Increasing Coordination Demands and the Impact on CIO Rank

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Abstract
There are a number of forces that have intensified the coordination demands in large, multi-business firms in recent years. This study considers the organizational response of the information technology function to meet those demands for coordination throughout the large firm. We utilize a unique measure, CIO Rank, to highlight an increase in the prominence of the IT function and specifically the top IT executive over the fifteen year period, 1993 to 2007. Data representing 186 Fortune 1000 firms was used to test hypotheses that the demand for coordination influences the CIO Rank and firms that address high demands for coordination with an elevated role for the IT function perform better. While the empirical evidence of an increasingly prominent role for IT is strong, the evidence is mixed regarding the contingent effect of coordination demands on the role of the IT function and subsequent firm performance.

1. Introduction

Most people that follow the business world would not dispute the claim that today’s environment of business is turbulent. One must look no further than the recent financial crisis on Wall Street, the growing competition from every corner of the planet described as the flattening of the world [10] and rapid technological change that not only affects technology-intensive sectors but can impact the structure of competition in all industries [29, 31]. In this paper, we argue that this increasingly uncertain and volatile environment that firms face creates demands for coordination. We are specifically interested in the information systems and technology (IT) function’s role in addressing these demands for coordination in large business enterprises. The CIO Rank is taken as an indicator of the role and structure of the IT function.

The theoretical underpinning to this work is based on information processing theory. We argue that the rapid-paced and uncertain environment requires the large business enterprise to process more information in order to create a coordinated response among its differentiated subunits to this ever-changing context in which it operates.

We argue that the demand for coordination has increased dramatically in the past fifteen years. We describe in section 2 factors that have contributed to a rise in the coordination demands in the large enterprise and the specific implications of each of those factors for the IT function. As a result of the increasing demands for coordination, we theorize that the information processing demands of the firm are increasing in parallel. This places elevated importance on the unit that is primarily responsible for providing the medium for information processing, the IT function.

We utilize a measure of the relative power and prominence of the top IT executive in the firm, what we call CIO Rank, to represent the relative influence of both the IT function and the specific executive responsible for the function. Using a contingency view, we postulate that when demands for coordination in the enterprise are highest, the relative influence of the IT function is expected to be highest in order to manage those demands.

Firms that successfully align the role of the IT function with the demands for coordination in the enterprise are expected to perform better than firms that do not. The basic premise is that a firm that fails to meet the coordination demands of the firm will miss synergistic opportunities between subunits of the firm and be less effective than it might if it acted in a coordinated fashion to leverage complementary skills, resources and capabilities. Meanwhile, a firm that chooses an elevated role for the IT function when the needs of the firm are for basic support is probably overspending, experiencing inefficiency in its IT operations.

The paper is structured as follows. We begin with a theoretical discussion of the information processing perspective and provide evidence of recent environmental changes that have increased coordination demands in large firms. Section 3 spells out the specific hypotheses to be tested. Section 4
explains how we operationalize the constructs in the study. Section 5 addresses the characteristics of the data and lays out how the analysis was conducted. Results are presented in section 6 followed by a discussion of those results in section 7. Finally, section 8 concludes with limitations and opportunities for future research.

2. Theoretical Background

2.1. An Information Processing View

Today’s volatile and complex environment means that organizations face high levels of task uncertainty. It is difficult to predict the environment and therefore equally challenging to plan in advance the most appropriate organizational response in this constantly shifting playing field. Foundational to our theory is the information processing view, the notion that task uncertainty increases the amount of information that must be processed by the organization to maintain performance [11]. An increased reliance on information processing suggests that an emphasis is placed on the role played by the IT function to supply information processing capability to the rest of the organization. If the firm demands more information processing capability, it is likely that the IT function is expected to play an important role in providing that capability for the firm. In a sense, the IT function may act as a coordinating device by either enabling or serving as an important conduit for information processing in the firm.

We acknowledge that there are multiple perspectives that might be useful to explain how coordination influences the performance of the firm. For example, performance of different coordination mechanisms is influenced by institutional forces unique to each firm (e.g. the culture, and work practices) and the influence of powerful external actors controlling the resources of the firm [20]. While this complexity is of ultimate interest, we focus on the structural contingency view, one that suggests that a firm’s coordination needs are met with the most appropriate organizational response for addressing those demands felt by the firm. An increase in CIO rank suggests that the increasing demands for coordination are being met in part by increased information processing and the redesign of work processes and systems.

We consider coordination in the same sense as previously defined, as “integrating or linking together different parts of an organization to accomplish a collective set of tasks” [36, p. 322]. Although coordination is more than simply sharing information. It involves multiple actors or groups acting in a concerted fashion based on the information shared via such communication. The development of our theory follows the ideas presented by Malone in that the “coordination structure” is “a pattern of decision-making and communication among a set of actors who perform tasks in order to achieve goals” [25, p. 1319]. Malone particularly emphasizes information processing and the role of IT in coordination structure. We concur with this view and extend it to include the IT function as a coordination mechanism via standardization and as a direct facilitator of mutual adjustment that may occur between entities of the organization.

In the following section, we consider some of the key forces that have increased coordination demands in large scale businesses in the past 15 years.

2.2. Increasing Coordination Demands

There are a number of environmental forces that have changed dramatically in recent years that have significantly influenced the demand for coordination in the firm. They include technology affordances, knowledge sharing demand, regulatory climate, oversight demand and product/service convergence. All of these forces intensify interdependence and increase the demand for coordination or integration among the business units of the firm. One effective IT response to the demand for coordination is standardization of technology, data and business processes with the corresponding increase in the role, importance, and centralization of the IT function.

2.2.1. Technology Affordances. Technology continues to be faster and cheaper every year, but the important point is that it is possible through current technology to manage the entire enterprise in a more integrated fashion than was possible in the past. The concept of technology affordance does not create any imperatives for coordination in the firm, but provides opportunities. Large-scale databases now afford the opportunity to capture and store enterprise-wide data in a single instance. The database no longer acts as a limitation on the data integration of the firm, but instead as an enabler for information sharing among the subunits. Additionally, standard internet protocols have allowed efficient communication both across the firm and between different firms, linking people and allowing for coordination of people across the world. These new technology affordances mean that it is possible for coordination to take place on a much broader scale. While this does not infer that information processing
requirements are met, it means that requirements that exist may be managed through IT.

2.2.2. Knowledge Sharing Demand. Especially in an information-based society, knowledge is an important aspect of firm performance. In fact, there are a number of reasons why a knowledge management capability that cuts across multiple business units improves overall corporate performance by exploiting closely related, but complementary knowledge [33]. Related knowledge may be exploited by knowledge management capability that achieves efficiency in innovation, sales and marketing, and administrative functions. A firm that shares knowledge between business units benefits from lower costs in research and development [27], economies of scale and scope with respect to sales and marketing [4], cross-selling capability [26] and even creates customer lock-in and competitive advantage [32].

The complementary nature of the knowledge related to product, customer, and managerial processes means that the firm may benefit from the simultaneous implementation of multiple knowledge capabilities [34]. So, firms that are able to harness the benefits of related, but complementary knowledge across the firm perform better. IT plays an important role in the creation of knowledge management capabilities through its role as a cross-unit coordinating mechanism [12]. While human-intensive mechanisms may coordinate across units, they are constrained both by the limits of human cognition [3] and the fact that the maintenance of knowledge synergies via direct human linkages is costly [15]. In contrast, IT infrastructure, strategy, human resource management and sourcing that is consistent across the firm, called IT relatedness, is associated with higher knowledge management capability [33]. When IT is standardized across the enterprise, knowledge management capability is more likely to develop because it is efficient to communicate and process information among different business units.

Therefore, additional demands from the environment that require greater knowledge management capability are likely to be associated with more common IT infrastructure, strategies, human resource practices and sourcing management, encouraging coordination, rather than localized business unit-specific solutions.

2.2.3. Regulatory Climate. The regulatory climate is an important environmental factor that is difficult, if not impossible, for a single firm to control. In particular, legislation such as the Sarbanes-Oxley Act of 2002 has a profound impact on the management of the firm as a whole and the IT function specifically. The basic premise of the Sarbanes-Oxley legislation is of course that the organization is able to demonstrate that security and controls are in place to ensure effective financial reporting. But, the implications are widespread. Financial reporting is no longer the relatively straightforward accumulation of the financial transactions from each of the subunits, but is a continuously coordinated effort involving finance, IT, corporate risk management and the business units. For example, demonstrating adequate security of the information systems requires the technical staff to safeguard data through appropriate passwords, authentication and authorization verification. But this security cannot be done in a vacuum. Business units must adjust their processes to ensure that corporate security requirements are enacted to protect the integrity of data and systems while not constraining the activities of the business. Regulation also creates incentives for companies to develop economies of scale with respect to the implementation and documentation of its processes. A company that coordinates standardized processes across its separate business units reduces the number of unique processes it must document, maintain and manage. This demand is likely to compel the firm to make IT decisions that consider the need to standardize across the overall corporation ahead of the needs of each business unit for customized, unique IT. In fact, the 2006 Financial Executives International Survey of SOX 404 Costs indicated that centralized companies benefitted from lower compliance costs relative to their decentralized counterparts [8]. While no explanation is provided, we believe that companies that take a corporate perspective are able to drive standardization through common technology and applications across the firm. A coordinated approach requires less adjustment to accommodate local differences among business units and, consequently, less cost.

2.2.4. Oversight Demand. There are pressures that demand more oversight and top management control and hence lead to the centralization of the IT function.

The regulatory environment mentioned above and intense public scrutiny has created increased incentives for management accountability, including the threat of criminal prosecution, in that the top executives in public firms are expected to personally sign-off on the financial statements of the firm. This increased pressure means that the IT function faces “raised expectations to provide accurate, visible, and timely information, while ensuring the protection, privacy, and security of (the) organization’s information assets” [6, p. 77]. This means that not only is the specific ranking of the CIO likely to be elevated, but the
importance of the IT function is raised as well. In fact, many top executives are insisting that some functions meet certification requirements in order to disperse responsibility from top executives to those other functions in the organizations [16], notably IT.

Corporate board members are increasingly expected to play a hands-on role in oversight of the firm. Models such as the balanced scorecard [18] “are needed to help directors cope with complexity, and to ensure that they focus on the things that really matter” [5, p. 153]. But to achieve a balanced scorecard that measures and aggregates the firm’s financial information requires data that is consistent across the enterprise. This can be done after the fact with complicated mapping and cross-reference algorithms or more efficiently through the standardization of data into similar formats across the company or even integration of data in common systems. Either way, the need to support a balanced scorecard or similar corporate performance measurement tool drives coordinated decision making that cuts across business units.

2.2.5. Product/Service Convergence. The concept of product/service convergence is exemplified by major initiatives at large corporations to create a single face for the suite of products and services they provide. Well-documented cases include the effort at Nestlé to transform the “separate brands into one highly integrated company” [37] from its diverse portfolio of operating businesses. There are economies of scale and scope when any of the common functions of the firm are combined into a consolidated effort across the firm. Additionally, there are significant top-line benefits that a strong corporate brand, accomplished by the coordinated effort of multiple product lines, creates [1].

In certain cases, the ability to provide a single face to the customer across multiple products and services may be an imperative of doing business. “National account business is growing because more big customers want a single supplier who can service all their facilities” [17, p.233] and drive cost efficiencies. Companies such as Wal-Mart may buy from multiple business units within a supplier firm, but expect to have consolidated purchasing and invoice information with that supplier, requiring coordinated systems across the firm.

So far, we have argued that volatility and uncertainty of the current business environment have intensified the coordination demands on the organization and then detailed five areas in which the intensity of information processing requirements may lead to the IT function playing a pivotal role in addressing these coordination demands. Next, we consider the rank of the CIO in this context.

3. Hypotheses

While the relative rank of the CIO in the firm certainly indicates the influence of the individual CIO, we additionally consider the relative rank of the CIO in the organization as an indicator of the strategic importance of the IT function in the firm. Previous work connects the rank of the top IT executive to the strategic role of IT in the firm [30, 19]. Based on the need for coordination and the resulting level of information processing intensity in the firm, we expect the key individual and function related to information to be of elevated importance as the information processing intensity increases. We also expect that the coordination demands enumerated in section 2 place burdens on the IT function to facilitate coordination via the standardization of data, business applications and business processes. The CIO and the IT function are uniquely positioned in many firms with a global view and a focus on the technology that drives such standardization. And in some cases, the IT function may even act as a direct facilitator of mutual adjustment between otherwise disjoint units of the firm. These three main responses to the coordination demands of the enterprise are placing increasing importance on not only the technology, but the organizational role played by the IT function. Thus, we expect that the relative ranking of the CIO among top executives in the firm has increased in the fifteen years covered in this study and suggest H1.

H1: The rank of the CIO has increased in the period from 1993 to 2007.

Beyond an assessment of the overall change in CIO rank over time, an examination of various contingent factors may provide valuable insights into the unique environment that each firm faces and the appropriate organizational response.

An IT executive and IT function with a global perspective on the firm’s businesses is better positioned to understand the synergies that exist between businesses. More importantly, the IT function with the trust of the organization as a strategic partner of the business has more leverage to address the specific coordination requirements of the firm. So, if the coordination demands are high, then a CIO with higher rank is likely to be able to better address the information processing requirements of the firm. We propose that firms that are diversified encounter greater coordination demands simply because of the differentiated nature of each business unit as compared
to single business operations. In firms that diversify into related businesses, we expect more synergies to exist between the businesses and for the coordination requirements to be large. As a result we suggest hypothesis H2a:

H2a: The rank of the CIO is higher when the related diversification of the firm is higher.

In comparison, we expect firms that diversify into unrelated businesses to operate as a portfolio of separate companies. As such, we expect the coordination requirements of such a firm to be less than firms with more related diversification. Additionally, theory suggests that IT is most likely to be governed by business unit IT managers and IT staff as opposed to corporate units when diversification is unrelated [31]. The result is many less influential IT executives distributed throughout the firm rather than one strong IT executive at the corporate level. As a result we suggest H2b:

H2b: The rank of the CIO is lower when the unrelated diversification of the firm is higher.

In the case of vertical integration, we expect the requirement for tight coupling across business operations spanning the value chain to require close coordination. Business units that are sequentially linked in the overall production of the firm’s product or services must carefully coordinate production schedules, inventory, and logistics. As a result, we expect that coordination requirements are higher in vertically integrated firms and propose:

H2c: The rank of the CIO is higher when the vertical integration of the firm is higher.

If these hypotheses relating the CIO Rank and related diversification, unrelated diversification and vertical integration are true, then it is likely there are performance implications for the firm that appropriately addresses coordination demands. The next set of hypotheses proposes that the alignment of the rank of the CIO to match or fit the coordination demands of the enterprise leads to better firm performance. Due to the high level of coordination that is required in a firm diversified into related businesses, we expect that such firms perform better when the CIO is a higher ranking executive in the firm. The CIO and the IT function are positioned to provide the information processing capability demanded by the firm. The IT function is also positioned with a firm-wide view in order to facilitate standardization. Finally, the IT organization and its CIO must have adequate influence in the organization to link the subunits that they support. At the same time, a firm with lower coordination demands may be overspending and reducing its flexibility in the marketplace if a strong CIO and IT function is not required to meet the coordination demands of the company. Therefore, we propose hypothesis H3a that tests the interaction effect of CIO Rank and related diversification on firm performance.

H3a: The rank of the CIO moderates the relationship between the related diversification of the firm and firm performance.

In the case of unrelated diversification, the same argument applies, but the difference is that the coordination requirements are believed to be minimal in unrelated businesses. Business units remain basically autonomous, with little need for coordination among them. Performance is based mainly on the performance of each individual business segment, not on the existence of a top-level CIO or increased information processing capability linking the units. As a result, we do not expect the rank of the CIO to influence firm performance within similar levels of unrelated diversification.

H3b: The rank of the CIO does not moderate the relationship between the unrelated diversification of the firm and firm performance.

With respect to vertical integration, the intense coordination demands of firms that are vertically integrated are expected to require additional information processing capability to address these intense demands and yield strong firm performance. Therefore, we suggest a higher CIO rank improves the relationship between vertical integration and firm performance.

H3c: The rank of the CIO moderates the relationship between the vertical integration of the firm and firm performance.

In the next section, we elucidate how the previously mentioned constructs are measured in the empirical test of these hypotheses.

4. Measurement

4.1. CIO Rank (rank)

We base CIO Rank (rank) on data provided by Corporate Affiliations which lists the top 10 executives in each firm for the period from 1993-2007. Names
and titles for the top 10 executives in each firm based on relative compensation, title and overall influence in the corporation are provided for each year by Corporate Affiliations. We identify the top ranked information systems or technology executive (if listed) from among all of the executives reported based on the title reported in this list.

We use the generic term CIO, however, this generic term represents a wider range of titles that identify the top information systems or information technology executive in the firm. Titles determined to be top information systems or technology executives commonly included key words such as information, technology, data processing, systems, MIS, CIO or CTO.

In the majority of cases, the top IT executive is easily identified by title from the Corporate Affiliations list. In other cases, it is not apparent that a title represents an information systems or technology executive. For example, the title of Chief Investment Officer (CIO) is common among financial institutions, while the title Chief Technology Officer (CTO) often represents the executive in charge of research and development in R&D intensive firms. These titles are frequently indistinguishable from their IT counterparts of CIO and CTO. In case of ambiguity, we used additional sources (corporate annual reports, press releases, internet networking sites) to ensure that the title represents the top IT executive.

Corporate Affiliations lists the executives with values of 1 through 10, with 1 being the most powerful executive in the firm. From this list, we identified the top IT executive. We recorded the Corporate Affiliations ranking and then transformed the ranking (rank = 11 - Corporate Affiliations Rank) so that our measure yields a larger value for a more powerful executive. With our scale, the CEO or Chairman typically has a rank of 10. Lower ranking executives receive subsequent ranks 9, 8, 7, etc. If the IT executive does not appear in the list of executives, we assign a rank of 0. This is actually a conservative approach for our study as we are measuring the change in rank over time, meaning that any effect we detect may in fact be larger in reality.

4.2. Vertical Integration (vi)

Vertical integration captures the degree to which the firm participates in the full breadth of the value chain, from raw materials to retail sales. We utilize Fan and Lang’s [7] measure, deploying the Bureau of Economic Analysis’ (BEA) benchmark input-output tables to capture the extent to which industries use products produced by other industries. BEA provides benchmark input-output at this lowest level of detail every five years, so we utilize the 1997 benchmark input-output tables to calculate the 1993-1999 measures of vertical integration and the 2002 benchmark input-output tables to calculate the 2000-2007 measures.

The industry-level input-output measure is then applied to a given firm based on the firm’s participation in those segments. Firm segment data is taken from the Compustat annual segment database for each of the years 1993 to 2007.

4.3. Related Diversification (rd)

Related diversification measures the extent to which a firm is diversified into multiple, closely related business segments. We deploy the entropy measure from Palepu [28], but use the contemporary 2 digit NAICS codes to identify segments that are related to the firm’s overall industry.

4.4. Unrelated Diversification (ud)

Unrelated diversification measures the extent to which a firm is diversified into multiple, but unrelated business segments. Again, we use the entropy measure from Palepu [28], as with related diversification.

4.5. Control Variables

Dummy variables were created to categorize the firms into 20 industries as a means to control for industry specific returns as an alternative explanation for firm performance. The industry categories are based on the two-digit NAICS code for each firm.

The size of the firm is controlled using total annual revenue (sales) as a proxy for size. The sales figure is log-transformed to correct for non-normality, with the subsequent measure being labeled lnsales in this study.

A set of dummy variables were created for each year 1994-2007 to control for the overall economic climate faced in a given year. 1993 is used as the base year for this purpose.

Two additional measures were used to help characterize the firm. Annual expenditures on advertising (advexp), controlling for the relative investment in brand and product differentiation, and research and development (rdexp), indicating the relative investment in internally driven innovation, offer alternative explanations to the hypothesized relationships to be tested. Both measures were log-transformed to create lnadvexp and lnrdexp respectively.
4.6. Performance

The performance of the firm is quantified using three different measures: Tobin’s q (a ratio of the stock market value relative to the firm’s book value), Return on Assets (roa), defined as net profit / total assets, and Return on Sales (ros) or profit margin of the firm: net profit/revenue. Annual values for each of the components of these calculations are taken from Compustat. Tobin’s q was found to be distributed non-normally and log-transformed to arrive at an approximately normal distribution for the dependent variable. ROA and ROS were found to be approximately normal and were not transformed in this analysis.

5. Data & Analysis

216 companies were randomly selected from the 2008 Fortune 1000 list [9] for inclusion in this study. These companies represent the largest U.S. firms based on annual revenue. 30 companies were dropped from the sample for three specific reasons related to the availability of quality data on those firms. 16 companies are privately held so data on a key aspect of the study, business segmentation, is not available. Six of the companies are banks that do not report business segment data in the same fashion as all other firms, making comparisons with other firms ill-advised. Finally, for eight firms, top executive data from Corporate Affiliations was available for only one year during the study time period, usually due to recent change in ownership status. The remaining 186 firms comprise the sample used in the analysis.

Data were matched from three main sources. The top executives of the firm were collected from Corporate Affiliations [22]. Business segment and overall corporate annual performance data (sales, returns, sales by segment, diversification, assets, liabilities, etc.) were sourced from Compustat. Finally, Bureau of Economic Analysis [2] input-output tables provided information about the level of trade between industries used in the vertical integration measure.

Table 1 summarizes the characteristics of the titles of the top IT executives in the sample for three of the study years, 1993, 2000 and 2007, to describe the trend in titles over time. For example, 43.2% of the firms in our sample reported a top executive with “CIO” or “Chief Information Officer” in the title in 2007, while that was true of just 5.5% of the firms in 1993. While the titles of most top IT executives suggest that they are focused primarily on IT, the proportion of firms where the top IT executive has a title indicating additional responsibility beyond the IT function more than doubled in our sample of firms during the study period (4.4% in 2007).

We deploy a Tobit regression model in all cases where CIO Rank is the dependent variable [35] to correct for the left-censored nature of the distribution of the measure CIO Rank. Nearly half of the company-years in our study show a CIO Rank of 0 (the CIO was not listed among the top 10 executives in the firm) leading to a distribution of the dependent variable that violates the normality assumption as shown in Figure 1. The Tobit correction accounts for the fact that the value of CIO Rank is not precisely known for that portion of the sample that is censored [23].
In all regression analyses where performance is the dependent variable, ordinary-least squares regression was performed using the software R. The full regression model suggests that the performance (FP) of firm i is a function of rd, ud, vi, rank and their interactions after controlling for annual fluctuations in economic conditions (year k).

\[
FP_i = \beta_0 + \beta_1rd_i + \beta_2ud_i + \beta_3vi_i + \beta_4rank_i + \beta_5rd_i \times rank_i \\
+ \beta_6ud_i \times rank_i + \beta_7vi \times rank_i + \sum \gamma_{33}year_{13} + \epsilon_i 
\]  

\( (2) \)

6. Results

6.1. CIO Rank over Time

We found very strong evidence that the rank of the CIO increased significantly over the time period from 1993-2007. Based on a Tobit model regressing rank as a function of time, the average rank increased by 0.188 per year from 1993-2007 \((\beta_{time} = 0.188, t = 7.38, p <0.001)\). See the Time column of Table 2 for a regression summary. This effect is quite robust in that it persists in additional regression models controlling for other firm level parameters (related and unrelated diversification, vertical integration, firm size, advertising expense and R&D expense). To provide an idea of the magnitude of this change, the average CIO Rank in the sample was 1.14 in 1993, but increased to 3.03 in 2007. The upward trend is evident in Figure 2. Also evident in the figure, there is a dramatic increase in CIO Rank in the late 1990s, followed by a reduction in CIO Rank between 2002 and 2003. While we do not have specific evidence of the cause, this seems to correspond to the euphoria with respect to technology during the “dot-com” era, followed by a period of adjustment to a more realistic assessment of the business value of technology. Interestingly, it appears that the upward trend in CIO Rank is again gaining momentum in recent years.

![Figure 2. CIO Rank Over Time 1993-2007](image)

6.2. Impact of Coordination Demands on Rank

The CIO Rank may be influenced by a potentially infinite list of factors, so we focus here on a series of factors related to the coordination demands of the firm. We find that after controlling for the effects of time and firm size, related diversification is negatively related to CIO Rank \((\beta_{rd} = -0.9531, t = -3.632, p <0.001)\). This is contrary to our expectation in H2a. Meanwhile, hypotheses H2b and H2c are supported as unrelated diversification is negatively related to CIO Rank while vertical integration is positively related to CIO Rank. The overall finding is that diversification and CIO Rank are negatively related, without regard to the relatedness of the diversification. However, related diversification has only one-half the negative effect that unrelated diversification has on rank in our sample, with the implication being that unrelated firms are more likely to have a lower ranked CIO than related firms. Meanwhile, a vertically integrated firm is more likely to have a higher ranked CIO. The regression summary is in the “Additional Predictors” column in Table 2.

![Table 2. Regression Predicting CIO Rank](image)

<table>
<thead>
<tr>
<th>CIO Rank</th>
<th>Time Only</th>
<th>Additional Predictors</th>
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<tbody>
<tr>
<td>time</td>
<td>0.188***</td>
<td>0.2219***</td>
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<td></td>
<td>(0.0254)</td>
<td>(0.0271)</td>
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<tr>
<td>rd</td>
<td>-0.9531***</td>
<td>-0.9531***</td>
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<td></td>
<td>(0.2624)</td>
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<tr>
<td>ud</td>
<td>-2.2016***</td>
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<td></td>
<td>(0.4784)</td>
<td>(0.4784)</td>
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<tr>
<td>Vi</td>
<td>56.6743***</td>
<td>56.6743***</td>
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<tr>
<td></td>
<td>(10.4112)</td>
<td>(10.4112)</td>
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<td>Insales</td>
<td>-0.0675</td>
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<td>(0.0949)</td>
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Significance levels: ***/∗∗∗ p < 0.01
Note: Industry returns are controlled in the "Additional Predictors" regression using each firm’s two-digit NAICS code.

Based on the supposed relationship between the structure of the firm (diversification and vertical integration) and CIO Rank, we suggest that there must be strategic implications to the rank of the CIO in the firm. In the next section, we explore this proposition by considering the influence that the CIO Rank may have in moderating the firm structure/performance relationship.
6.3. Performance Implications of CIO Rank

We begin by interpreting the main effects of the diversification measures, vertical integration and CIO Rank on firm performance.

Across all three performance measures, we find that related diversification is a detriment to firm performance (analyses I, III and V in Table 3). This result corroborates previous findings that diversification, whether in related or unrelated businesses, is associated with lower firm performance [21]. The analysis also provides some evidence that unrelated diversification is negatively associated with performance. Analyses I and III demonstrated the negative effect to be statistically significant, while analysis V is not statistically significant.

With regard to vertical integration, there was no impact on performance in this sample. This may reflect the inherent tradeoff between the additional production costs of operating throughout the value chain vs. the cost of coordinating via the market [13, 14].

Our analysis also indicates that a higher CIO Rank is associated with negative performance, at least based on ros and roa performance measures (analyses III and V in Table 3). The effect of CIO Rank on Tobin’s q is not significant (analysis I).

Next, we consider the combined interaction effects of CIO Rank and the firm diversification measures on firm performance. This analysis is intended to provide insight into whether the CIO Rank moderates the relationship between diversification and firm performance. In other words, can a higher CIO Rank negate the adverse effects of diversification?

CIO Rank does appear to moderate the effect of related diversification on firm performance, based on the significant interaction terms corresponding to rd*rank in analyses IV and VI. The rd*rank effect on Tobin’s q was not statistically significant, although it was consistent in the direction of the sample effect. However, the direction of this moderation is in the opposite direction of our hypothesized influence. We expected that a higher CIO Rank would support coordination and information sharing between related businesses and offset the adverse effects of such diversification. We find the opposite to be true.

The evidence is less clear with respect to the influence of CIO Rank on the effect of unrelated diversification on firm performance. Analyses II and IV do not find a statistically significant moderating effect of CIO Rank on the relationship. Although a non-significant finding does not confirm any hypothesis, it does suggest that the CIO Rank may not influence the coordination of firms that diversify into unrelated businesses, or coordination is not an important factor impacting performance in unrelated firms.

In concurrence with standard statistical practice, we do not interpret any interaction effects when the main effect is not significant (ie. the influence of rank on vi’s relationship to firm performance and the interaction ud*rank in analysis VI).

### Table 3. Summary of Regression Results Using Different Performance Measures

<table>
<thead>
<tr>
<th>Performance</th>
<th>I</th>
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<td>ln(Tobin’s q)</td>
<td>ln(Tobin’s q)</td>
<td>ROA</td>
<td>ROA</td>
<td>ROS</td>
<td>ROS</td>
</tr>
<tr>
<td>rd</td>
<td>-0.283456*** (0.034876)</td>
<td>-0.243630*** (0.043961)</td>
<td>-0.0194545*** (0.0035657)</td>
<td>-0.0104763** (0.0044846)</td>
<td>-0.0181875*** (0.0050684)</td>
<td>-0.009836 (0.06375)</td>
</tr>
<tr>
<td>ud</td>
<td>-0.151107*** (0.058208)</td>
<td>-0.126817* (0.068044 )</td>
<td>-0.0100614 * (0.0059511)</td>
<td>-0.0133442* (0.0069414)</td>
<td>0.0071187 (0.0084592)</td>
<td>-0.007396 (0.009867)</td>
</tr>
<tr>
<td>vi</td>
<td>-1.764555 (1.449396 )</td>
<td>-2.609122 (2.179937)</td>
<td>0.1379834 (0.1481861)</td>
<td>0.0072303 (0.222384)</td>
<td>0.0120052 (0.2106382)</td>
<td>-0.007367 (0.316108)</td>
</tr>
<tr>
<td>rank</td>
<td>-0.006088 (0.005469)</td>
<td>0.001536 (0.007392)</td>
<td>-0.0021240*** (0.0005592)</td>
<td>-0.0010904 (0.0007541)</td>
<td>-0.0032313*** (0.0007948)</td>
<td>-0.003145 *** (0.001072)</td>
</tr>
<tr>
<td>rd*rank</td>
<td>-0.018994 (0.012381)</td>
<td>-0.041593*** (0.0012630)</td>
<td>-0.0041593*** (0.0012630)</td>
<td>-0.003703** (0.001795)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ud*rank</td>
<td>-0.016332 (0.023426)</td>
<td>0.0022417 (0.0023898)</td>
<td>0.0022417 (0.0023898)</td>
<td>0.009786*** (0.003397)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vi*rank</td>
<td>0.289467 (0.425453 )</td>
<td>0.0349078 (0.434021)</td>
<td>0.0349078 (0.434021)</td>
<td>-0.013236 (0.061694)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01
Note: Dummy variables for each year 1994-2007 control for the cyclical performance of firms based on overall economic conditions. Firm size is controlled using the variable Insales. Control variables are omitted from the table.
7. Discussion

The most unmistakable finding of the study is that the CIO Rank increased significantly during the period 1993-2007. As mentioned above, the average CIO Rank in our sample of large firms increased from 1.14 in 1993 to 3.03 in 2007. While other alternative explanations are plausible, we suggest one rationale for this very apparent change is the increased demand for coordination in the firm. Our analysis relating the diversification measures and vertical integration to CIO Rank provides some evidence of the types of coordination that may influence CIO Rank and the role of the IT function.

To our surprise, related diversification is negatively related to CIO Rank. While we expected that closely related businesses would present higher demands for coordination and suggest an elevated role for IT in the firm, this was not true in our sample. One challenge with this relationship is the two-dimensional aspect of related diversification. The measure captures similarity of the industries in which the firm does business, but it also measures the segmentation of the firm into different businesses. Based on our findings, it appears that diversification of any type reduces the CIO Rank. It may be that highly diversified firms maintain the autonomy of their business units, forgoing any benefit of significant coordination. As a result, business unit CIOs may remain particularly powerful, with the corporate CIO playing a less critical role.

We did find strong evidence that vertical integration is positively related to the CIO Rank. This is supportive of the theory that vertical integration presents high demands for coordination throughout the supply chain and the CIO’s elevated rank reflects the important role that IT plays in addressing those demands.

Our analysis on firm performance is less clear. One of the challenges is that many other factors may account for firm performance. We controlled for fluctuations in economic conditions and attempted to triangulate based on three separate performance measures. We were, however, surprised by the fact that CIO Rank does not positively influence the relationship between related diversification and firm performance. Again, it may be on account of the two-dimensional nature of the rd measure, the fact that rd captures both the relatedness of the businesses of the firm and the fact that the firm is differentiated into many businesses. It may also be that a company diversified in related businesses has lower coordination requirements than we theorized. If common language is shared, common systems are utilized in similar industries and related businesses already engage in close communication regardless of IT, than IT may not be required to address the information processing needs of the firm. However, as mentioned in section 2, it may be that the structural contingency view that we take in this study provides an incomplete explanation. It may be that the heterogeneity of culture and differences in the power of external stakeholders for example play an important role in how much influence the CIO and IT function have with respect to the overall performance of the firm. It is also possible that the technical coordination that IT provides acts to thwart flexibility and adaptability generally associated with better performance.

With regard to unrelated diversification, the evidence is ambiguous across the three performance measures. However, the moderation effect is positive in all cases and significant in terms of ROS. This would seem to indicate that a higher CIO Rank may positively influence the relationship between unrelated diversification and performance. There may be more synergies among unrelated companies than we posited, especially with respect to the coordination demands of knowledge sharing, regulatory climate, oversight demand and product/service convergence mentioned in section 2.

Finally, there was no significant moderation on vertical integration. While we still contend that vertical integration creates high demands for internal coordination, it is also true that outsourcing creates high demands for external coordination [24]. What is unclear is what function in the organization is most responsible for the external coordination required to transact business with an outsourcing partner firm? Further work should be considered to separate the internal and external coordination demands.

8. Conclusions and Future Research

This study has presented evidence of an increasing demand for coordination in the large business enterprise over the last fifteen years. An information processing perspective is used to argue for an increasingly prominent role for IT as a response to the increasing coordination demands in the enterprise. We use the CIO Rank in the firm to represent the relative influence of the IT function in the firm. A dramatic increase in the CIO Rank among our sample of Fortune 1000 firms was observed in the period from 1993 to 2007. We also found evidence that the CIO Rank is higher in vertically integrated firms, while we found evidence contrary to our expectations regarding diversification, that the CIO rank is actually lower in more
diversified firms. The overall influence of the CIO Rank on Firm performance was unclear.

One of the unique contributions of this study is the new measure, CIO Rank, created for use throughout the analysis. While it is not without its limitations (e.g. the left censored nature of its distribution), it can be calculated from data that is generally available to researchers, may be consistently replicated and has intuitive appeal. This measure used in combination with the Tobit regression model is a powerful new tool for studying the CIO and the IT function. Interestingly, the CIO Rank measure might easily be extended to cover other business functions beyond IT. For example, the rank of the top finance or marketing executive might be useful to address questions in those fields.

The sample used in this study presents certain limits to the generalizability of the findings. With the Fortune 1000 as the population, the type of firm that this research applies to is generally large, U.S. based and publicly-traded companies engaged in multiple segments. Additionally, banks were not included because of their very different structure and reporting requirements. Care should be taken to generalize the results to firms of similar size and industry.

This particular study may be extended to include factors of culture and external stakeholders to provide a richer explanation of performance in terms of coordination. Additionally, it may be necessary to use lagging indicators of performance in future work to reflect the time required to see changes in organizational structure reflected in firm performance.

In summary, we suggest that focusing on the coordination demands of the firm is an important perspective for understanding the governance and structure of the IT function. While there are certainly other important factors to consider in the governance and structure of IT [31], we argue and present empirical evidence that the coordination demand of a changing environment in large, multi-business unit firms is an additional factor to consider in both the role and structure of the IT function in large companies.

9. References


