Operationalizing IS/IT Functional Structure

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Abstract

A structural contingency theory of IS/IT functional structure is presented which relates IS/IT functional structure to IS/IT performance contingent both on the types of economy the organization expects from the IS/IT function and the volatility of the competitive environment. Three types of economies are articulated which impact the appropriateness of the IS/IT functional structure profile: economies of scale, economies of scope, and economies of integration. IS/IT functional structure consists of both technical and organizational elements. Three key structuring constructs (complexity, formality, and centrality) are described to delineate six key IS/IT structuring variables: technical complexity, organizational complexity, technical formality, organizational formality, technical centrality, and organizational centrality. Grounded research propositions are presented relating three profiles of IS/IT functional structure (local, partner, and uniform structures) with the three types of economies. The moderating relationship of volatility on the relationship between the fit between economy and structure and IS/IT performance is also specified.
INTRODUCTION

Creating an appropriate structure for the IS/IT function within an organization can be a difficult and complicated undertaking. Our interactions with chief information officers (CIOs) from large organizations reveal that this difficulty comes from at least two sources. First, information systems/information technology (IS/IT) has an impact on almost all elements of most organizations. Given the complexity inherent in contemporary firms, it is not surprising that the IS/IT function must often meet a complex and competing set of organizational objectives (Brown and Magill, 1998; Ross, 2003) from the various corporate and business units within the organization. Specifically, these various demands require that the IS/IT function create different types of organizational economies or synergies. Second, the volatile nature of competitive and technical environments makes effectively monitoring technological opportunities and threats to organizations a continuous process and tenuous. The IS/IT function must be organized or structured to effectively position the IS/IT function in the context of these organizational demands and environmental conditions.

There are at least two perspectives one may take in understanding IS/IT structure. One perspective conceptualizes structure as the act of organizing IS/IT elements. Under this perspective, IS/IT structure is viewed as a process which must be managed in order to maintain effective relationships among IS/IT elements. A second perspective conceptualizes structure in terms of descriptions of the configurations of IS/IT elements and the relationships among these elements. Under this perspective, structure is not a process, it is a characteristic of the IS/IT function. In our research we adopt the second
perspective and define IS/IT structure as the patterns of organizational and technical elements of the IS/IT function and the patterns’ relationships among these elements.

In this research, we examine IS/IT functional structure by addressing the following research questions: (1) What are the important constructs which comprise the IS/IT structure concept?, and (2) How should the IS/IT function be structured to meet a complex set of organizational objectives and environmental conditions? We address these questions by combining insights from our extensive interactions with senior IS/IT executives and an extensive review of the existing body of IS/IT and strategic management literature to develop a framework for operationalizing IS/IT functional structure. Additionally, we present a set of grounded propositions relating IS/IT functional structure to IS/IT performance.

The balance of this paper is organized into four sections. First, we present a framework for operationalizing IS/IT functional structure and review the relevant strategic management and IS/IT literature related to IS/IT functional structure. Next, we describe the methodology we followed to articulate configurations of IS/IT functional structure variables. Third, we specify configurations of IS/IT functional structure variables and research propositions relating IS/IT functional structure with IS/IT performance. Finally, we outline the contributions of this research and an agenda of future research related to the IS/IT functional structure concept.

**OPERATIONAL FRAMEWORK AND RELEVANT LITERATURE**

At the conceptual level, we have a relatively straightforward research model (see figure 1). We propose that fit between organizational demands on the IS/IT function and IS/IT functional structure is positively related to IS/IT performance. Additionally, we
propose that this relationship is modified by the environment. In this section, we outline the relevant literature to each of the major constructs.

**Figure 1 – Conceptual Research Model**

Fit between organization demands on IS/IT and IS/IT functional structure

The competitive environment

IS/IT Performance

**IS/IT Functional Structure**

Allen and Boynton (1991) define IS/IT structure as the set of policies and rules that govern an organization’s actual and planned arrangements for computers, data, human resources, communications facilities, software, and management responsibilities. From this definition it is clear that IS/IT structure is comprised of both technical and organizational elements. Technical structure as captured in the arrangements and relationships between technology platforms, data, applications, systems software, and networking technologies. Organizational structure as comprised of the arrangements and relationships among IS/IT divisions or entities, processes, and management responsibilities. Prior IS/IT research has examined the relationship between technology and organizational structure (Ahituv, et al, 1989, Ein-Dor and Segev, 1982) and demonstrated a need to manage both technical and organizational elements of the IS/IT (Feeny and Willcocks, 1998). There are more extensive bodies of literature which relate to technical and organizational elements of structure separately, which we outline below.
Technical Structure

The prior literature has most often described the technical elements of IS/IT functional structure in terms of IS/IT architecture. As Ross (2003) notes, there are several concepts of IS/IT architecture described in the literature. One view suggests that architecture and infrastructure can be thought of almost interchangeably (Weill and Vitale, 2003). Under this view, IS/IT architecture describes the blueprint of the next IS/IT infrastructure. This limits the architecture construct to a description of the plan for centrally controlled and maintained IS/IT capabilities which form the basis of shared IS/IT services (Weill and Broadbent, 2000). A second view of architecture utilizes the natural analogy to the field of architecture to describe an enterprise IS/IT architecture in the context of the business (Zachman, 1999). Under this view, IS/IT architecture describes the relationships among business processes and the IS/IT infrastructure, data, and applications which support those processes. This view is more comprehensive than the infrastructure view. It is typically focused on technologies and how they support business processes. Ross (2003 p. 32) identifies a third conceptualization of IS/IT architecture as the “organizing logic for applications, data, and infrastructure technologies… intended to enable the firm’s business strategy.” Although this view describes architecture in terms of what IS/IT enables the firm to do, it is not very operational. It does not describe how the IS/IT function is designed and structured to deliver and maintain IS/IT capabilities which are the foundation of what IS/IT enables the firm to accomplish.

Standardization is a prominent element of technical architecture. Ross (2003) reminds us that IS/IT architecture should be conceptualized as more than just technology
standards. Ross articulates a staged model of architectures which describes the relationship between the types of standardization utilized and the different stages of the organization of the IS/IT function. Prior IS/IT research has operationalized several different elements of IS/IT standards. For example, Ein-Dor and Segev (1982) operationalize IS/IT integration – or standardization of systemic outputs and interfaces among systems – in terms of the proportion of data that exists in shared databases, the number of applications that utilize common files, and the number of functions served by applications. Brown and Bostrum (1994) operationalize formalization – or standardization of processes – as the existence of IS/IT process guidelines, the extent to which the guidelines exist in written form, the degree to which employees are expected to follow the guidelines, and finally the extent to which the guidelines are actually followed.

An obvious and interesting question that can be asked as part of the discussion of technical architecture is how would an organization choose whether to employ technical standards or not, and which type of standardization should be employed. To find an answer to this question, one may look to the strategic management literature. Robins and Weirsema (1995) argue that individual business units must have shared, firm specific strategic assets before incorporating the different business units within the same organization creates performance which exceeds the sum of the performance of the different business units. In other words, unless there are firm-specific strategic assets utilized by a given business unit, it will perform better as a separate entity than as part of a conglomeration. In order for an asset to be both firm specific and strategic it must be both unique to the organization and add value to the firm. In the context of IS/IT, standards can create firm specific assets. This is a counter-intuitive argument as most
view technology standards in terms of market or industry standards. Under this view, the adoption of standards makes the technologies employed by organizations more similar than firm specific. However, when standards are viewed from the perspective of the organization, they become more firm-specific. An asset is deemed to be specific when the next best utilization of that asset yields less value than its current use. In other words if the properties of an asset make it particularly well-suited to create value for one firm, but if any other company were to utilize that asset it would generate less value; then that asset would be deemed specific. In the context of IS/IT, if the properties of the technologies utilized in the organization make them particularly well suited to creating value for that firm, but would create as much value for another firm, the technologies would be considered asset-specific. IS/IT standards at the firm level create asset specificity because the extent to which organizational specifications (or standards) exist which govern technologies, IS/IT processes, and systems; the technologies themselves become more suited to that particular organization and therefore are not as well suited to meeting the needs of another organization. Therefore, as organizations employ enterprise technology standards, they may also be creating firm-specific technology assets. The extent to which those assets are strategic will then dictate whether they should be adopted in much the same manner that business units must adopt firm-specific and strategic assets before the performance of a corporation will outperform the sum of the business units operating independently.

The control mechanisms that will be put in place to incorporate different business units within the same organization create bureaucratic costs (Jones and Hill, 1988) which must be outweighed by the value created by creating a multi-business operation (Jarillo,
By analogy, IS/IT standards create certain administrative costs. These costs must be outweighed by potential synergies, or economies, created by the standardization before the IS/IT standards are justified. If the costs of standardization are not outweighed by the benefits, a firm should choose to not implement IS/IT standards. There are two significant costs of standardization: creation and enforcement. Creation includes those activities associated with the development of an IS/IT standard. The cost of enforcement includes all costs incurred to ensure that the standards are adhered to across the organization. A firm will therefore adopt IS/IT standards only when the expected benefits, or economies, derived from the standards outweigh the costs of creation and enforcement of the standards.

The strategic management literature also provides another insight into the adoption of standards. Organizations may decide to create core capabilities, or the ability to perform an organizational task more effectively or efficiently than any other organization. Core capabilities serve as the basis for competition for an organization, but may also create core rigidities, or a stifled ability to innovate (Leonard-Barton, 1992). Core rigidities, or the inability to change, form as a result of organizational inertia. This becomes problematic when environmental circumstances change and the value of performing that particular organizational task is diminished. In much the same way, creating IS/IT standards may become problematic, if the circumstances under which those standards are most appropriate change. If a firm competes in a volatile environment, managers may choose to not employ standards even if they expect the economies provided by the standards to exceed the costs of creating and enforcing the standards in the short run. Because the circumstances under which a given set of
standards are appropriate may change, managers may choose to under-standardize their organization in an effort to encourage innovation.

**Organizational Structure**

There is a large body of literature related to the organization elements of IS/IT structure (Agarwal and Sambamurthy, 2002). The literature has identified three models of IS/IT structure which can be described in terms of the locus of control for IS/IT: centralized structure, decentralized structure, and federal structure (Sambamurthy and Zmud, 1999; Allen and Boynton, 1991). In the centralized model, the control of IS/IT is concentrated in the corporate IS/IT function. In the decentralized model, control of IS/IT is disperse throughout the organization in the hands of the individual business unit IS/IT functions. The federal model is really a hybrid between the centralized and decentralized models where the corporate IS/IT function and the various business units share control. Hybrid structures also exist to the extent that the IS/IT structure is not consistent across the organization (Brown, 1997). Corporate IS/IT may control all decisions for some business units, but not others.

The federal structure is the most prevalent IS/IT organizational form (Sambamurthy and Zmud, 1999). The existence of federal forms can be explained using a variety of theoretical perspectives (Hoskisson, et al, 1993; Lewin and Volbera, 1999). However, it seems clear that the federal forms are most adept at meeting the need to centrally coordinate IS/IT activities while at the same time allowing business units autonomy to customize IS/IT products and services to fit unique business needs (Allen and Boynton, 1991; Handy, 1992; Kahai, et al, 2003; La Belle and Nyce, 1987) and are therefore most appropriate for organizations where central coordination and local
autonomy are both important. This is the case in most large contemporary organizations as IS/IT is expected to play a role both in supporting individual business unit activities and in integrating across these activities (Adams, et al, 2004).

The literature related to IS/IT structure is well-developed. Most of the literature adopts a contingency approach which highlights the need to design IS/IT structures so that the behaviors of IS/IT employees and managers are consistent with desired organizational outcomes for IS/IT (Zmud, 1984; Allen and Boynton, 1991). Research has been conducted to describe the contingency factors that influence the structural choices related to IS/IT (Sambamurthy and Zmud, 1999; Brown and McGill, 1998; Ahituv, et al, 1989; Tavakolian, 1987; Ein-Dor and Segev, 1982; Olsen and Chervany, 1981). Some of the factors that have been identified in this literature include industry, firm size, corporate strategy, and corporate structure.

Most often structure is operationalized in relation to the control of the decisions that are made with respect to IS/IT within the organization. Brown and McGill (1998) classify these decisions as those pertaining to IS/IT infrastructure and applications. Infrastructure refers to the set of shared IS/IT services provided throughout the organization (Weill and Broadbent, 2000) while applications refer to the specific uses of IS/IT within the organization. Sambamurthy and Zmud (1999) identify three elements of IS/IT that can be controlled by either corporate IS/IT or at the business unit level: infrastructure, use, and project management. Infrastructure refers to decisions with respect to hardware and software platforms as well as network and data architectures. IS/IT use refers to decisions with respect to long and short-term plans for applications as well as planning, budgeting, and the day-to-day operations and services. Project
management consists of decisions related to the acquisition, development, and deployment of IS/IT applications within the organization. Sambamurthy and Zmud (1999) further identify three sets of stakeholders that may lay claim to the control of infrastructure, use, and/or project management: corporate IS, divisional IS, and line managers.

One can utilize the locus of control construct to differentiate between centralized, decentralized, and federal IS/IT organizational structures. In the centralized IS/IT structural model, the locus of control for all three of these elements (infrastructure, use, and project management) is concentrated in the corporate IS/IT function. In the decentralized model, the locus of control for all three elements is distributed into the hands of business unit managers. There are many variations of the federal model. The defining characteristic of these models is that neither corporate IS/IT nor business unit managers control all three elements.

The decision on organizational architecture is based on the relative advantages of each architectural choice. As discussed above, choosing an appropriate IS/IT organizational structure is an exercise in determining which stakeholders should control which types of IS/IT decisions (Kahai, et al, 2003; La Belle and Nyce, 1987). The benefits of each architectural choice can be conceptualized in terms of the locus of optimization within the organization. The locus of optimization refers to perspective from which a firm chooses to optimize the technological decisions of the organization. Managers may choose to optimize IS/IT at the business unit level, thereby building systems that best suit the needs of all individual business units; or they may choose to optimize IS/IT at the corporate level, building systems that service the entire
organization. Business unit optimization provides business unit managers with the ability to quickly deliver IS/IT solutions to meet their current market conditions. Although this may be a powerful competitive weapon for business units, it may also be inefficient and lead to integration problems should the organization decide to share information resources across business units. Optimization at the business unit level is associated with the decentralized model for IS/IT structure. Optimization at the corporate level leads to IS/IT synergies across the organization, but business unit managers may find that corporate solutions do not completely satisfy all of their IS/IT needs. The centralized IS/IT structural model is used to achieve corporate optimization. Managers may also choose a level of optimization between business units and corporate. For this they should employ a federal structure. As Allen and Boynton (1991) point out, the federal structural models may be most appropriate for most organizations, because they can capitalize to some degree on the strengths of both centralization and decentralization. The federal models allow an organization to focus on the corporate optimization and business unit optimization at the same time. Whether an element of IS/IT is optimized at the corporate or business unit level will depend on whether that element of IS/IT is controlled centrally or controlled in a distributed structure.

In most cases, federal structures provide for corporate optimization of IS/IT infrastructure through centralized control of infrastructure. This allows the organization to create economies of scale and global connectivity of systems across the organization by limiting the number of hardware and software platforms that must be supported in the organization and defining the data and network architectures, respectively. Whether a firm decides to exercise centralized control for IS/IT use and project management is a
function of whether an organization wants to optimize IS/IT use and project management at the business unit level or at the corporate level. The decisions to centralize use and project management are not completely independent. As managers choose to optimize IS/IT use more toward the corporate level than the business unit level, most business units will not be able to effectively manage IS/IT projects to deliver systems that fit organization-wide needs. Likewise as managers choose to localize control of IS/IT use into the hands of business units, it becomes less likely that project management efforts will be controlled at the corporate level, because corporate IS/IT employees will lack the specific knowledge necessary to create applications that are closely tied to the needs of the business units.

**Major Structuring Constructs**

It is clear from the prior literature and our interactions with IS/IT executives that there are both organizational and technical elements of IS/IT functional structure. We now turn our attention to describing the major constructs related to structure as they have been described in the strategic management literature. This literature has suggested an important distinction between structural and structuring characteristics of organizations (Dalton, et al, 1980). Structural characteristics include the physical characteristics of organizations (size, span of control, etc.). Structuring characteristics consist of the policies and activities that occur within an organization to prescribe or restrict the behaviors of individuals within the organization. There are three main structuring characteristics described in the literature: complexity, formality, and centrality (Dalton, et al, 1980). Complexity refers to the number of distinct structural elements and the number of relationships among these elements. Formality refers to the existence of written
specifications which relate to structural elements. Finally, centrality refers to the degree to which decision-making is concentrated in the hands of a few managers within an organization.

For this research we have determined to focus on the structuring element of IS/IT functional structure for two reasons. First, it would be difficult to specify all of the physical technical and organizational characteristics of contemporary IS/IT organizations. Second, the volatile nature of technologies would almost certainly make any current conceptualizations of the physical technical characteristics of organizations obsolete in a short period of time. For these reasons, we will not conceptualize IS/IT structure in terms of the instantiations or modes of technical or organizational structure or in terms of structural dimensions.

**Key IS/IT Functional Structure Variables**

Utilizing the perspective that IS/IT structure contains both technical and organizational elements and each of the structuring characteristics of structure outlined in the strategic management literature, we have developed a framework for operationalizing IS/IT functional structure. As we described above, technical structure is captured in the arrangements and relationships between technology platforms, data, applications, systems software, and networking technologies. Organizational structure is comprised of the arrangements and relationships among IS/IT divisions or entities, processes, and management responsibilities. We assert that there are six important variables for operationalizing IS/IT functional structure: technical complexity, organizational complexity, technical formality, organizational formality, technical centrality, and
organizational centrality. The following table contains representative research from both the IS/IT and strategic management literature on each of the six variables.

**Technical and Organizational Complexity**

Complexity is related to the number of and relationships among different organizational specializations (Payne and Mansfield, 1976; Pugh, et al, 1968; Hage and Dewar, 1973). Organizational complexity refers to the number different specializations incorporated within the IS/IT function. These may include different IS/IT organizational divisions or entities, processes, or management responsibility specializations and the relationships among them. Technical complexity refers to the number of different technical platforms, systems software installations, data definitions, and applications utilized within the organization and the relationships among them. Complexity can be conceptualized as the opposite of standardization. The more standardized an organizational or technical structure, complexity is decreased.

**Technical and Organizational Formality**

Formality refers to the extent to which appropriate organization and technical configurations and relationships are expressed in written form. Organizational formalization refers to the extent to which the behaviors and activities of divisions, processes and individuals are specified in written form. Technical formality exists when guidelines for platforms, systems software, data, and applications exist in written form.

**Technical and Organizational Centrality**

Centrality refers to the extent to which one or a few managers control or make most organizational decisions. In the context of the organizational elements of IS/IT functional structure, centrality refers to the extent to which one or a few managers control
most of the decisions related to IS/IT divisions, processes, and management responsibilities. Technical centrality exists when one or a few managers control all decisions related to technical platforms, systems software, data, and applications.

**IS/IT Role and Economy Foci**

Just as prior research has highlighted the various aspects and dimensions of IS/IT functional structure, researchers have also examined IS/IT role and the various types of economies created by IS/IT within organizations. This research has identified organizational expectations, goals and foci for IS/IT, as well as the strategic nature of the current and future portfolio of information systems as significant elements of the role that IS/IT plays within an organization (McFarlan, 1984; Tallon, et al, 2000; Sabherwal and Chan, 2001; Chan, et al, 1997). There is no consensus, however, on how IS/IT roles should be defined. Our conceptualization of IS/IT roles is consistent with the expectation that IS/IT plays different roles in different organizations. Through our interactions with the CIOs of many large organizations and our interpretation of the literature, we (Adams, et al, 2004) have found that there are three levels of roles that IS/IT plays within an organization. These levels are (1) to support individual organizational activities, (2) to provide synergy across organizational activities, and (3) to enable and create organizational change. In some ways, these levels can be thought of as stages in the development of the IS/IT organizational role. In other words, in order to fulfill a more extensive role within the organization, IS/IT must first fulfill the levels that represent less responsibility (see Figure 2).

When the role of the IS/IT function is simply to support individual business activities, the systems within the IS/IT organization must provide significant functionality
to sustain the basic functions of the organization. In fulfilling this role, the IS/IT function develops systems that are closely tied to executing specific business processes. IS/IT may be seen as a critical enabler for these processes. However, IS/IT may also be seen as merely an important ingredient for the success of these business activities, and not necessarily a difficult element to provide.

**Figure 2 – IS/IT Role Categories**

Extensiveness of Role

Role Levels

- **Support Business Activities**
- **Support Business Activities**
- **Support Business Activities**
- **Enable Organizational Change**
- **Create Organizational Synergies**
- **Create Organizational Synergies**

Providing synergies across business activities is the next level of responsibility, or role, for the IS/IT within the firm. This role involves the ability to connect systems, applications, and data across the organization, in addition to the ability to support business activities individually. Since IS/IT is not responsible for creating or facilitating organizational change in this second role, many of the linkages are based on technologies that accomplish the integration of very different systems. In some rare cases, the IS/IT
function is charged in the second role with initiating the “enterprise view” of business process changes to achieve synergies through an overall enterprise view of business activities. More commonly, however, the synergies are created by patching existing systems together rather than developing a common blueprint for business processes across the organization.

Responsibility for changing the business involves the ability to fundamentally change the organization including its products and/or its services, in addition to supporting and integrating business activities. In this role, IS/IT may be called upon to be a catalyst in changing the organization by suggesting changes to the products and services offered by the company, improving the organizational market or geographic reach of the organization, and influencing changes in industry practices that are enabled by IS/IT. As part of this role, IS/IT is expected to develop an enterprise view of business processes and take a prominent role in improving these processes.

Our research has highlighted the fact that organizations achieve different economies from IS/IT depending on the role that IS/IT plays in that organization. In order to gain insight into the nature of organizational economies, we turn to the literature on organizational strategy. Of particular interest to this discussion is the work of Jones and Hill (1988) who discuss the potential synergies, or economies that an organization can achieve through the three different strategies for diversification.

They describe three types of economies that organizations may enjoy: economies of internal markets, economies of integration, and economies of scope. Economies of integration result from the ability to utilize specialized assets to increase organizational efficiency, eliminate sub-optimization in the allocation of organizational resources, and
reduce the need to draft complex contracts to control supplier behavior. Economies of scope arise through the sharing of strategic resources across business unit boundaries. Resources may be imperfectly divisible, meaning that the purchase of a resource may lead to costly excess capacity for a fully autonomous business. The sharing of such resources across business units allows for the capacity of a resource to be fully utilized. Economies of scope may also result from the creation of organizational synergies across common business units. Economies of internal markets include the ability to allocate resources, monitor business unit performance, and remove the leadership of a poorly performing business unit more efficiently than a market. Jones and Hill (1988) argue that different firms achieve different economies depending on the diversification strategy of the organization.

Figure 3 – Types of IS/IT Economies

By analogy, one can describe three types of economies that are created within the information systems function: economies of scale, economies of integration, and economies of scope (see figure 3). Economies of scale are derived from the ability to
reduce costs in acquiring and maintaining IS/IT resources. This is done by standardizing or limiting the number technologies that are supported within the organization.

Economies of integration stem from the organization’s ability to maintain specialized technology assets to improve the efficiency of business operations. This is achieved through integrating business processes across the enterprise. Economies of scope are derived when IS/IT resources and capabilities can be applied to many different organization situations. These economies are created as the IS/IT function facilitates and enables organizational change.

Each of the roles provides a context in which the organization can expect IS/IT enabled economies. Economies of scale can be derived as the IS/IT function supports individual business activities. They are derived by effectively managing IS/IT related resources that are brought to bear in the support of these activities. Economies of integration result from creating linkages across organizational activities. The creation of these linkages requires specific technology assets that improve the efficiency of the organization by connecting organizational processes. Finally, economies of scope result from the ability of the IS/IT function to apply IS/IT related resources and capabilities in new and innovative ways to support and enable business changes.

Given the fact that the three IS/IT roles represent different levels of responsibility for the IS/IT function within the organization, they may also require different IS/IT functional structure configurations in order to fill those roles. In the next section we will turn our attention to some specific propositions relating IS/IT economies to IS/IT functional structures.
IS/IT Performance

IS/IT performance has been the focus of a great deal of research in information systems. In most cases performance is the dependent variable of interest. As a result, much of the research done in IS/IT has focused on utilizing an adequate measurement of performance while concentrating much of the conceptual effort in formulating the research on the independent variables. A few studies have focused on the conceptual basis for IS/IT performance.

DeLone and McLean (1992) developed a taxonomy of IS/IT performance variables based on how IS/IT performance was conceptualized in prior research. They describe six different categories of IS/IT performance variables: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. System quality is related to assessments of the elements of the processing system. Information quality is concerned with the quality of the outputs of the information system. Measures of use are constructed to determine the actual utilization of the system by the users. User satisfaction measures the users’ response to utilizing the system. Measures of individual impact are concerned with assessing the degree to which an individual’s behavior is affected by utilizing the system. Organizational impact is concerned with changes in the organization as a result of the information system.


this they describe six classes of IS/IT measurement variables: infusion measures, market measures, economic measures, usage measures, perceptual measures, and productivity measures. Infusion measures capture the extent to which IS/IT permeates the organization. Market measures are utilized to capture the reactions of customers (both internal and external to the firm) to utilizing IS/IT. Economic measures attempt to capture the effect of IS/IT toward generating financial or productivity improvements in the organization. Usage measures capture an individual’s actual use of an information system. Perceptual measures are used to capture the attitudes and beliefs of users toward utilizing an information system. Finally, productivity measures capture the extent to which the use of an information system enhances the productivity of an individual within an organization.

There are many notable examples of IS/IT performance indicators that have been utilized in prior research. Armstrong and Sambamurthy (1999) developed the construct of IT assimilation which measures the effect of IT in supporting, shaping, and enabling firms’ business strategies and value-chain activities. Hitt and Brynjolfsson (1996) compare several objective indicators of performance. Work has also been done to measure the effect of IS/IT in improving organizational performance in terms of productivity (Hitt and Brynjolfsson, 1996), accounting ratios (Barua, Kriebel, and Mukhopadhyay, 1995, Hitt and Brynjolfsson, 1996), market-based measures (Dos Santos, Peffer, and Mauer, 1993), and Tobin’s Q (Bharadwaj, Bharadwaj, and Konsynski, 1999). Finally a subjective method of assessing the business value generated by IS/IT has been developed (Tallon, et al, 2000). For the purposes of this study, we adopt perceptual measures of IS/IT performance as reported by IS/IT executives.
The Competitive Environment

Much work has been done in the strategic management literature to describe different elements of the competitive environment that firms compete within. Dess and Beard (1984) describe three characteristics of an organization’s task environment that are particularly interesting: munificence, dynamism, and complexity. Munificence speaks to the capacity of the environment in terms of the amount of growth can be maintained in the environment. Dynamism refers to the degree of industrial instability or turbulence. Complexity refers to the level of heterogeneity in the tasks that are performed by organizations in an industry. Miller and Friesen (1977) offer a complementary view of an organization’s competitive environment. They assert that the competitive environment can be characterized in terms of dynamism, hostility, and heterogeneity which correspond to Dess and Beard’s factors of dynamism, munificence, and complexity, respectively.

There are several contingency factors which are likely to influence the structuring choices an organization might make. Information technology is particularly dynamic for organizations. IS/IT is dynamic both in terms of the technological options available to firms for adoption, and in terms of the technological demands IS/IT customers and users place on the IS/IT function. Because of the volatile nature of information technology, we will examine the effects of volatility on the structural choices firms make with respect to IS/IT.

RESEARCH METHODOLOGY

The objectives of this study have been to develop conceptualizations of IS/IT functional structure and some grounded propositions about the relationships among structuring dimensions, organizational demands for IS/IT economies, and environmental
volatility. Rich conceptualizations create an understanding of functional structure that captures the complexity inherent in the construct. We endeavored to create conceptualizations that are inclusive of all types of functional structure. The conceptual development of the functional structure dimensions presented in the previous section and subsequent functional structure framework provide such conceptualizations.

Additionally, we set out to maintain a level of generalizability in our conceptualizations in order to capture patterns of functional structure configurations across organizations. In order to simultaneously address each of these objectives, we undertook a study of 10 large organizations over the course of the last four years. In the next section, we report the results of our efforts to conceptualize functional structure and some grounded propositions relating three configurations of structure.

The Participating Firms

Specific characteristics of the participating firms can be found in Table 1. Due to extensive interactions among executives from each firm in a series of interviews and CIO focus group meetings, we have selected organizations from different industries. In all, there are seven different industries represented. None of the companies that are classified in the same industries are considered competitors. In many cases, the participating firms were suggested by peer organizations, as a consequence of the firm and IS/IT executive’s reputation for excellence among the participating firms. In addition to the diversity of the firms with respect to industry, the firms are quite diverse in terms of many organizational characteristics. Annual sales range from a low of $650 million to a high of $50 billion. IS/IT spending as a percentage of sales ranges from 1.0% in two of the firms to as much as 12% in a firm competing in a particularly information intensive industry. Actual
spending on IS/IT in these firms ranges from a low of around $15 million to more than half a billion dollars. The firms are diverse in terms of organizational structure and number of business units, total number of employees and total number of IT employees.

<table>
<thead>
<tr>
<th>Company</th>
<th>Industry</th>
<th>Annual Sales ($ Millions)</th>
<th>IT Budget/ Sales (%)</th>
<th># of Business Units</th>
<th># of Employees</th>
<th># of IT Employees</th>
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<tr>
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<td>28</td>
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<td>B</td>
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<td>2</td>
<td>10,000</td>
<td>1,100</td>
</tr>
<tr>
<td>D</td>
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<td>6</td>
<td>57,000</td>
<td>600</td>
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<tr>
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<td>3</td>
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<tr>
<td>F</td>
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<td>G</td>
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<td>4,000</td>
<td>NA</td>
</tr>
<tr>
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<td>Wholesale/Retail</td>
<td>650</td>
<td>2.3</td>
<td>4</td>
<td>1,200</td>
<td>50</td>
</tr>
</tbody>
</table>

Data Gathering

Data for this study was collected in a variety of ways in a number of different settings. These can be categorized as large group meetings with the CIOs of the companies, large group meetings with other senior IT executives in the partner firms, on-site interviews with senior IT executives in each firm, and responses to short questionnaires. Several large group meetings were held over the course of three years to discuss topics related to the management of the IS/IT function. As part of these meetings, executives offered insights into the conceptual development of the functional structure construct.

A number of on-site interviews were conducted during this same time period. These interviews were conducted with the CIO’s from the participating firms as well as other senior IS/IT and business executives within those same organizations. These interviews were typically open-ended designed to gain as much insight from the organizations as possible. Some of the more recent interviews were more focused in
nature as we attempted to get specific feedback on the refinement of the IS/IT functional structure concept. Both the large group meeting and on-site interviews were extremely important to the conceptual development of the functional structure dimensions and the construction of the structure profiles.

**CONFIGURATIONS OF STRUCTURE AND GROUNDED PROPOSITIONS**

We assert that although it may be valuable to examine the underlying structural constructs separately, or by looking at bivariate correlations among the constructs; the different dimensions of IS/IT functional structure may be more profitably studied in a holistic, multivariate fashion. This is clearly the same argument Miller (1986) makes concerning the relationship between organizational strategy and structure. It seems clear that the choices managers make with respect to the underlying constructs are not completely independent of each other. These choices are likely to be related both because choices across the structural dimensions must be internally consistent (e.g. a firm may choose a centralized organizational structure to facilitate the ability to create and enforce a high level of formalization) and because the factors which influence appropriateness of structural choices may impact the different dimensions in a consistent manner (e.g. the environmental conditions dictate that a centralized structure, a high level of formalization, and a low level of complexity). Because the different dimensions of IS/IT structure are not independent it is valuable to study the IS/IT functional structure concept utilizing a multi-variate approach.

**Configurations of IS/IT Functional Structure**

We have determined to take a multi-variate approach to studying IS/IT functional structure. We have two conceptual options for determining how the underlying
dimensions fit together to create configurations of IS/IT functional structure: taxonomy
and typology (Venkatraman, 1989). A taxonomy is a somewhat theory-less empirically
driven approach to identifying configurations. In this approach a researcher collects data
about the variables of interest and then utilizes a statistical technique, such as cluster
analysis, to let the data identify configurations based on correlations between variables.

The development of a typology is a logic driven activity. Below, we develop a
typology of IS/IT functional structures based on technical complexity, organizational
complexity, technical formality, organizational formality, technical centrality, and
organizational centrality. Doty and Glick (1994) explain that the development of a
typology is an exercise in the creation of theory on at least two levels, grand level
theories relating the individual types to a dependent variable and mid-level theories
concerning the relationships of the individual elements of the typology with each other.
The grand theories of our research are represented by our overall research model (Figure
1). The mid-range theories are embedded as the logic presented to justify the existence of
each of the archetypes of structure, described below.

Often a typology is created using what we term to be bottom-up logic. That is the
researcher identifies a set of dimensions about a particular topic of interest and then
specifies all of the possible configurations of those dimensions. Each unique combination
is considered a separate type of the phenomenon of interest. For example, if there were
two possible states for each of the six main variables in the study, then taking a bottom-
up approach, we would identify 64 possible types of IS/IT functional structure.

Because, as argued above, we believe that the different dimensions of architecture
are not completely independent of each other and we also argue that many of the 64
“possible” architectural configurations are very similar to each other; we have adopted a top-down approach to specifying a typology of architectures to generate a parsimonious set of architectural types which are distinct from each other. Utilizing the different economy foci that IS/IT executives may have in the IS/IT function as a framework, we identify four distinct types of IS/IT functional structure. In this context, we identify the configurations of the IS/IT functional structure dimensions which are best positioned to create the given economy. The result is a set of three “ideal types” of IS/IT functional structure which are most appropriately positioned to meet its respective economy focus and one type which is not associated with the pursuit of an economy.

**Contingency Theory and Contingency Factors**

Proponents of structural contingency theory (Chandler, 1962, Donaldson, 1996) present arguments for determining when a given organizational configuration, or structure, is most appropriate for a firm to adopt. This work examines the impact of internal and environmental characteristics, or contingency factors, on the optimal structure of the firm. Work in structural contingency theory has identified organizational strategy, size, task uncertainty and technology (Donaldson, 1996) as well as the information processing needs of an organization (Galbraith, 1977; Tushman and Nadler, 1978) as contingency factors. Structural contingency theory presents the argument that contingencies are not necessarily completely deterministic. Managers make decisions on the configurations of their organizations in response to these contingency factors. Those organizations with the best fit between these contingency factors and structure will perform better than the competition.
We group the contingency factors which influence the appropriateness of the IS/IT structural position into two groups: those which are related to the economy focus of the IS/IT function; and those which are related to environmental volatility. Specifically, we propose the detailed research model described in figure 4. We propose two sets of grounded propositions. In the first set, we describe direct effect of fit between economy focus and structural profiles and IS/IT performance. The second delineates the expected moderating relationship of environmental volatility on the fit performance relationship.

**Figure 4 – Detailed Research Model**

![Figure 4 – Detailed Research Model](image)

**Fit Between Economy Focus and IS/IT Performance**

Table 2 outlines the expected profiles of IS/IT structure variables for each economy focus. Each of the profiles represents a distinct type of IS/IT functional structure. Below we describe each of the types of IS/IT functional structure.

**Local Structure**

The local structure is most appropriate for those organizations with an economy of scale focus. As described above, economies of scale result from reducing costs associated with acquiring and supporting technologies. The local structure is characterized by low levels of organizational formality and organizational centrality. In other words, the IS/IT function is relatively decentralized in terms of IS/IT decision-making. Such organizations have moderate levels of organizational complexity, which
typically have a large number of different organizational IS/IT elements, but relatively few imposed relationships among these elements. From a technical perspective, local structures employ moderate levels of technical centrality characterized by centralized control of technical platform and systems software decisions, but relatively decentralized control of data and application decisions. Technical formality is typically moderate in organizations with local structures as written specifications are developed to guide platform and systems software decisions. Finally, technical complexity is relatively low because there are a limited number of platforms and systems software configurations supported and a limited amount of integration results in few relationships among technical elements.

Table 2 – Profile Archetypes of IS/IT Functional Structure

<table>
<thead>
<tr>
<th>Structure Variable</th>
<th>Local Structure</th>
<th>Partner Structure</th>
<th>Uniform Structure</th>
<th>Ad Hoc Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical complexity</td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>?</td>
</tr>
<tr>
<td>Organizational complexity</td>
<td>Moderate</td>
<td>High</td>
<td>Low</td>
<td>?</td>
</tr>
<tr>
<td>Technical formality</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>?</td>
</tr>
<tr>
<td>Organizational formality</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>?</td>
</tr>
<tr>
<td>Technical centrality</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>?</td>
</tr>
<tr>
<td>Organizational centrality</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>?</td>
</tr>
</tbody>
</table>

**Partner Structure**

The partner structure is most appropriate for those organizations with an economy of scope focus. As described above, economies of scope result from utilizing IS/IT related capabilities in different organizational settings. Organizations utilizing the partner structure typically have a moderate level organizational centrality. In other words, the IS/IT function is balanced in terms of IS/IT decision-making with some decisions controlled by the corporate IS/IT function and some controlled by business units. The partner structure is characterized by moderate levels of organizational formality, where some organizational elements and relationships among elements are specified by written
policies or guidelines. Such organizations have high levels of organizational complexity, which typically have a large number of different organizational IS/IT elements and imposed relationships among these elements. From a technical perspective, partner structures employ moderate levels of centrality, formality, and complexity. Corporate IS/IT and business units each control elements of the technology decisions in the firm resulting in written specifications for those elements which are controlled by the IS/IT function. Moderate levels of complexity result from the fact that there are moderate numbers of technologies utilities in the firm and some imposed integration among these elements.

**Uniform Structure**

The uniform structure is most appropriate for those organizations with an economy of integration focus. As described above, economies of integration result from creating firm specific technology assets to optimize IS/IT processes. The uniform structure is characterized by high levels of organizational formality and organizational centrality. In other words, the IS/IT function is relatively centralized in terms of IS/IT decision-making. Such organizations have low levels of organizational complexity, which typically have a small number of different organizational IS/IT elements and few relationships among elements because of the similarity of the elements and the high level of formalization. From a technical perspective, uniform structures employ high levels of technical centrality characterized by centralized control of technical decisions. Technical formality is typically high in organizations with a uniform structure as written specifications are developed to guide technology decisions. Finally, technical complexity
is relatively low because there are a limited number of technologies supported and a limited number of relationships that need specification.

**Ad Hoc Structure**

Some organizations have a relatively indistinguishable economies focus. These organizations are likely to adopt an ad hoc functional structure. Ad hoc structures are characterized by relatively little coherence in the patterns of structuring variables.

**Research Propositions**

Since we argue that economy focus has a significant impact on the appropriateness of a given IS/IT structural position, we assert that organizations which adopt the ideal type IS/IT architectural position will experience higher levels of IS/IT performance than those which do not. Specifically, we propose the following:

- Proposition 1a - In organizations with an economy of scale focus, having a local structure is associated with higher IS/IT performance than having other structural types.
- Proposition 1b - In organizations with an economy of scope focus, having a partner structure is associated with higher IS/IT performance than having other structural types.
- Proposition 1c - In organizations with an economy of integration focus, having a uniform structure is associated with higher IS/IT performance than having other structural types.

Additionally, we assert that the competitive environment may contain significant contingency factors. As the volatility of the competitive environment increases, IS/IT must be more flexible and responsive to both technological change and changes in the business demand for IS/IT. Because some of the structural positions are more responsive than others, we expect that the relationship between structural choice and IS/IT performance is moderated by the level of volatility in the competitive environment of the
organization. That is in stable environments, we expect that matching structural
dimensions with economy focus is most optimal. In extremely volatile environments, we
expect that the adoption of the most flexible and responsive structures will be positively
associated with IS/IT performance. Specifically, we present proposition 2.

Proposition 2 – The volatility of the competitive environment moderates the
relationship between IS/IT functional structure and performance in that those
organizations that compete within extremely volatile environments must employ a
responsive structure regardless of economy focus.

CONTRIBUTIONS AND FUTURE RESEARCH

This research makes at least two important contributions to the body of
knowledge in IS/IT research. First, it increases our conceptual understanding of the
construct of IS/IT functional structure. Second, we provide a framework from which
future research can be executed with a clearer understanding of IS/IT structure and the
relationship of structure to the firm and competitive environment.

Underscoring the arguments presented in the description of the structuring
configurations, is the proposition that there are optimal IS/IT structuring choices
managers should make given different organizational and environmental contingencies.
The set of hypotheses which are embodied in these propositions must be validated in
subsequent empirical research. These hypotheses include those we present in this paper
related to organizational synergies and environmental volatility. There are other factors
that likely influence the appropriateness of an IS/IT structuring position. Additional
research should be conducted to identify these factors and illustrate the effects of these
contingencies on the appropriateness of organizational choices. Finally, we expect our
operationalization of the structure constructs to become a valuable language which
executives and researchers can utilize to communicate about these constructs.
Operationalizing IS/IT Functional Structure

To extend the work presented in this paper, we are working to empirically validate the proposed propositions. We are in the process of collecting survey responses from large companies to determine each firm’s position with respect to technical and organizational structuring positions. Using the data described above and an independent measure of IS/IT performance, we assess this relationship with regression techniques. After classifying each organization with respect to the economies, we will measure the Euclidean distance between each organization and the structural types that we hypothesize to be most appropriate for that organization given the profile economies. We expect to find that the distance measure between the actual and the ideal types of structure to be significantly, and inversely, related with IS/IT performance.

REFERENCES


Dos Santos, B. L., Peffers, K., & Mauer, D. The impact of information technology investment announcements on the market value of the firm. *Information Systems Research, . 4*, p1-23.


Operationalizing IS/IT Functional Structure


