11-30-2009

An Information-Processing Perspective of IS-Business Integration: A Review of Research and a Conceptual Model

Miguel I. Aguirre-Urreta
DePaul University, maguirr6@depaul.edu

Follow this and additional works at: http://aisel.aisnet.org/sprouts_all

An Information-Processing Perspective of IS-Business Integration: A Review of Research and a Conceptual Model

Miguel I. Aguirre-Urreta
DePaul University, USA

Abstract

This paper presents a review framework of research related to inter-departmental integration, with a focus toward research into the IS-business relationship. While much of the literature reviewed lies outside the Information Systems realm, it is proposed here that related research in other business disciplines has much to contribute to the current interest in the integration between the Information Systems function, and line management in organizations. The main contribution of this manuscript lies in the identification of an appropriate theoretical base that can be employed in the study of this relationship.

Keywords: IS/Business integration, information processing theory, differentiation, information processing requirements, information processing capacity

AN INFORMATION-PROCESSING PERSPECTIVE OF IS-BUSINESS INTEGRATION: A REVIEW OF RESEARCH AND A CONCEPTUAL MODEL

ABSTRACT

This paper presents a review framework of research related to inter-departmental integration, with a focus toward research into the IS-business relationship. While much of the literature reviewed lies outside the Information Systems realm, it is proposed here that related research in other business disciplines has much to contribute to the current interest in the integration between the Information Systems function, and line management in organizations. The main contribution of this manuscript lies in the identification of an appropriate theoretical base that can be employed in the study of this relationship.

INTRODUCTION

Past research conducted in an attempt to link some attributes of IT or the IS function and firm performance has largely concentrated on two main areas: the competitive advantage to be derived from strategic applications, and the relationship between investments in information technology and firm performance, both meeting with mixed results. The earlier research stream (e.g. Ives and Learmonth, 1984; Bakos and Treacy, 1986) argued that specific technologies could amount to a source of sustained competitive advantage, by either improving cost positions, scale economies, improved power relations with customers and suppliers (Porter, 1985) or by creating switching costs. The limitations of this approach have been conceptually critiqued based on the inability to inhibit or avoid replication, and the increased costs that may occur when trying to enforce switching costs strategies (Mata, Fuerst and Barney, 1991).

Alternatively, researchers have tried to measure the impacts of information technology in a macroeconomic context, focusing on the relationship between dollar investments in information technology and a variety of performance measures such as firm productivity, profitability, and customer surplus; both at an aggregate level, meeting with mixed success (for a review of this research stream see Brynjolfsson and Hitt, 1996 and Kohli and Devaraj, 2003). However, since this relationship, even if positive, does not specify the causal mechanisms by which information technology is put to use, researchers have recently turned to more granular approaches in search of a more detailed description of the intermediate impacts that link information technology and firm performance.

A review of research on IS-business partnerships

While the ability to effectively harness the power of Information Technology as an element of competitive strategy has long been a standing issue with both academic researchers and practitioners, the role of the partnership between the IS function and other departments of the firm, also referred to as integration, was really brought to the forefront by a series of articles in the practitioner-oriented literature in the early nineties. In their exploration of the role of IT in the 1990s, Rockart and Short (1989) highlighted the role of IT in achieving integration both within the value chain of the organization and between functional areas, and a required degree of partnership between the line businesses and their IT organizations regarding the design and implementation of new systems. This integration would in turn require greater competence and skills from the IT organization, a seamless infrastructure, and cross-functional education involving both IT and line managers regarding aspects of the other's function.

The concept of partnership was explored in more detail by Henderson (1990), whose review forms the basis of most later academic research on the subject. He distinguished between *partnership in context* (which involved the degree to which the partners believe that it will be sustained over time) and *partnership in action* (the ability of partners to influence policies and decisions that affect the operational performance of the partnership). The former is determined by the extent to which partnerships achieve mutual benefits (financial, innovation, risk sharing, and improved working environment), and their level of commitment (shared goals, incentive systems, and contracts) and predisposition (trust and existing attitudes and assumptions). On the other hand, partnership in action reflects shared knowledge, mutual dependency on distinctive competencies and resources, and organizational linkage (process integration, information integration, and social networks). While, as it will be shown later, many of these received some

attention from academic researchers, Henderson (1990) also identified six different actions to be taken in order to build and sustain a partnership, which have not been extensively investigated. These included education, joint planning, measurement and control, effective use of teams, multilevel human resource strategy, and technology. The need to develop strong and on-going partnerships between IT personnel and line managers has been established as one of eight imperatives in which IT organizations must excel if they want to be successful in an increasingly complex environment (Rockart, Earl and Ross, 1996). In this relationship, both partners need to work together to understand business opportunities, determine needed functionality, choose among technology options, and determine situations where business need must come before technical excellence. These steps do closely resemble the first two stages depicted in NEBIC, those of choosing technologies and matching them with economic opportunities (Wheeler, 2002). The authors also emphasize that the key users of information technology are functional, product and geographical line managers (Rockart et al, 1996). These then become the other side of the partnership including the IS function, and thus set the scope of the discussion for the remaining of this paper. These groups are what one would colloquially refer to as "the business".

The work of Ross, Beath and Goodhue (1996) also had a significant impact with their characterization of the IS-business partnership as one of three IT assets, that firms must build and leverage to generate sustainable competitive advantage. Finally, Feeny and Willcocks (1998) characterized nine different core IS capabilities in terms of the skills required to achieve them, their time horizon, and motivating values. Here, business systems thinkers require high business, and medium technical and interpersonal skills, are focused on strategy (how does the business add value, and how could it create more) and are concerned with protecting and developing the long term position of the organization, whereas successful relationship builders exhibit medium

business and high technical and interpersonal skills, are focused on the present, and address issues of structure and individual roles and goals.

It is quite clear, then, the importance that the practitioner-oriented literature has ascribed to the partnering relationships between the IS function and the business side of organizations. Academic research, however, has somewhat lagged in this area and has yet to produce a comprehensive characterization of the concept and its multiple dimensions, for it appears that this construct is definitely not unidimensional. In what has come to be an oft-cited piece of conceptual research in the IS literature, Mata et al (1995) provided an analysis of the potential of four attributes of information technology to build and sustain competitive advantage. Employing a resource-based perspective, the authors concluded that only managerial IT skills had the potential to create a competitive advantage that would not be easily replicated, because of their often tacit nature, path-specific dependencies and social complexity. Cited examples of these skills included the ability to understand and appreciate business needs, to work with the business in the development of appropriate applications, to coordinate IT activities in a way that would support the business, and the ability to anticipate future IT needs. The extent to which these skills are actually heterogeneously distributed across firms and thus be a source of competitive advantage is an empirical question that has yet to be examined. However, this research provided a strong conceptual argument for the importance of looking into these skills in search of the role of IT in creating competitive advantage.

The limited empirical research so far conducted on IS-business partnerships has chosen to emphasize only a small number of the several potential dimensions and mechanisms identified by the practitioner literature, and has tended to focus on the shared and cross-functional knowledge and organizational linkage aspects of the relationship. In an early study, Nelson and

Cooprider (1996) provided evidence that shared knowledge (e.g. understanding and appreciation, both in turn a function of mutual trust and influence) had a positive effect on the performance of the IS group. Reich and Benbasat (2000) also looked at the importance of shared domain knowledge, together with implementation success, communication between IT and business executives, and connections between business and IT planning processes. The authors found that all four factors had a positive impact on short-term alignment between business and IT, but only shared domain knowledge affected long-term alignment. Another stream of research also examined the business and IT competence of managers and IT personnel and their various impacts. Thus, IT competence of business managers is proposed to lead to both improved intentions toward line technology leadership, and actual partnerships with IT people (Bassellier, Reich and Benbasat, 2001); and together with IT experience toward increased intentions to champion IT in their area of influence (Bassellier, Benbasat and Reich, 2003). On the other hand, business competence present in IT professionals has a positive influence in their intentions to form future IS-business partnerships (Bassellier and Benbasat, 2004). Alternatively, business-IS linkages have been proposed to indirectly (through knowledge integration) influence the systems development capability of organizations, characterized in terms of fit with business needs and development flexibility (Tiwana, Bharadwaj and Sambamurthy, 2003). However, a more complete characterization of the IS-user partnership (Subramani, Henderson, and Cooprider, 1999; based on Henderson, 1990) only met with limited success in establishing the relationship between these partnerships and IS service and operational performance measures.

More recently, information systems researchers have begun to establish relationships between IT capabilities or competence and some measures of firm performance, even if fully mediated by other variables. Then, IT competence in new product development, through

reconfigurability and alignment, has a positive effect on achieved competitive advantage (Pavlou and El Sawy, 2004). Strategic alignment does also mediate an IT capability (infrastructure flexibility) and its impact on firm performance (Tallon and Kraemer, 2002). Ravichandran and Lertwongsatien (2005) hypothesized, and found, a positive but indirect relationship between IS resources and firm performance. In this case, IS human capital, infrastructure flexibility, and partnership quality, operating through IS capabilities (planning, development, and operations) and IT support for core competencies (market-access and functionality-related) affected firm performance, as evidenced by both subjective and objective measures. Here internal partnership quality was measured as a function of shared knowledge, understanding of the working environment, trust, joint planning, and interdepartmental conflict (or lack thereof).

In their extensive review of Information Systems research employing the resource-based view of the firm, Wade and Hulland (2004) characterized IS-business partnerships as representing the processes of integration and alignment between the IS function and other functional areas of the firm. Eight of the studies included in the review formed the basis for the definition of this construct. It should be noted, however, that name and definitions vary quite significantly from article to article. For instance, Powell and Dent-Micallef (1997) talk about "*Integration of IT planning with the overall goals, strategies, and strategic planning processes of the firm*" (p. 384), while Ravichandran and Lertwongsatien (2005) emphasized issues of conflict and timeliness of information in their measure of internal partnership quality, which was found to be a strong determinant of IC capabilities. Bharadwaj, Sambamurthy and Zmud (1998) measured IT-business partnerships in terms of sponsorship, climate, and educational initiatives, and found it to be an important component of the overall IT capability of a firm. Thus, there is a growing amount of empirical research, generally rooted in the resource-based view of the firm,

the highlight the important impact of IS-business partnerships in various measures of either IT or overall firm performance. On the other hand, the conceptualization of IS-business relationships as a resource or capability has not lent itself to research on the antecedents and mechanisms involved in achieving such integration, nor to the level of integration between functions that would be most appropriate under difference organizational contexts. While, intuitively, integration or partnership between the IS function and the business side is beneficial to the organization, to the extent that it is costly to achieve such a state it is interesting to understand what and how the required amount of partnership is required.

Alternatively, it is possible to conceptualize fostering integration between the IS function and the rest of the organization to a degree that allows the system to process the amount of information that is required by a variety of external and internal factors. That is the basic premise of conceiving of organizations as information processing systems, as developed by Galbraith (1974) and others. In addition, adopting this perspective allows information systems researchers to benefit of a significant amount of scholarship in other, related fields, that has already examined some of the linkages between functional areas of the firm (marketing, in particular). Thus, the main objective of this paper is to review past research related to the integration of functional areas and propose a model, grounded in the information processing theory of the organization, to guide future research in this area.

The rest of this manuscript is organized as follows. Next, a review of information processing theory, together with its usage in past information systems research, is presented, followed by a discussion on why the notion of integration, required and achieved, is central to the proposed model. Afterwards, past information systems and research in related business disciplines is presented to form the basis of a comprehensive picture of the mechanisms by

which integration is needed and achieved by organizations. Finally, directions for future research are noted.

INFORMATION PROCESSING THEORY

The review on this section is based largely on the works of Galbraith (1977), Tushman and Nadler (1978) and Egelhoff (2005). An early distinction should be made between the theoretical position reviewed here and other frameworks that emphasize cognitive views of organizational information processing (e.g. Daft and Weick, 1984). In those perspectives, while environmental conditions may still be the stimulus of information processing, the emphasis is placed on the influenced of what occurs within the individual (i.e. psychological determinants) and between individuals (social-psychological determinants). In contrast, information-processing theory is represented in terms of the capacities of different kinds of organizational structures and processes to transfer information within an organization. This perspective has also been referred to as the logistical view of organizational information processing. The cognitive perspective addresses how strategic decisions are made, while the logistical perspective tries to explain the information capacities inherent in the organizational design, and evaluate them against requirements for information processing.

The information-processing view of the organization rests on the basic premise that, the greater the uncertainty of the task, the greater the amount of information that has to be processed by decision makers. Although theorists viewing the organization from this perspective have traditionally considered environmental uncertainty to be the key contingency, later the list of factors has been expanded to include characteristics of the task, the relationship between subunits, and organizational strategy adopted by the organization. Although all these are likely

influenced by environmental uncertainty, they mediate the direct effect of the latter on the need to process information. The key intervening concept, information processing, can be defined as including the gathering of data, the transformation of data into information, and the communication and storage of information in the organization. It also relies on the basic contingency notion that the structure and processes of an organization should match or fit characteristics of certain variables both inside and outside the organizational system, and that those organizations that manage to accomplish this fit would be rewarded in performance as compared to those that do not. Finally, information-processing theory assumes that, as organizations grow, they differentiate to realize the benefits of economies of scale and specialization, . At any time, these subunits are interdependent in varying degrees and must share scarce resources. Thus, the basic unit of analysis is the subunit, the basic structural problem is to design subunits and relations between subunits capable of dealing with information processing requirements faced during task execution. The general information-processing approach to organizational design is depicted in Figure 1.
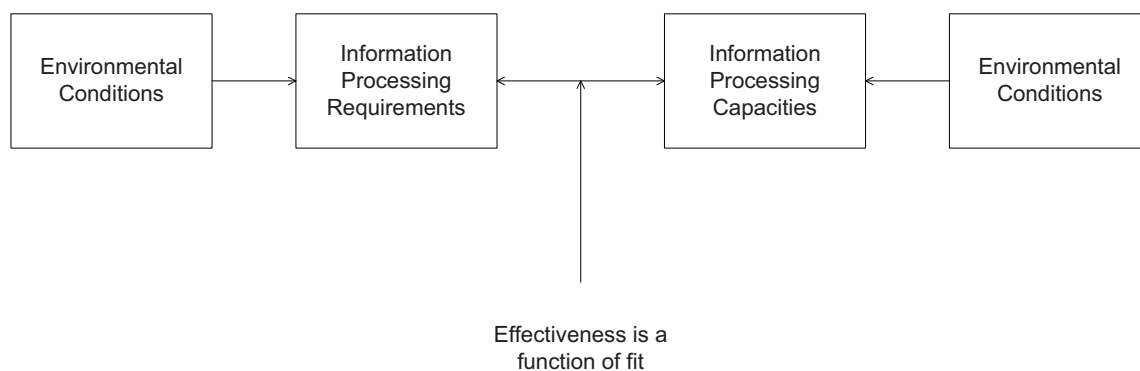

Figure 1. General Information-Processing Approach (Egelhoff, 2005)

On the one hand, the impact on an organization of its strategy and the environmental factors with which it chooses to deal can be expressed in terms of the *information-processing*

requirements they create. On the other hand, the potential of the organization to cope with these requirements can be expressed in terms of the *information-processing capacities* furnished by its organizational design. Instead of attempting to measure information processing directly, macro-level studies must use information processing as an abstract intervening concept to aid in positing relationships between directly measured characteristics of an organization's design and its strategy and environment, both of which have identifiable information-processing implications. In this article, in order to specify the dimensions that are being used to measure and evaluate information-processing capacities and requirements, the concept of inter-functional integration is put forward as a useful representation of the required and achieved information-processing capabilities between differentiated subunits. Before developing the notion of integration in more detail, a brief review of research in information systems employing this perspective is presented next.

Information systems research using Information-Processing Theory

Information-processing theory, somewhat surprisingly considering the role that information technologies could conceivably play in this arena, has received little attention as an underlying theoretical perspective for research. Nevertheless, it has recently been used in as varied settings as inter-organizational relationships (Premkumar, Ramamurty and Saunders, 2005), global information technology (Jarvenpaa and Ives, 1991), and intra-organizational diffusion of information technology innovations (Cooper and Wolfe, 2005).

In a case study of the diffusion of new imaging technology at a large financial corporation, Cooper and Wolfe (2005) focused on employing information-processing theory as a lens with which to examine the adaptation process of new technologies. The model suggests that

matching information processing volume and richness to uncertainty and equivocality reduction requirements of an IT innovation contributes to successful IT adaptation. Departmental interdependence and task variety were identified as sources of uncertainty, while departmental differentiation and task analyzability were related to equivocality. The experiences of the organization included a failed first phase of implementation, and a posterior success following a reframing of the original goals and objectives of the innovation. In addition, the authors were able to integrate information-processing theory with the innovation literature.

In an altogether different setting, Jarvenpaa and Ives (1993) studied how global information technology can support the multinational firm as it seeks to coordinate global operations, diffuse innovations worldwide, or provide integrated service to a global corporate customer. The authors identified three distinct strategic orientations (national responsiveness, efficiency, and shared learning) that implied different levels of environmental and task uncertainty and had varying requirements for information processing globally. Working from Bartlett and Ghoshal's (1989) general decision-making structures (multinational, global, international, and transnational) a set of four matching IT configurations were developed, varying in the locus of IT decision making, number of common systems, mode of operations, IT reporting relationships, and development approaches used. The main hypothesis of interest was the performance effects of appropriate matching of each multinational structure form to one of the developed IT configurations. Support was found for the prediction that firms reporting to follow different IT configurations exhibited different and distinctive ways of organizing IT worldwide. The second hypothesis, positing that a firm's global IT configuration would match the IT manager's perceived business structure of the firm, on the other hand, received only weak support.

Finally, Premkumar et al (2005) used information processing theory to examine the fit between information processing needs and information processing capability in an interorganizational supply chain context, and to examine its effect on performance. The authors examined information processing needs in the context of supply chain relationship, identifying a variety of factors (e.g. product description complexity, technology uncertainty, etc.) grouped under environmental uncertainty, and others (such as firm investment, supplier investment, and trust) as uncertainty about the relationship. On the information-processing capacities side of the fit relationship, the authors focused on IT support for procurement lifecycle activities, such as EDI (Electronic Data Interchange), Extranets, and Public e-marketplaces. Data collected through a survey of senior buyers or purchase managers from large manufacturing firms showed that the interactive effects of information-processing requirements and capacities had a greater effect on performance than that of main effects, providing support for fit theory. In particular, the authors developed their taxonomies of requirements and capabilities using cluster analysis, which represents a novel way of operationalizing this theory.

An examination of these three examples highlights that, while not extensively employed, information-processing theory in IS research has been rather successful in providing a useful theoretical lens to conduct empirical research in a variety of related areas. Attention now is turned to the usage of inter-departmental integration as the mediating conduit between processing requirements and capacities in the proposed model of IS-business relationships.

Inter-departmental integration

That inter-departmental integration can be critical in the ensuing success of the joint outcome was proposed in a seminal conceptual piece by Gupta, Raj and Wilemon (1986), who

focused on the integration between R&D and marketing in the innovation process. Afterwards, a substantial literature in both marketing and new product development focused on alternative causes for needing integration, and how to achieve it. The basic framework is reproduced in Figure 2. A substantial literature has used this or variations of this framework as a basis for research of the interface.
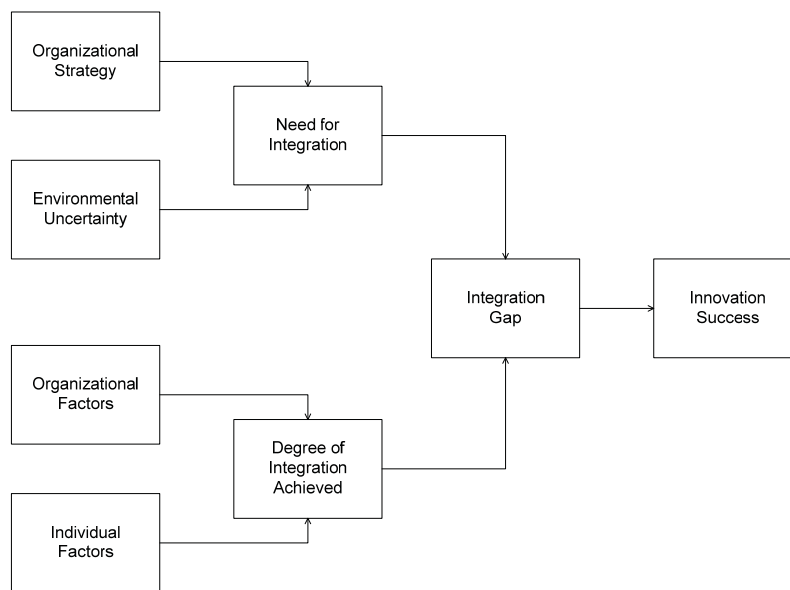

Figure 2. Model of the Marketing-R&D Interface (Gupta, Raj and Wilemon, 1986)

The authors of this perspective note the three overarching research questions that guided their propositions, which are echoed here and posited to be as critical for the studying of IS-business integration as they were for their original purpose:

1. How much integration is required? Do some firms require a greater degree of integration than others? What factors affect the degree of integration required between [IS and the business]?

2. How much integration is achieved? What factors affect the degree of integration achieved between [IS and the business]?

3. How does integration affect success? To what extent does the level of integration contribute to success?

In his review of the integration concept, Kahn (1996) noted the differential uses and definitions it has received in the literature. In particular, one stream of research focused on integration as interaction or communication-related activities, whereas other literature associated integration with collaboration. In the first case, emphasis is placed in the use of communication in the form of meetings and information flows between departments. The other literature portrayed interdepartmental integration as collaboration, where departments work together under common goals. From these definitions, interaction represents that structural nature of cross-departmental activities, it adds structure to how departments interrelate; collaboration, on the other hand, represents the unstructured, affective nature of interdepartmental relationships. Thus, interaction and collaboration can be construed as unique and independent processes (Kahn, 1996). Viewed from the perspective of information-processing theory, interaction and collaboration closely resemble processes that, in the former case, increase the capacities for information processing and, in the latter case, reduce the need for information to be processes. This mapping of the concepts to information-processing theory was not something that was discussed by the author, yet it provides a clear base for linking research involving integration to the framework proposed in this paper. However, Kahn (1996, Kahn and Mentzer, 1998) was close to this idea when the posited that the interaction (statistically speaking) of the interaction and collaboration perspectives on integration would have a strong direct effect on performance.

There are three important advantages to focusing on the concept of inter-departmental integration, as the main focus of interest in this model. First, from a theoretical standpoint, the integration/interaction/collaboration constructs closely resemble the elementary components of

information processing theory, as detailed above. Thus, the foundation for research in inter-departmental relationships rests on solid, theoretical ground; most importantly, the information-processing perspective offers the explanation for why observed empirical results, even if as hypothesized, can be expected to occur. Second, from a practical perspective, the notion of integration has substantive face validity, as it has surfaced recurrently in interviews with executives and senior managers, and is frequently included in practitioner-oriented publications as critical to the success of organizations. Finally, and also from a practical standpoint, basing the model on the integration construct allows IS research to take advantage of a substantial corpus of both conceptual and empirical literature, developed mostly in the marketing and R&D realms, that serves as a validated starting point for the analysis of the relationships between IS and the business. The following section details research on factors affecting the need for integration, while the section after discusses factors that create processing capacity.

FACTORS AFFECTING THE NEED FOR INTEGRATION

Figure 3 presents the proposed model of factors affecting the need for integration between the IS area and line management. All the relationships presented here are grounded in past conceptual and empirical research; however, most of them have not been examined in an information systems context.
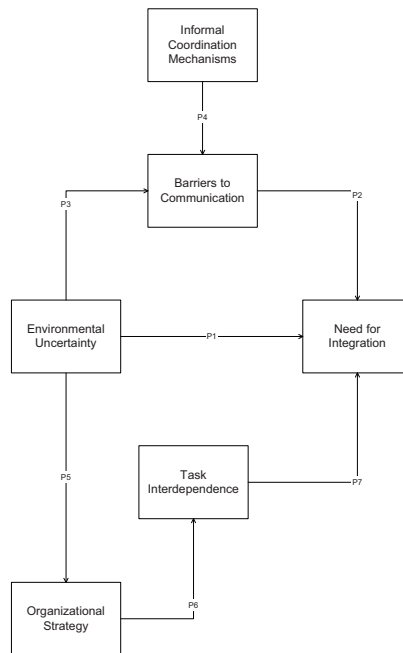
Figure 3. Factors Affecting the Need for Integration

Beginning with the early work of Tushman and Nadler (1978), three main influences affect the information-processing requirements of the organization. One of these factors, subunit task characteristics, relates to the internal organization of subunits in an organization. Since this model is concerned mostly with the relationships between subunits and not with the internal organization of any particular one, that force will not be considered any further.

A second factor that influences the need for integration is the task environment, represented in the model as environmental uncertainty. While this is a much debated and contested context, several authors (e.g. Galbraith, 1977, Tushman and Nadler, 1978, Egelhoff, 2005) consider environmental uncertainty to be a direct determinant of the need to process information. Even if dimensions of this construct do vary somewhat from study to study, in general, the following characteristics seem to be present in most definitions of the concept: number of environmental components with which the organization interacts or is dependent on, degree of similarity between relevant environmental components, degree to which relevant

environmental components remain the same over time, and degree of complexity of relevant environmental components (Mealiea and Lee, 1979). Proponents of the contingency theory of organizational design have emphasized the importance of environmental uncertainty in structuring the firm to cope with the various levels of information processing requirements. Thus, the following proposition about the relationship between environmental uncertainty and need for integration can be stated:

> *Proposition 1:* greater environmental uncertainty will be related to higher need for integration between IS and the business.

Alternatively, starting with the seminal work of Lawrence and Lorsch (1969), there has been growing consensus that, as environmental uncertainty increases, organizations engage in a process of differentiation or specialization, where subunits adapt to best meet the demands of their (sub)environment. Their overall argument can be simplified into three main principles:

- Organizational performance is determined by the organization's ability to cope with its environment.

- The degree of differentiation into subsystems is based on environmental requirements; each subsystem selectively adapts to that part of the environment most relevant to the subsystem.

- The degree of integration across subsystems is consistent with the requirements of the total environment.

The authors differentiated between basic subsystems such as sales, production, and R&D (this research was conducted in the early-mid sixties), and thus segmented the environment into market, technical-economical, and scientific. Their contention was that these subsystems would develop differently based on how they interacted with their particular sub-environment. More

precisely, Lawrence and Lorsch (1969) postulated that the varying attributes of subsystems would be, as they relate to the personal characteristics of the organizational members:

- Orientation of members toward others (social or task-oriented interpersonal orientations)

- Time orientation of members (dependent on the time needed to get feedback from the environment)

- Goal orientation of members (each subsystem would develop a concern regarding the goals of their specific environment).

Consistent with past literature (e.g. Khan, 1996; Moenaert and Souder, 1990), this factor is labeled Barriers to Communication. Strongly related to the differences identified by Lawrence and Lorsch (1969), these can include issues such as personality (including goals and aspirations, needs, and motivation; see Saxberg and Slocum, 1968), cultural thought worlds (e.g. Gupta, Raj and Wilemon, 1986) or language (in the sense of discipline-specific or technical jargon).

This is the area of the proposed model where IS researchers have focused the most so far. Boyton, Zmud and Jacobs (1994) examined the impact of managerial IT knowledge, a composite variable measuring IT management's knowledge of business units and line management's knowledge of the value and potential of IT, on IT use in three business units of a large organization, finding strong and significant effects. Nelson and Cooprider (1996) also found support for a model depicting shared knowledge, an understanding and appreciation among IS and line management for the technologies and processes that affect their mutual performance, as a direct antecedent to IS performance, fully mediating the effects of mutual trust and mutual influence on performance. Reich and Benbasat (2000) focused on the practices and antecedents to alignment between business and IT objectives, through a large set of semi-structured

interviews. Their resulting model includes shared domain knowledge and successful IT history as antecedents to communication between executives and connections between business and IT planning, which in turn jointly influence alignment. The stream of research led by Bassellier and Benbasat (Bassellier, Reich and Benbasat, 2001, 2003; Bassellier and Benbasat, 2004) focused on the effects of business managers' IT competence and business competence of IT managers on successful outcomes of IT, such as championing IT projects or, particularly important, intention to form IT-business partnerships. However, much research still needs to be conducted in this area. In particular, the three original issues identified by Lawrence and Lorsch (1969) have yet to be researched in the context of IT-business relationships. Still, it is possible to put forth two propositions regarding these relationships:

> *Proposition 2:* the degree of differentiation between IS and line management results in a greater need for integration across the two areas.
>
> *Proposition 3:* increasing environmental uncertainty results in increased differentiation between members of the two areas.

Coordination mechanisms have traditionally been classified into formal and informal, reflecting respectively the structural or affective nature of the processes involved in achieving coordination. As such, the latter closely resemble the collaboration dimension of integration developed by Kahn (1996). This group of mechanisms, also referred to as "subtle" include issues such as informal communication, cross-unit human resource practices, and organizational culture. More formal mechanisms include the roles played by task forces, permanent committees, or individuals in an integrator role. One important departure from traditional models in this paper is the argument that informal or subtle coordination practices affect integration through reducing the level of differentiation existing between members of the two areas, that is ultimately reducing

the need for integration; whereas formal mechanisms affect integration through an increase in the information-processing capacity of the relationship, ultimately increasing the achieved level of integration. Traditionally, both formal and informal mechanisms have been perceived as impacting the same dimensions. However, it is here argued that informal coordination practices do not necessarily increase the communication capacity of an organization, but rather reduce the need for communication to occur since participants in it share objectives, goals, and similar frames of mind, thus reducing the need for clarifications. A review of research in informal coordination mechanisms, both in IS and related areas, is presented next.

Khan (1996) highlighted, as possible outcomes of collaboration between departments, the following: collective goals, mutual understanding, informal activity, shared resources, common vision, and "esprit de corps". The author found strong and significant effects of collaboration on performance in many different relationships occurring between the manufacturing, R&D, and marketing areas. Similar results were found in the context of coordination between internal units of multinational organizations (Martinez and Jarillo, 1992). On the other hand, while showing a significant relationship between relocation and incentives and rewards, and integration between marketing and R&D, Leenders and Wierenga (2002) were not able to support a hypothesized relationship between informal social movements or personnel movement across departments and integration between those. Khan and McDonough (1997) also found an important relationship between collocation and integration and performance, but moderated by the type of relationship departments held with each other. In their review of the literature, Griffin and Hauser (1996) noted the important impact of informal coordination mechanisms, such as personnel movement and informal social systems on the reduction of conflict between areas.

Within the information systems realm, coordination mechanisms have not received a similar level of attention. However, the work of Brown (1998, 1999) has already started to explore some of this issues. The chosen methodology so far has relied on structured or semi-structured interviews with executives or small case studies, large scale surveys or fieldwork have yet to occur. Regarding human-resource practices for coordination, Brown (1998) found that three main practices were used by most of the interviewed executives: training and development initiatives directed at increasing cross-unit linkages, job rotations of a temporary nature implemented to provide cross-unit experience, and rewards and appraisal systems designed to motivate collaboration. There is also evidence (Brown, 1999) that the impacts of these coordination mechanisms may be dependent on the governance form, centralized or divisionalized, adopted by the organization. Some of the mechanisms reviewed there included physical collocation and interdepartmental events. In both studies, the underlying assumption was that horizontal mechanisms were implemented in order to remove barriers to cross-unit collaboration. Other related research looked at regular conferences and forums (DeSanctis and Jackson, 1994) and training and newsletters (Zmud and Lind, 1986) as informal communication mechanisms.

From the research detailed above, and keeping in mind the distinctive effects of formal and informal coordination mechanisms, the following proposition relates these to the need for integration, mediated by the degree of differentiation or barriers to communication present between departments:

> *Proposition 4:* informal coordination practices such as interdepartmental events,
>
> networking, personnel rotation and cross-unit training, will reduce the barriers to

communication between departments, indirectly reducing the need for integration between them.

Organizational strategy was also included in the original factor model proposed by Gupta et al (1986); however, no influence of environmental uncertainty was proposed. From the perspective developed here, and based on much contingency research, organizational strategy is shown as a function of environmental uncertainty. The most common characterization of organizational strategy employed in extant research has been that of Miles and Snow (1978). Miles and Snow argued that companies develop their adaptive strategies based on their perception of their environments. Hence, as seen above, the different organization types view their environments in different ways, causing them to adopt different strategies. These adaptive strategies allow some organizations to be more adaptive or more sensitive to their environments than others, and the different organization types represent a range of adaptive companies. Because of their adaptive strategies, prospector organizations are the most adaptive type of company. In contrast, reactor organizations are the least adaptive type. The other two types fall in between these extremes: analyzers are the second most adaptive organizations, followed by defenders. Since business environments vary from organization to organization, having a less adaptive strategy may be beneficial in some environments, such as highly regulated industries (for an interesting example relating organizational strategies, change and inertia in a regulated industry see Forte, Hoffman, Lamont and Brockmann, 2000).

On the other hand, prospector organizations clearly have an advantage over the other types of organizations in business environments with a fair amount of flux. Companies operating in mature markets in particular benefit from introducing new products or services and innovations to continue expanding. As Miles and Snow note, no single strategic orientation is the

best. Each one—with the exception of the reactor organization—can position a company so that it can respond and adapt to its environment. What Miles and Snow (1978) argue determines the success of a company ultimately is not a particular strategic orientation, but simply establishing and maintaining a systematic strategy that takes into account a company's environment, technology, and structure. From these considerations, it is possible to argue for a relationship between environmental uncertainty and the strategic orientation of an organization, such that:

> *Proposition 5:* the degree of perceived environmental uncertainty affects the choice of organizational strategy by the focal organization.

While the relationship between organizational strategy and task interdependence may not have been the focus of past empirical research, there is significant amount of evidence from the IS field that differences in strategic stances do impact the both the way the IS function is organized and what is required from it. An extension of this would require assuming that changes in organization and performance demands of a department would have an effect on its interdependence with other areas, which appears to be a tenable one. Early on, Tavakolian (1989) found that prospector and defender firms differ markedly on the degree of centralization present in there is units. Focus on diversification, economies of scale or scope, and exploitation strategy can also have strong effects on the structure of both the IS function and IS activities carried on inside the IS structure (Sambamurthy and Zmud, 1999; Brown and Magill, 1998, Brown, 1997). These studies also show evidence of the contingent relationship between strategy and environment uncertainty and structure. Based on the strategic orientations framework developed by Venkatraman (1989), Chan et al (1997) developed a corresponding of strategic orientation for the IS function, containing the same eight dimensions as the business orientation model. The authors found that alignment between the two perspectives, which included varying

degrees of IS support for external defensiveness, proactiveness, and aggressiveness, was a superior predictor of performance than actual realized strategy. Returning to the Miles and Snow (1978) typology, Sabherwal and Chan (2001) construed different IS profiles to match the requirements of the three strategic topologies (reactors were not considered) and found strong support for the performance effects of correspondence between specific IS profiles and strategic types. The different IS profiles differed in their main strategic orientation (efficiency, flexibility, and comprehensiveness), and in the level of support provided to the four main types of information systems in organizations: operational, market information, interorganizational, and decision support. The performance effects of this alignment issues were also the focus of research by Bergeron, Raymond and Rivard (2004), who found misalignment between business strategy, business structure, IT strategy, and IT structure, to be nefarious for firm performance. In sum, it seems reasonable to argue that the choice of organizational strategy (itself a consequence, albeit partially, of the task environment of the organization) has an effect on the types of activities and interdependence with other departments that need to be carried on by the IS function. The following proposition thus follows:

> *Proposition 6:* the choice of organizational strategy as a direct effect on the type and level of task interdependence required from the IS function.

The role of inter-unit task interdependence in the need to process information, here the need for integration, has been a long-standing proposition of information-processing theory. Tushman and Nadler (1978) argued that the degree to which a subunit is dependent upon other subunits in order to perform its tasks effectively is a source of uncertainty with implications even broader than task characteristics and task environment. To the extent that units or subunits are relatively autonomous of each other, there is little need for communication or coordination in

order to perform their activities effectively. As interdependence arises between units, increased needs for coordination are manifest, and ultimately influence the outcome of the, now joint, tasks. Thompson (1967) characterizes interdependence, in increasing order of complexity, as either pooled, sequential, or reciprocal. The theory suggests that the more complex the inter-unit interdependence, the greater the task uncertainty that must be deal with, and thus the greater the need for information-processing. The last proposition in this section is thus stated as follows:

> *Proposition 7:* as task interdependence increases, so does the need for integration between sub-units.

FACTORS AFFECTING THE ACHIEVEMENT OF INTEGRATION

Regarding factors that affect the level of integration that is achieved, there have traditionally been two, not necessarily alternative but complementary, lines of thinking. On the one hand, integration between departments is argued to be a function of the structure adopted by the organization, that is, issues or mechanistic vs. organic structures, or formalization, centralization and complexity. On the other hand, coordination, or capacity to process information, can also be achieved through formal mechanisms, such as committees, integrator roles, task forces, etc. Figure 4 depicts the factors affecting the achievement of integration between departments.
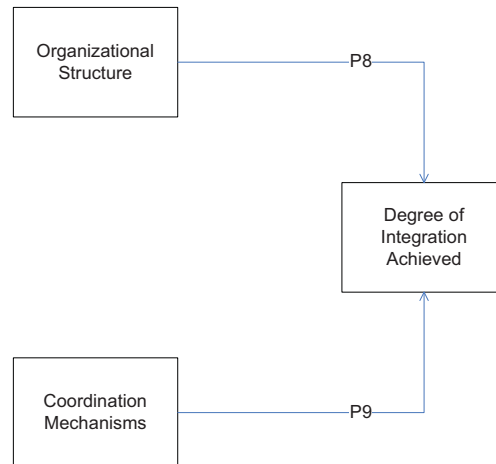
Figure 4. Factors affecting the degree of achieved integration

Regarding organizational structure, it is interesting to note that authors developing this relationship have tended to argue similar effects for many of the common structure variables, such as formalization or centralization; this occurs even leaving aside the troublesome structure-performance literature (Dalton, Todor, Spendolini, Fielding and Porter, 1980). On the one hand, Tushman and Nadler (1978) argue for the greater information-processing capacity of organismic, as opposed to mechanistic, structures. The authors base their proposition on the highly interconnected nature of communication networks present in these organizational forms which, since they are not dependent on a single individual, are resistant to information overload; they also tend to be associated with less formality, less attention to rules and regulation, and greater peer involvement in decision making (which could be interpreted as being less centralized). The authors also note that organismic structures are more costly (more time, effort, energy, and less subject to managerial control) than mechanistic ones, and thus benefits need to be balanced against other tradeoffs. A similar issue will be raised when discussing mechanisms for coordination and control; this points to the possibility of appropriately optimizing costs and benefits of providing information-processing capacity against the need for integration to reach an

effective compromise. Gupta et al (1986), on the other hand, argued for effects of formalization, complexity, and centralization, independently instead of as a form of organizational structure, as previously discussed. In this case, less formalization leads to greater integration, because increased formalization and stringent rules and regulations can impair information flows between professionals; less (specialized) complexity leads to a higher degree of integration; and finally increased employee participation and a more diffused concentration of power lead to a greater degree of integration to be achieved. An empirical test of their arguments, however, met with limited success as to the effects of organizational structure variables on achieved integration (Parry and Song, 1993). However, based on the extent of theoretical development on these issues, the following propositions can be stated (note that propositions 8a, 8b, and 8c are taken from Gupta et al, 1986):

> *Proposition 8:* organizational structure dimensions will have an impact on the level of integration that can be achieved.

>> *Proposition 8a:* the lower the degree of formalization in an organization, the greater the degree of integration that will be achieved.

>> *Proposition 8b:* the lower the concentration of power in an organization, the greater the degree of integration that will be achieved.

>> *Proposition 8c:* the greater the degree of employee participation in decision-making, the greater the degree of integration that will be achieved.

The other line of research in achieving integration, which has received significantly more attention than organizational-level variables, relates to coordination mechanisms. These have traditionally been divided into informal and formal. Informal coordination mechanisms aim at

reducing cognitive differences and integrating frames of reference between people in different areas or departments, and been included in this review in the section leading to Proposition 4. An important issue regarding these mechanisms is that, while they are posited to be the least expensive form of improving the fit between integration needed and achieved, they are also very dependent on individual participants. These socialization processes rely, to some extent, on the relative temporal permanence of organizational members within both their areas and the organization as a whole, rotation and turnover of personnel creates new individual gaps that need be closed. Formal coordination mechanisms, on the other hand, are standing roles that exist beyond the particular members that serve on them at any given point in time. Figure 5 shows different conceptualizations of these mechanisms by leading organizational researchers.
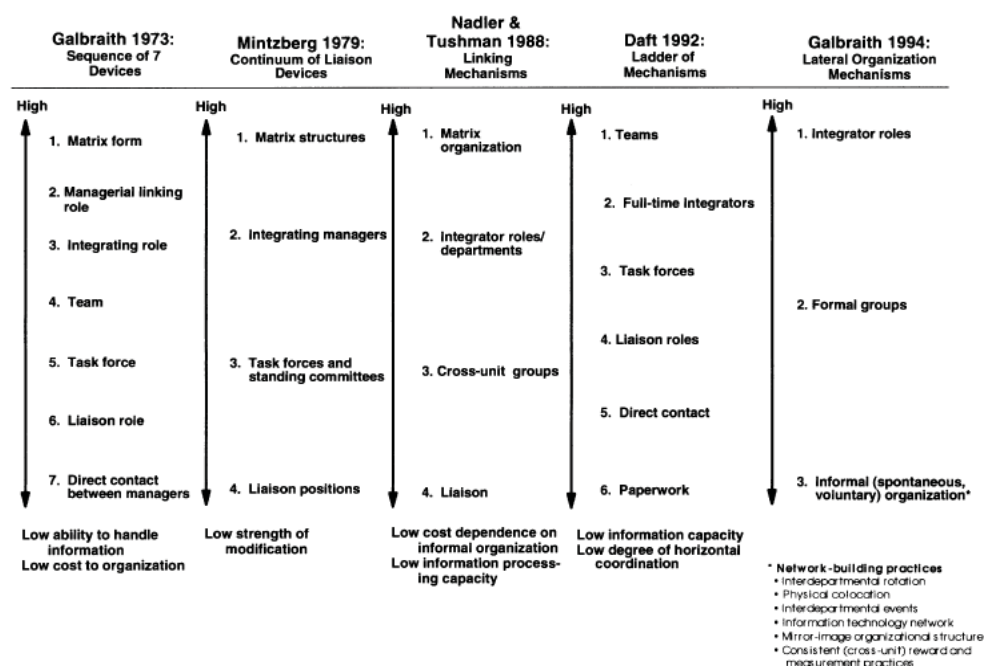
Figure 5. Continua of horizontal linking devices (from Brown, 1999)

It is important to note two issues from Figure 5. First, while there are some differences, there is relative agreement as to both the major types of integrating mechanisms and their relative position in the continuum of coordination capacity. And second, this ordering also

represents the relative of both implementing, operating and maintaining these mechanisms in an organization. This last issue points to the possibility of optimizing the usage of these mechanisms in response to a particular level of integration needed. It is not necessarily the case, as has been recognized by many of these authors, that all organizations would do well in being as integrated and coordinated as it is possible, to the extent that there are costs associated with achieving any given level of coordination, organizations should strive to only achieve the amount of integration and coordination that is required from the factors discussed in the section above, and not more nor less than that. The following proposition relates coordination and control mechanisms to information-processing capacity, or level of achievable integration:

> *Proposition 9:* different coordination mechanisms have different capacities for effective information processing.

THE FIT BETWEEN INTEGRATION NEEDED AND ACHIEVED

A significant amount of contingency literature reviewed above (e.g. Egelhoff, 2005; Galbraith, 1974; Tushman and Nadler, 1978; Lawrence and Lorsch, 1969) supports the performance effects that arise from adequate fit between contingency-level variables, in this case information-processing requirements (i.e. need for integration) and information-processing capacity (i.e. degree of integration achieved); also at the empirical level (e.g. Keller, 1994) results obtained from this perspective have shown to be good predictors of performance for organizations. Then, the last proposition of this framework relates information-processing requirements and capacities, on the one hand, and performance, on the other:

Proposition 10: organizations will be more effective when there is a match between the level of inter-departmental integration required and the level achieved by the organization's structure and coordination mechanisms.

CONCLUSION

This paper presented a review framework of research related to inter-departmental integration, with a focus toward research into the IS-business relationship. While much of the literature reviewed lies outside the Information Systems realm, it is proposed here that related research in other business disciplines has much to contribute to the current interest in the integration between the Information Systems function, and line management in organizations. The main contribution of this manuscript lies in the identification of an appropriate theoretical base that can be employed in the study of this relationship. While there has been a growing interest, both in the academic and practitioner literatures, about the relationship between information systems and the rest of the organization, empirical research and conceptual development conducted so far had lacked a base theory to support the predicted effects of the variables under study, as well as the propositional framework that related different constructs together with an underlying rationale.

Information-processing theory, as developed by Galbraith (1973) and Tushman and Nadler (1978), provides such a foundation. The conceptual research started by these authors was augmented with examples of more current empirical findings obtained mainly in the realm of the inter-departmental marketing interface.

It is the hope of this paper that the framework proposed here would allow future interested researchers to both (a) integrate past findings into a coherent model, and (b) identify

areas where our knowledge is still lacking and employ the underlying concept of the organization

as an information-processing system to guide future efforts.

REFERENCES

Bakos, J. and Treacy, M. (1986). "Information technology and corporate strategy: a research perspective", *MIS Quarterly*, 10:2, 107-119.

Bartlett, C. and Ghoshal, S. (1989). *Managing across borders: the transnational solution*. Boston, MA, Harvard Business School Press.

Bassellier, G. and Benbasat, I. (2004). "Business competence of information technology professionals: conceptual development and influence on IT-business partnerships", *MIS Quarterly*, 28:4, 673-694.

Bassellier, G., Benbasat, I. and Reich, B. (2003). "The influence of business managers' IT competence on championing IT", *Information Systems Research*, 14:4, 317-336.

Bassellier, G., Reich, B. and Benbasat, I. (2001). "Information technology competence of business managers: a definition and research model", *Journal of Management Information Systems*, 17:4, 159-182.

Bharadwaj, A. (2000). "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS Quarterly*, 26:1, 41-56.

Bharadwaj, A., Sambamurthy, V. and Zmud, R. (1998). "IT capabilities: theoretical perspectives and empirical operationalization", *Proceedings of the 19th International Conference on Information Systems*.

Boynton, A., Zmud, R. and Jacobs, G. (1994). "The influence of IT management practice on IT use in large organizations", *MIS Quarterly*, 18:3, 299-318.

Brown, C. (1997). "Examining the emergence of hybrid IS governance solutions: evidence from a single case site", *Information Systems Research*, 8:1, 69-94.

Brown, C. (1998). "Linking intra-organizational stakeholders: CIO perspectives on the use of coordination mechanisms", *Center for Information Systems Research,* Sloan School of Management, WP-304.

Brown, C. (1999). "Horizontal mechanisms under differing IS organization contexts", *MIS Quarterly*, 23:3, 421-454.

Brown, C. and Magill, S. (1998). "Reconceptualizing the context-design issue for the information systems function", *Organization Science*, 9:2, 176-194.

Brynjolfsson, E. and Hitt, L. (1996). "Paradox lost? Firm-level evidence on the returns to information systems spending", *Management Science*, 42:4, 541-558.

Chan, Y., Huff, S., Barclay, D. and Copeland, D. (1997). "Business strategic orientation, information systems strategic orientation, and strategic alignment", *Information Systems Research*, 8:2, 125-150.

Cooper, R. and Wolfe, R. (2005). "Information processing model of information technology: an intra-organizational diffusion perspective", *The DATA BASE for Advances in Information Systems*, 36:1, 30-48.

Daft, R. and Weick, K. (1984). "Toward a model of organizations as interpretation systems", *Academy of Management Review*, 9:2, 284-295.

Dalton, D., Todor, W., Spendolini, M., Fielding, G. and Porter, L. (1980). "Organization structure and performance: a critical review", *Academy of Management Review*, 5, 49-64.

DeSanctis, G. and Jackson, B. (1994). "Coordination of information technology management", *Journal of Management Information Systems*, 10:4, 85-111.

Egelhoff, W. (2005). "Information-processing theory and the multinational corporation", in *Organization Theory and the Multinational Corporation*, 2nd edition, Ghoshal, S. and Westney, E., editors.

Feeny, D. and Willcocks, L. (1998). "Core IS capabilities for exploiting information technology", *Sloan Management Review*, Spring, 9-21.

Forte, M., Hoffman, J., Lamont, B. and Brockmann, E. (2000). "Organizational form and environment: an analysis of between-form and within-form responses to environmental change", *Strategic Management Journal*, 21, 753-773.

Galbraith, J. (1974). "Organization design: an information processing view", *Interfaces*, 4:3, 28-36.

Griffin, A. and Hauser, J. (1996). "Integrating R&D and marketing: a review and analysis of the literature", *Journal of Product Innovation Management*, 13, 191-215.

Gupta, A., Raj, S. and Wilemon, D. (1986). "R&D and marketing managers in high-tech companies: are they different?", *IEEE Transactions on Engineering Management*, 33:1, 25-32.

Gupta, A., Ray, S. and Wilemon, D. (1986). "A model for studying R&D-marketing interface in the product innovation process", *Journal of Marketing*, 50, 7-17.

Henderson, J. (1990). "Plugging into strategic partnerships: the critical IS connection", *Sloan Management Review,* Spring, 7-18.

Ives, B. and Learmonth, G. (1984). "The information system as a competitive weapon", *Communications of the ACM*, 27:12, 1193-1201.

Jarvenpaa, S. and Ives, B. (1993). "Organizing for global competition: the fit of information technology", *Decision Sciences*, 24:3, 547-580.

Kahn, K. (1996). "Interdepartmental integration: a definition with implications for product development performance", *Journal of Product Innovation Management*, 13, 137-151.

Kahn, K. and McDonough, E. (1997). "An empirical study of the relationships among co-location, integration, performance, and satisfaction", *Journal of Product Innovation Management*, 14, 161-178.

Kahn, K. and Mentzer, J. (1998). "Marketing's integration with other departments", *Journal of Business Research*, 42, 53-62.

Keller, R. (1994). "Technology-information processing fit and the performance of R&D project groups: a test of contingency theory", *Academy of Management Journal*, 37:1, 167-179.

Kohli, R. and Devaraj, S. (2003). "Measuring information technology payoff: a meta-analysis of structural variables in firm-level empirical research", *Information Systems Research*, 14:2, 127-145.

Lawrence, P. and Lorsch, J. (1969). *Organization and Environment: Managing Differentiation and Integration*, Homewodd, IL: Irvin.

Leenders, M. and Wierenga, B. (2002). "The effectiveness of different mechanisms for integrating marketing and R&D", *Journal of Product Innovation Management*, 19, 305-317.

Liker, J., Collins, P. and Hull, F. (1999). "Flexibility and standardization: test of a contingency model of product design-manufacturing integration", *Journal of Product Innovation Management*, 16, 248-267.

Martinez, J. and Jarillo, J. (1991). "Coordination demands of international strategies", *Journal of International Business Studies*, 22, 429-444.

Mata, F., Fuerst, W. and Barney, J. (1995). "Information technology and sustained competitive advantage: a resource-based analysis", *MIS Quarterly*, 19:4, 487-505.

Mealiea, L. and Lee, D. (1979). "An alternative to macro-micro contingency theories: an integrative model", *Academy of Management Review*, 4:3, 333-345.

Miles, R. and Snow, C. (1978). *Organizational Strategy, Structure, and Process*. McGraw-Hill, New York.

Moenaert, R. and Souder, W. (1990). "An information transfer model for integrating marketing and R&D personnel in new product development projects", *Journal of Product Innovation Management*, 7, 91-107.

Nelson, K. and Cooprider, J. (1996). "The contribution of shared knowledge to IS group performance", *MIS Quarterly*, 20:4, 409-432.

Parry, M. and Song, X. (1993). "Determinants of R&D-Marketing integration in high-tech Japanese firms", *Journal of Product Innovation Management*, 10, 4-22.

Pavlou, P. and El Sawy, O. (2004). "From IT competence to competitive advantage in turbulent environments: a dynamic capabilities model", *Working Paper*.

Porter, M. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*, The Free Press, New York.

Powell, T. and Dent-Micallef, A. (1997). "Information technology as competitive advantage: the role of human, business, and technology resources", *Strategic Management Journal*, 18:5, 375-405.

Premkumar, G., Ramamurthy, K. and Saunders, C. (2005). "Information processing view of organizations: an exploratory examination of fit in the context of interorganizational relationship", *Journal of Management Information Systems*, 22:1, 257-294.

Ravichandran, T. and Lertwongsatien, C. (2005). "Effect of information systems resources and capabilities on firm performance: a resource-based perspective", *Journal of Management Information Systems*, 21:4, 237-276.

Reich, B. and Benbasat, I. (2000). "Factors that influence the social dimensions of alignment between business and information technology objectives", *MIS Quarterly*, 24:1, 81-113.

Rockart, J. and Short, J. (1989). "IT in the 1990s: managing organizational interdependence", *Sloan Management Review,* Winter, 7-17.

Rockart, J., Earl, M. and Ross, J. (1996). "Eight imperatives for the new IT organization", *Sloan Management Review*, Fall, 43-55.

Ross, J., Beath, C. and Goodhue, D. (1996). "Develop long-term competitiveness through IT assets", *Sloan Management Review*, Fall, 31-42.

Sabherwal, R. and Chan, Y. (2001). "Alignment between business and IS strategies: a study of prospectors, analyzers, and defenders", *Information Systems Research*, 12:1, 11-33.

Sambamurthy, V. and Zmud, R. (1999). "Arrangements for information technology governance: a theory of multiple contingencies", *MIS Quarterly*, 23:2, 261-290.

Saxberg, B. and Slocum, J. (1968). "The management of scientific manpower", *Management Science*, 14:8, 473-489.

Subramani, M., Henderson, J. and Cooprider, J. (1999). "Linking IS-user partnerships to IS performance: a socio-cognitive perspective", *MISRC Working Paper WP99-01*, University of Minnesota.

Tallon, P. and Kraemer, K. (2002a). "The impact of IT capabilities on firm performance: perspectives on the mediating effects of strategic alignment", *CRITO Working Paper*.

Tallon, P. and Kraemer, K. (2002b). "Investigating the Relationship between Strategic Alignment and IT Business Value: The Discovery of a Paradox," in *Creating Business Value with IT: Challenges and Solutions,* Namchul Shin, editor, Idea Group Publishing.

Tavakolian, H. (1989). "Linking the information technology structure with organizational competitive strategy: a survey", *MIS Quarterly,* 309-317.

Thompson, J. *Organizations in Action*, New York, McGraw-Hill, 1967.

Tiwana, A., Bharadwaj, A. and Sambamurthy, V. (2003). "The antecedents of information systems development capability in firms: a knowledge integration perspective", *Proceedings of the 24th International Conference of Information Systems*.

Tushman, M. and Nadler, D. (1978). "Information processing as an integrating concept in organizational design", *Academy of Management Review*, 3:3, 613-624.

Venkatraman, N (1989). "The concept of fit in strategy research: toward verbal and statistical correspondence", *Academy of Management Review*, 14:3, 423-444.

Venkatraman, N. (1989). "Strategic orientation of business enterprises", *Management Science*, 35:8, 942-962.

Wade, M. and Hulland, J. (2004). "The resource-based view and information systems research: review, extensions, and suggestions for future research", *MIS Quarterly*, 28:1, 107-142.

Wheeler, B. (2002). "NEBIC: a dynamic capabilities theory for assessing net-enablement", *Information Systems Research*, 13:2, 125-146.

Zmud, R. and Lind, M. (1986). "The use of formal mechanisms for linking the information systems function with end-users", in *Managers, Micros and Mainframes*, Wiley, New York, 133-149.