentive alignment between business and IT is a key IT governance issue. We show that good governance requires that business mangers as well as IT mangers expend effort in not only in executing the functional area projects, but expend informational-effort in “informing” other teams so as to mitigate information asymmetry. We propose that while importance of alignment has been well understood in the literature, mechanisms such as wage contracts that incentivize such alignment has been a critical missing link. This research builds that link through a
principal-two-agent model and identifies the properties of optimal wage contracts that induce both business manager and IT manager to self select optimal efforts on two dimensions, core-effort and informational-effort where efforts have externalities associated with each project. state the case of incentive alignment in their research commentary.

This paper is organized as follows: in §2 we set the model when projects are at the departmental level, in §3 we develop optimally aligned contracts, §4 we extend the model to enterprise level projects and analyze contracts, in §5 we develop an incentive based IT governance framework for the firms operating in heterogeneous business and IT environments and we conclude with discussion and managerial implications in §6.

2. Model

In this paper we consider two project settings: (1) Small business and IT projects that are at the departmental level wherein success or failure of any single project has insignificant impact on the overall performance of the firm, and (2) Enterprise wide transformational projects such as an ERP implementation which have significant impact on firm performance. We first develop the model under the setting 1.

2.1 Projects and the Firm:

We consider a firm with two types of projects (1) Business projects where the business manager \( m \) has primary responsibility and, (2) IT projects where the IT manager \( t \) has primary responsibility. Our set up is on the lines of Itoh (1991), wherein the firm is the principal with two agents. An example of this setting is a firm that is automating responses to customer queries and the business manager is responsible to ensure appropriate promotion, training and other related tasks to meet revenue, quality and customer service goals. The IT manager’s task is to ensure that the application is appropriately staffed to support all related technical aspects of the system such as response time, network support, browser support, transaction security, ease of use and deliver of the IT infrastructure as well as applications in a timely manner within the prescribed budget.

In our setting the success of any project is defined in terms of meeting the business value goals of the firm. The prospects of the business project (IT project) being successful improves if the business manager (IT manager) is informed about IT capabilities (business environment). We denote success (failure) by \( S \) \( (F) \) and both states are observable and verifiable. More specifically we denote the success (failure) of the business project by subscript \( mS \) \( (mF) \) and similarly for the IT project success (failure) as \( tS \) \( (tF) \).

2.2 Business manager and IT manager:

The business manager (IT manager) expends core-effort within the business (IT) project and has the ability to expend informational-effort to share and educate the IT manager (business manager) on the needs, requirements and capabilities. Thus, in our model effort by both managers is two-dimensional, core-effort \( x \) and informational-effort \( y \). We denote the effort expended by the business manager as \( c_m: x_m, y_m \) and by the IT manager \( c_t: x_t, y_t \). Effort is unobservable and thus is non-contractible. Cost of effort is heterogeneous for each manager type and is given by \( c_m(.) \) and \( c_t(.) \) for business manager and IT manager respectively, where \( c(.) \) is positive and convex for all \( e \).
Our setting is that of moral hazard and therefore success of a project is stochastic. The probability of success of the business (IT) project depends not only on the core-effort of the business (IT) manager but also on the informational-effort of the IT (business) manager and is denoted by \( P_{ms}(x_m, y_m) \) and \( P_{is}(x_i, y_m) \). There are four possible outcomes: both projects are successful and we denote this joint probability by \( P_{SS} = P_{ms} \times P_{is} \); the business project is successful and the IT project is a failure denoted by \( P_{SF} = P_{ms} \times (1 - P_{is}) \); the business project is a failure and the IT project is successful denoted by \( P_{FS} = (1 - P_{ms}) \times P_{is} \); both projects are failures denoted by \( P_{FF} = (1 - P_{ms}) \times (1 - P_{is}) \). Note that our model has effort externalities associated with each project.

**Assumption 1:**

(a) \( \frac{\partial P_{ms}}{\partial x_m} > 0 \) and \( \frac{\partial P_{is}}{\partial x_i} > 0 \) for all \( x, y \); (b) \( \frac{\partial P_{ms}}{\partial y_m} \geq 0 \) and \( \frac{\partial P_{is}}{\partial y_i} \geq 0 \) for all \( x, y \) and with strict inequality for all \( x > 0 \); (c) \( \frac{\partial P_{ms}}{\partial x_m} > \frac{\partial P_{ms}}{\partial y_m} \) when \( x, y = 0 \); (d) \( P_{ms}(x_m, y_m) \in (0, 1) \), \( P_{is}(x_i, y_m) \in (0, 1) \) for all \( x, y \).

Assumption 1 addresses the marginal effect in the probability of success for a unit increase in effort and (a) assumes that a marginal increase in core-effort has a positive impact on the probability of success, (b) assumes that a marginal increase in informational-effort has at least a non-negative impact on the probability of success and a positive impact if there is any core-effort expended, (c) assumes that the marginal effect of core-effort increase is greater than the marginal effect of informational-effort increase at start and, (d) states that \( P(.) \) is a probability value generated from a point distribution.

Therefore, contingent upon observed state, the firm offers four wage contracts namely \( SS; \ w_{mSS}, w_{iSS} \), \( SF; \ w_{mSF}, w_{iSF} \), \( FS; \ w_{mFS}, w_{iFS} \), \( FF; \ w_{mFF}, w_{iFF} \). We assume that both managers are risk averse and have the same preferences towards risk, and we denote the utility from wages for business and IT manager as \( u(w_m) \), and \( u(w_i) \), where \( u(.) \) is positive and concave. Now the utilities of the business manager and IT manager can be expressed as

\[
U_m(w_m) = u(w_m) - c_m(e_m) \quad \text{and} \quad U_i(w_i) = u(w_i) - c_i(e_i).
\]

Note that both \( e_m \) and \( e_i \) are two dimensional vectors.

**Assumption 2:**

(i) \( \frac{\partial c_m}{\partial x_m}, \frac{\partial c_m}{\partial y_m} \geq 0 \), \( \frac{\partial c_i}{\partial x_i}, \frac{\partial c_i}{\partial y_i} \geq 0 \), \( \frac{\partial c_i}{\partial x_i}, \frac{\partial c_i}{\partial y_i} \geq 0 \), for \( \forall \ x \) and \( y \), with strict inequality if \( x > 0 \), or \( y > 0 \), and (ii) \( e_m \) and \( e_i \) are strictly convex.

Assumption 2 describes the conditions on the marginal effect of core-effort and informational effort on the cost of effort of the both type of managers.

Given a wage schedule \( w_m, w_i \) (note that both \( w_m \) and \( w_i \) are state dependent four dimensional vectors) and effort levels of both the managers \( e_m, e_i \), the expected utilities of the business manager and IT manager are:

\[
U_m(w_m, e_m, e_i) = P_{SS}U_{mSS} + P_{SF}U_{mSF} + P_{FS}U_{mFS} + P_{FF}U_{mFF}
\]

\[
U_i(w_i, e_m, e_i) = P_{SS}U_{iSS} + P_{SF}U_{iSF} + P_{FS}U_{iFS} + P_{FF}U_{iFF}
\]

**2.3 The Firm and its Optimization Problem:**
The firm derives value $v_{SS}$ when both projects are successful, $v_{SF}$ when the business project is successful and the IT project is a failure, $v_{FS}$ when the business project is a failure and the IT project is successful and $v_{FF}$ when both projects are failures. Therefore the expected value of the business and IT project to the firm is:

\[ V(e_m, e_t) = P_{SS}v_{SS} + P_{SF}v_{SF} + P_{FS}v_{FS} + P_{FF}v_{FF} \]

The firm’s optimization problem can now be written as choice of optimal wage schedule $w_m, w_t$ that induces optimal effort $e_m, e_t$ such as to maximize the firm’s expected value $V(e_m, e_t)$ from both projects, subject to participation and individual compatibility constraints. Assuming that the outside option for both the manager is zero, the participation constraint is straightforward:

\[ U_m(w_m, e_m, e_t) \geq 0, \quad U_t(w_t, e_m, e_t) \geq 0 \]  

(1)

The individual compatibility constraints ensure that both managers will not do better by choosing any other effort level than that desired by the firm, given the wage schedule. Thus the optimal effort levels form a Nash equilibrium as effort is non-contractible. Note that this formulation is different from that of a standard moral hazard setting. The incentive constraints of both managers are:

\[ U_m(w_m, e^*_m, e_t) \geq U_m(w_m, e_m, e_t) \quad \forall e_m \neq e^*_m \]

\[ U_t(w_t, e^*_m, e^*_t) \geq U_t(w_m, e_m, e_t) \quad \forall e_t \neq e^*_t \]  

(2)

Now, we can write the firm’s optimization problem as:

\[ \text{Max} \left\{ V(e_m, e_t) - \left[ P_{SS} w_{mSS} + w_{iSS} + P_{SF} w_{mSF} + w_{iSF} + P_{FS} w_{mFS} + w_{iFS} + P_{FF} w_{mFF} + w_{iFF} \right] \right\} \]

Subject to (1) and (2).

3. Optimal Wage Contracts:

We solve the optimization problem (3) in two stages as in Grossman and Hart (1983). In the first stage, for a given effort level $e_m, e_t$ we find the minimum wage schedule. In the second stage, given the wage schedule from the first stage, the firm maximizes value by selecting the optimal effort levels and offering the state dependent wage schedule such that both managers self select that effort levels and outcomes are realized with the probability as planned by the firm.

In the first stage in order to find the wage schedule, we define $h(U)$ as the inverse function that generates the wage corresponding to a given level of utility obtained by the manager. Since both managers have the same preferences towards risk, both managers have the same inverse function.

\[ \text{Min} \left\{ P_{SS} \times h U_{mSS} + h U_{iSS} + P_{SF} \times h U_{mSF} + h U_{iSF} + P_{FS} \times h U_{mFS} + h U_{iFS} + P_{FF} \times h U_{mFF} + h U_{iFF} \right\} \]

Subject to (1) and (2)

Assumption 3: The solution to the first stage generates positive core-effort, i.e. $x_m > 0$ and $x_t > 0$. 

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As discussed earlier, Assumption 1 ensures that success probability increases with a marginal increase in informational-effort. Note that Assumption 1 and 3 together ensure that any optimal wage contract requires positive informational-effort.

The solution to (4) generates a schedule of wages for any given effort that is optimal for the managers and is denoted as \( W(e_m, e_t) \). In the second stage, given this wage-effort schedule, the firm maximizes value (net of wages) by choosing the optimal effort levels for both managers as follows:

\[
\max_{e_m, e_t} V(e_m, e_t) - W(e_m, e_t)
\]  

(5)

The objective of this model is to generate the optimal wage contracts and investigate the conditions under which joint effort is necessary, i.e. when and under what conditions will the IT manager and the business manager be incentivized to expend informational-effort.

**Proposition 1:** (a) *The first best wage contract can be implemented if (i) the managers’ efforts are observable and thus contractible, or, (ii) the managers are risk neutral.* (b) *When the managers are risk averse, the optimal wage contract requires that the wages be contingent on the success of both business project as well as IT project.*

Proposition 1 generates the benchmark first best (FB) case that is compared to the results when managers are risk averse and where effort is not observable and wages can be contracted only on observed output. Under this moral hazard setting increased project success requires both effort types, and generates the conditions under which informational-effort will be positive and conditions where informational-effort may not be feasible.

**Proposition 2:** *When both managers have the same utility function i.e. \( U_m(.) = U_t(.) \), then (i) if the first-best solution has positive core-effort, then the optimal solution under risk averse managers also have positive core-effort, and (ii) a necessary and sufficient condition for positive informational-effort is that the ratio of marginal increase in project success to marginal cost increase is greater than this ratio for core-effort at first-best effort levels, i.e.*

\[
\frac{\partial P_m}{\partial y_m} / \frac{\partial P_m}{\partial x_m} > \frac{\partial c}{\partial y_m} / \frac{\partial c}{\partial x_m} \quad \text{and} \quad \frac{\partial P_t}{\partial y_t} / \frac{\partial P_t}{\partial x_t} > \frac{\partial c}{\partial y_t} / \frac{\partial c}{\partial x_t}
\]

at first-best effort levels.

The interpretation is that there is a smaller marginal cost increase for marginal improvement in success probability for informational-effort when compared to the same effect under core-effort.

4. **Future Work**

We plan to investigate the conditions for non-zero informational-effort and expect to generate requirements without which it may not be possible to incentivize the managers to expend informational effort. Such analysis will be useful to understand the managers’ attributes that are conducive to informational effort.

Under project setting 1, this paper will expand on the Itoh (1991) results by considering specific functional forms for output and effort- based success probabilities. These results will be mapped against a set of contingency factors such as the competitive environment, the rate of change in the firm’s markets and technology and the impact of IT to generate the conditions under which informational effort may be highly significant, moderately significant or not significant. We propose to develop a qualitative model based on our analytical findings that
informs managers about appropriate wage contracts for firms operating in different types of business environments and facing different types of technology landscape.

The paper will be further expanded to consider project setting 2 and the firm undertakes a large scale, transformational, enterprise level IT project where project failure may be catastrophic to the firm. An example may be the replacement of an ERP system with a distributed cloud based computing and information system. Under this setting the research objective is to determine the optimal levels of informational-effort and the wage contract necessary for such effort in order to optimize the success probability or project outcome.

References


