

AN EMPIRICAL INVESTIGATION ON THE IMPACT OF IT ORGANIZATIONAL ARRANGEMENTS ON FIRM PERFORMANCE

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ABSTRACT

Few studies have linked the form of information technology (IT) organization to firm performance. In this study we view the organizational arrangement of IT activities as a platform for developing complementary IT capabilities. By using the concept of strategic fit, we argue that the approach to organizing IT activities may have a positive effect on firm performance under certain conditions. Through testing our hypotheses on a sample of 798 observations, we have found that a centralized form of IT leads to positive performance effects when the scale of IT investment is high. However a decentralized form leads to positive performance effects when the level of firm diversification is high. Our findings thus provide both conceptual and practical implications.

Key words: IT Governance; IT Investment; Firm Diversification

Prior information systems (IS) research has shown the importance of running an effective IT organization to meet a firm's strategic and organizational needs. A strong focus in the previous studies has been on the mode of IT governance. Yet a salient research gap in the literature and hence a promising opportunity to pursue is how a firm's choice of organizing IT activities interacts with other organizational factors to affect firm performance. Little research has examined the performance impact of IT governance modes, for example, let alone the possible interactions between IT governance and certain organizational attributes. In the mean time, arguments related to the choice of IT governance modes in the past have often referred to the concept of fit, which has apparent performance implications. In other words, the concept of fit suggests that the effectiveness of a certain IT governance mode will depend on organizational contingencies such as those represented by a firm's IT and business strategies (Brown & Grant, 2005).

As an attempt to fill the research void, we study how the organizational arrangement of IT activities affects firm performance via the interaction with other variables such as the scale of IT investment and firm diversification. Past research has shown that the mode of IT governance is important for realizing business value from a firm's IT investment (Weill, 2004). A large-scale IT investment is often made in an attempt to integrate the various functions and business units of a firm, such as an enterprise application. Given the high level of such investments, it is of critical importance for centralizing a firm's IT capabilities to effectively coordinate such efforts. By contrast, a decentralized arrangement of IT activities may not be able to reap the benefits of enterprise-wide large-scale IT investments.

In the mean time, the organizational arrangement of IT activities may also interact with a firm's diversification strategy. Firm diversification has been studied in the previous IT literature as an important strategic variable that intertwines with IT variables such as IT investments (Dewan,

Michael, & Min, 1998), IT business value (Ravichandran, Liu, Han, & Hasan, 2009), and the like. Previous research has suggested that IT investments need to be adjusted or fine tuned to meet the need of diversification, especially the need to use certain organizational control systems to manage the diversified business portfolio (Ravichandran et al., 2009). By the same token, the arrangement of IT activities may also need to be adjusted to accommodate the needs of different types and levels of diversification.

Motivated to fill the research gap in the broad IT governance literature and also to produce some feasible directions for managers and practitioners, this study investigates the impact of the organizational arrangement of IT activities on firm performance. In particular we adopt a contingency perspective and argue that the organizational form of IT activities would interact with firm characteristics such as IT investment and firm diversification to affect firm performance. As a first step to unravel the performance implications of IT governance mode, it is hoped that our study would motivate future researchers to explore the subject in a much deeper manner.

THEORY AND HYPOTHESES

Organizing IT Activities for Organizational Capabilities

A traditional view of the organizational arrangement of IT activities has been focused on the IT governance mode, differentiated by the locus of authority for IT activities (Sambamurthy & Zmud, 2000). Often defined as centralized, decentralized, and federal, the mode of IT governance has been found related to a variety of organizational factors such as organizational structures, business strategy, primary industry, firm size, and environmental conditions (Brown & Grant, 2005). A recent commentary has called for a new organizing logic for IT activities, i.e. the platform logic (Sambamurthy & Zmud, 2000). By viewing the organizational arrangement of IT activities as a platform for developing important IT capabilities, the authors suggest that the organizing logic of IT activities should lead to those IT capabilities that are vital for business success through deploying IT initiatives.

In large complex organizations, a centralized corporate-level IS unit often coexists with decentralized business-level IS units. The allocation of IS human capital across an organizational hierarchy may reflect the management's efforts to develop IT capabilities to meet different managerial needs. Centralized corporate-level IS units aim at realizing enterprise-wide economies and efficiencies. Therefore a large centralized IS unit provide an important coordination capability across the organization. In the past, it has been shown that decisions regarding IT infrastructure development are often made by a central IS unit, which builds up the organization's coordination capabilities (Xue, Ray, & Gu, 2011). In the mean time, decentralized IS units at the business unit level may supply the necessary IT capabilities for developing applications that address local business needs. IS employees in a decentralized IS unit can work effectively with business-level managers and employees to create applications and tools to increase local responsiveness.

By using the capability perspective, the organizational arrangement of IT activities can be seen as a managerial choice that interacts with other firm characteristics to create value. In this study

we are interested in characteristics that may entail either a coordination need or a localization need. Particularly we investigate two factors that have seemed to be under-researched in the literature within such a context: the scale of IT investment and the degree of firm diversification.

Scale of IT Investment

The scale of IT investment is an important dimension of a firm's IT investment strategy (Ravichandran & Liu 2011). Also it has been the focus of a large body of research on IT business value (Kohli & Devaraj, 2003). A large scale IT investment often requires a more centralized arrangement of IT activities. Large scale investment projects are often of high level investments involving mission critical systems such as enterprise applications or infrastructure deployment. For deploying such systems, a firm often needs a centralized coordination capability. For example, a centralized IS unit has been shown in the past to facilitate IT infrastructure development by providing the necessary coordination capabilities across the firm (Sambamurthy & Zmud, 2000). From a management perspective, managers in a centralized corporate-level IS unit are better positioned to identify opportunities for technology investments as well as the technical requirements for effective deployment of such investments (Xue, Liang, & Boulton, 2008). In the mean time, they are also equipped with the needed structural power and resources to overcome any impediment in the process of deploying a large scale investment, particularly the potential resistance from local business units which may be more focused on their own objectives. With a more centralized IT capability for coordination, a large scale IT investment is more likely to create value for the firm. Therefore a more centralized arrangement of IT activities complements a large scale investment in IT, which should lead to performance improvement.

Hypothesis 1: Centralization (Decentralization) of IT activities is positively (negatively) associated with firm performance if the firm has a large scale IT investment.

Firm Diversification

Firm diversification is an important corporate-level strategy. Previous research has shown that the scope of the firm has a significant impact on a number of IT activities such as IT investment (Liu & Ravichandran, 2008) and IT governance. In the context of IT governance, it has been shown that diversification mode and diversification breadth influence the choice of IT governance modes (Sambamurthy & Zmud, 1999). A diversified firm is often involved in two or more distinct businesses. As a result, the diverse nature of the different businesses presents a great managerial challenge. Strategic decision-making often yields better outcomes if the decision-making authority is delegated to the individual business unit level because managers at the business level often have first-hand information and knowledge about how to compete in a particular industry environment. In a diversified firm, accordingly, divisional managers or business-level managers are often assigned with the operating responsibility of conducting day-to-day activities in their respective product markets. In terms of the arrangement of IT activities, the focus on divisional affairs or business-level strategies would require a firm's IT capabilities to concentrate on dealing with local technological needs, which requires a more decentralized organizational arrangement. The alignment between a firm's diversification strategy and a more decentralized IS organization should yield a positive performance effect since the diversification strategy would benefit from an array of more localized IT capabilities to cope with divisional needs. Therefore:

Hypothesis 2: Decentralization of IT activities is positively associated with firm performance if the firm has a high level of diversification.

Firms may pursue different types of diversification strategies. They may enter related industries that often share certain commonalities in value chain functions between them or they may enter unrelated industries that have no linkages to exploit between them. Related firms often seek for economies of scope through sharing activities or resources between business units, known as synergistic economies, whereas unrelated firms may take advantage of the internal capital market to allocate funds more efficiently than the external capital market, known as financial economies (Hill & Hoskisson, 1987). Relatedness in a firm's business portfolio often has an impact on the choice of IT governance modes. Firms that compete in related industries tend to have commonalities in their IT infrastructures and applications (Tanriverdi, 2005), which may require a centralized locus for IT-related decision making (Sambamurthy & Zmud, 1999). In other words, a centralized arrangement of IT activities in a related firm seems to provide the needed coordination capability for realizing economies of scope or synergistic economies. Hence a more centralized IS organization should complement a firm's related diversification strategy.

On the other hand, when firms compete in unrelated industries, the marked difference between the industries makes it difficult for realizing economies of scope. It also becomes more difficult for the staff in a centralized corporate-level IS unit to understand divisional business strategies and value creation processes due to the distance to the local conditions. Under this circumstance, the local IS staff are better positioned to develop technologies and applications that meet the distinctive IT needs of business units (Sambamurthy & Zmud, 1999). As a result, the IS organization should be structured in a way that accommodates the localization need for technology development through assigning business-level IT units autonomy and flexibility. Normally a more decentralized organizational arrangement of IT activities would fulfill such a need. Since each unrelated business unit essentially operates as an independent and autonomous entity, a decentralized IS organization should help each business unit effectively compete in its respective industry, which should contribute to the overall performance of the firm. To sum up the above arguments, we propose the following hypotheses:

Hypothesis 3a: Centralization (Decentralization) of IT activities is positively (negatively) associated with firm performance if the firm has a high level of related diversification.

Hypothesis 3b: Decentralization of IT activities is positively associated with firm performance if the firm has a high level of unrelated diversification.

METHODOLOGY

Data

We collected our data from the Compustat database and the annual surveys conducted by InformationWeek in their special issue InformationWeek 500. InformationWeek conducted annual surveys since 1989 on the innovative firms regarding their IT usage, which they published in the annual special issue named InformationWeek 500. The surveys contained a number of items related to firms' usage of IT and provided valuable information for research

purposes. We computed the variables for performance measures, diversification levels, and control variables from Compustat. IT investment and IS organization data were obtained from InformationWeek 500 during the 1999-2003 time period. We matched the firms listed in InformationWeek with firms in the Compustat database and our sample consisted of 798 firm-year observations during the five-year period.

Dependent Variable

The dependent variable in this study is firm profitability, measured by return on sales (ROS). We compiled the ROS data for the firms in our sample using data from Compustat.

Independent Variables

The main independent variable, the organizational arrangement of IT activities (IT decentralization), was measured by the ratio of the firm's business IT employees to corporate IT employees. The data used to compute this variable was obtained from the InformationWeek annual surveys. A large value of this variable indicates a more decentralized IT organization whereas a small value indicates a more centralized approach to IT organization. The scale of IT investment was measured by the ratio of IT budget to the firm's sales revenue, which was also obtained from the InformationWeek surveys.

In this study we used the entropy measure to measure firm diversification, not only because it is widely accepted but also because as one of its key properties, it allows for us to distinguish between related and unrelated diversification (Palepu, 1985). Given our focus on related and unrelated diversification this measure is more suited than other available measures of product diversification. Following procedures used in past strategy and IS studies (Palepu, 1985; Ravichandran, Liu, Han, & Hasan, 2009) we calculated the entropy measures for related and unrelated diversification using business segment data from Compustat. Total firm diversification was measured as the sum of related and unrelated diversification.

Table 1: Summary Statistics and Correlation Matrix

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1	ROS	0.156	0.148	1										
2	IT Decentralization	0.242	1.474	-0.02	1									
3	IT Investment	3.400	5.811	0.08 [§]	-0.00	1								
4	Firm Diversification	0.604	0.462	0.06	0.05	0.04	1							
5	Related Diversification	0.209	0.302	0.03	-0.03	0.08 [§]	0.57*	1						
6	Unrelated Diversification	0.395	0.380	0.05	0.09 [§]	-0.02	0.76*	-0.10	1					
7	Firm Size	8.285	1.331	0.27*	-0.05	0.00	0.25*	0.20*	0.15*	1				
8	R&D Intensity	0.043	0.137	-0.63*	-0.02	0.05	-0.15*	-0.07 [†]	-0.13*	-0.19*	1			
9	Advertising Intensity	0.011	0.031	0.09 [§]	-0.02	0.04	-0.03	-0.02	-0.01	0.07 [§]	-0.02	1		
10	Leverage	0.231	0.155	0.11*	-0.02	0.02	0.03	0.03	0.01	-0.08 [§]	-0.20*	-0.04	1	
11	Capital Intensity	0.071	0.086	0.26*	-0.04	0.05	-0.00	0.04	-0.03	0.12*	0.02	-0.07 [†]	0.18*	1

Note: [†] significant at 10%; [§] significant at 5%; * significant at 1%.

Control Variables

In the empirical analysis, we included dummy variables controlling for the fixed effect of industry sectors. Year dummies were also included since the observations ranged from 1999 to 2003. Since within the same industry environment firm performance varies due to the different strategies they pursue, firm characteristics such as size, R&D expenditure, advertising intensity,

capital intensity, and financial leverage were included as controls in our analysis. We controlled for firm size measured by the natural logarithm of a firm's total assets (in billion dollars). Following past studies, we used R&D intensity, the ratio of R&D expenditures to the firm's total sales, as a control variable. We measured advertising intensity by dividing the advertising expenditure by total sales. Firm leverage was measured by the widely used ratio of long-term debt to total capital (debt plus equity). Capital intensity is measured as the percentage of capital expenditures to sales. Table 1 presents the summary statistics and correlations.

ANALYSIS AND RESULTS

Our dataset turned out to be a very imbalanced panel data with 798 observations over five years and 338 firms. Since on average only 2.36 observations were available for each firm during the five-year period, instead of employing an advanced time-series technique, we decided to use Ordinary Least Squares (OLS) regression for the pooled data. Also we ran the analysis with Huber-White standard errors clustering on firms, which will produce a robust estimation of standard errors despite the presence of arbitrary correlations in error terms within a cluster (firm).

First we ran a model which included only control variables. The result was reported in Table 2 under Model 1. Model 2 includes the variable of IT investment and the variable of IT decentralization. Model 3 includes the interaction term between the IT investment variable and IT organization variable, which was used to test H1. By H1 we expected a positive (negative) interaction effect between IT investment and centralization (decentralization) of IT employees. The coefficient of the interaction term is negative and significant ($b=-0.003$, $p<0.05$), which suggests that a more centralized (decentralized) IT organization has a positive (negative) effect on return on sales when the scale of IT investment is high. We plot the interaction effect in Figure 1. As the figure shows, when the level of IT investment is high, the degree of IT centralization has a positive effect on return on sales, indicating that a more centralized IT organization has a positive effect on firm performance. When the level of IT investment is low, the degree of IT centralization has a slightly negative effect on return on sales. This result supports H1.

Model 4 adds the variable of firm diversification, i.e. the sum of related and unrelated diversification, and Model 5 adds its interaction with IT decentralization to test H2. By H2, we expected to see a positive interaction effect and the result supports it ($b=0.014$, $p<0.01$), suggesting that when the level of diversification is high, IT decentralization has a positive effect on return on sales. Likewise we plot the interaction effect in Figure 2. It can be seen in the figure that the negative relationship between IT

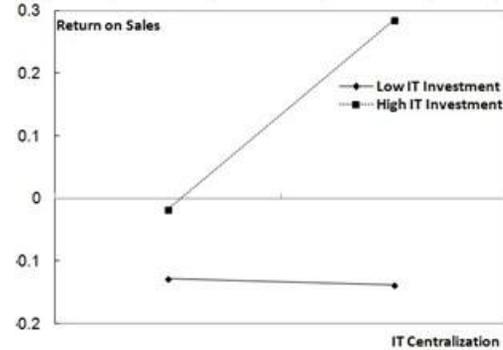


Figure 1: The moderating effect of IT investment scale

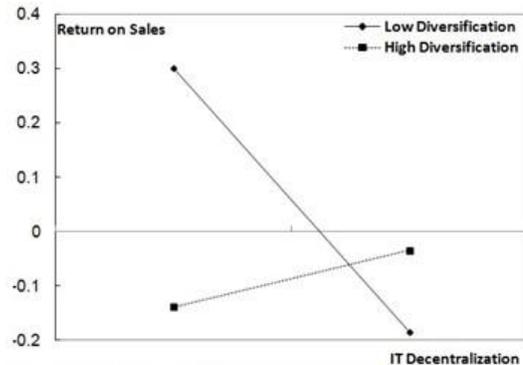


Figure 2: The moderating effect of firm diversification

decentralization and return on sales turns positive as the level of diversification increases. H2 is therefore supported. To test H3a and H3b, we included the two interaction terms in Model 7, i.e. the interaction between IT decentralization and related diversification and the interaction between IT decentralization and unrelated diversification. By H3a we expected a negative interaction effect of related diversification and by H3b a positive interaction effect of unrelated diversification. The former interaction, as revealed by the result in Model 7, has a negative coefficient but not statistically significant ($b=-0.019$, $p=0.248$). The latter has a positive and significant coefficient ($b=0.014$, $p<0.01$), supporting H3b. We plot the interaction effect of unrelated diversification in Figure 3.

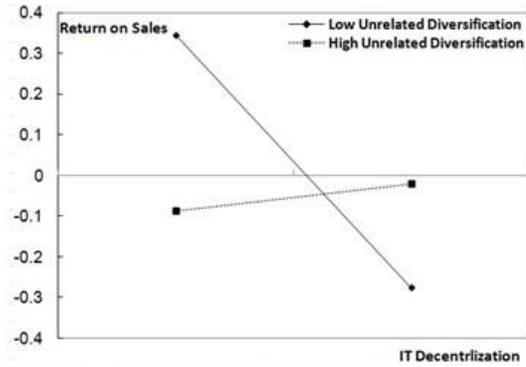


Figure 3: The moderating effect of unrelated diversification

Table 2: Regression Analysis of the Impact of IT Organizational Forms

	I	II	III	IV	V	VI	VII
R&D Intensity	-0.624* (0.154)	-0.661* (0.134)	-0.663* (0.133)	-0.684* (0.117)	-0.689* (0.115)	-0.684* (0.117)	-0.688* (0.116)
Advertising Intensity	0.299† (0.179)	0.262 (0.185)	0.258 (0.186)	0.316† (0.189)	0.306 (0.189)	0.314† (0.186)	0.305 (0.188)
Leverage	0.020 (0.045)	0.020 (0.045)	0.023 (0.045)	-0.049 (0.035)	-0.050 (0.035)	-0.048 (0.035)	-0.049 (0.035)
Capital Intensity	0.416† (0.251)	0.435† (0.258)	0.432† (0.258)	0.482* (0.154)	0.481* (0.153)	0.483* (0.154)	0.485* (0.151)
Size	0.011§ (0.005)	0.012§ (0.005)	0.013§ (0.005)	0.015* (0.005)	0.015* (0.005)	0.015* (0.005)	0.015* (0.005)
IT Investment		0.004§ (0.002)	0.005* (0.002)	0.003* (0.001)	0.003* (0.001)	0.003* (0.001)	0.003* (0.001)
IT Decentralization		-0.003 (0.003)	-0.008§ (0.003)	-0.002 (0.002)	-0.013* (0.005)	-0.002 (0.002)	-0.017* (0.006)
IT Investment × IT Decentralization			-0.003§ (0.001)				
Firm Diversification				-0.020 (0.013)	-0.019 (0.012)		
Diversification × IT Decentralization					0.014* (0.005)		
Related Diversification						-0.026† (0.016)	-0.031§ (0.015)
Unrelated Diversification						-0.016 (0.015)	-0.014 (0.015)
Related Diversification × IT Decentralization							-0.019 (0.016)
Unrelated Diversification × IT Decentralization							0.014* (0.005)
Constant	0.230* (0.042)	-0.008 (0.049)	-0.013 (0.049)	-0.004 (0.047)	0.001 (0.047)	-0.006 (0.048)	-0.000 (0.048)
Observations	798	798	798	740	740	740	740
R-squared	47.6%	50.7%	51.1%	53.4%	53.7%	53.4%	53.8%
ΔR-squared			0.4%*		0.3%*		0.4%†

Note: 1. Robust standard errors are reported in parentheses; 2. Coefficients of sector dummies and year dummies are not shown in the table; 3. Firm diversification is the sum of related diversification and unrelated diversification; 4. The number of observations changed in Model IV because there were missing values for the diversification variables and the sample size was reduced to 740; 5. † significant at 10%; § significant at 5%; * significant at 1%.

DISCUSSION

Recent research on IT governance has emphasized the importance of organizing IT activities for IT capabilities (Sambamurthy & Zmud, 2000). As firms attempt to consistently reap above-average returns from their IT investments, an important condition is that they make IT-related decisions effectively on a consistent basis. To do so, they often need to have an appropriate yet flexible IT organizational form to administer all major IT decisions. These decisions can be related to the management of technology expenditures and investments, budgeting and approval of IT spending, and application development. Such important IT decisions entail the usefulness and effectiveness of the overall IT strategy of the firm, and therefore have a critical influence on the overall success of IT use in the firm. Appropriate IT organizational structures should facilitate the development of relevant IT capabilities that lead to the maximization of firm efficiency and effectiveness. As a result, the choice regarding the IT organizational form should be a concerted effort to create firm-level capabilities enabled by IT.

This study adopts the aforementioned capability perspective and investigates the potential performance impacts of IT organizational forms under certain circumstances. As we found in this study, when the scale of IT investment is high, a more centralized form of IT activities positively affects firm performance, suggesting a coordination capability needed in such firms. In addition, when the diversification level is high, we found that a decentralized form of IT activities often yields better performance outcomes, suggesting that in diversified firms there is a strong need to localize IT capabilities to create custom applications and services. Similarly a strategy of unrelated diversification also interacts with a decentralized IT organizational form to positively affect firm performance. However, we did not find a positive interaction effect between related diversification and IT centralization. We suspect that in a diversified firm, the localization need of unrelated diversification might suppress the coordination need of related diversification. Hence a more decentralized organizational arrangement of IT activities is the dominant form in such a firm and the effect of related diversification is therefore weakened.

Previous research has shown that organization structures have a direct influence on IT governance forms (Ahituv, Neumann, & Zviran, 1989). Diversification can affect the structure used by a multi-business firm to manage the complexity created by a diversified business portfolio (Hill, 1985). It has been argued that diversified firms often adopt a multidivisional structure to separate the strategic responsibilities at the corporate level and the operating responsibilities at the business level, although the structures used by diversified firms can differ to address the specific challenge imposed by different types or levels of diversification strategy (Hill, Hitt, & Hoskisson, 1992). By the same token, IT governance is likely to be decentralized to address the demand of a multidivisional structure as firm diversification increases. The structure or form of IT organizations may thus complement the diversification strategy and enhances a firm's capability in using IT effectively, which eventually would enhance the firm's returns from IT investments.

Our study contributes to the broad IT governance research by establishing the linkage between a firm's IT organizational form and firm performance. We have shown that the linkage is contingent upon certain characteristics such as the firm's IT investment scale and diversification strategy. In so doing we have demonstrated potential synergistic effects between IT governance

and a firm's internal environment. We hope that our findings will encourage future researchers to explore the matter in more depth by identifying other contingencies, particularly those stemming from the firm's external environment. For IT practitioners, our findings would offer them valuable insights regarding how to structure IT organizations and prescriptions as to which type of IT organizational forms fitting their particular internal environment best. The existing literature on IT governance lacks an in-depth consideration of strategic variables such as diversification and this paper will fill this gap. Our findings suggest that policy makers in the firm should simultaneously focus on various factors such as IT organizational arrangements, IT investment, and firm diversification as a whole when seeking economic value from IT. A synergistic view of IT organizational forms and firm-level factors may yield better outcomes in terms of firm performance.

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