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Abstract

Many ERP implementations fail to achieve their hoped-for benefits and efforts invested in ERP implementations are often much larger than originally estimated. In addition, research on ERP implementation is still in its early stages and needs to be grounded in theory. To provide a theoretical foundation for ERP implementation research, the present paper first develops a definition and a framework for the construct of organizational integration. Subsequently, the paper presents a research model that explains ERP implementation efforts and benefits using the construct of organizational integration and its framework. Finally, the paper discusses the research and practical implications of the framework.

Résumé

Beaucoup d'implantations de systèmes intégrés de gestion (ERP) ne génèrent pas les bénéfices attendus, ne rencontrent souvent pas les échéances et dépassent les budgets. Par ailleurs, la recherche en implantation des systèmes intégrés est encore à une étape embryonnaire et a besoin de fondements théoriques. Pour combler ces lacunes, ce cahier définit le construit d'intégration organisationnelle et développe un modèle de recherche qui fait le lien entre l'intégration organisationnelle, les bénéfices d'implantation des systèmes intégrés et l'effort d'implantation requis. Enfin, les impacts potentiels de ce modèle sur la recherche et sur la pratique sont présentés.

Keywords

FD	IS Implementation
EL06	IS Integration
EL03	IS Success
EI0220	Software Development Effort

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Introduction

While the idea of designing highly integrated systems has existed for over thirty years (Dearden, 1972), it is only in the 1990s that enterprise systems aiming at a seamless integration of all the information flowing through an organization have become available and widespread. By the year 2000, over 60% of Fortune 1000 companies were considering or had already adopted at least one core ERP module (Stein, 1999) and estimates of the ERP market put it at $66 billion by 2003 (AMR Research, 1999). This is not surprising in light of their significant potential organizational benefits, ranging from more streamlined and efficient operations to longer term business reasons and strategic advantages accruing from the addition of new capabilities and the ability to provide more and better services (Markus and Tanis, 2000). Indeed, many firms (e.g., Chevron, Microsoft, Borden) have succeeded in achieving wide-ranging benefits from ERP implementations (Davenport, 1998; Pereira, 1999).

However, there are at least two important issues associated with many ERP implementations. *First, according to some estimates, 50% of ERP projects fail to achieve their hoped-for benefits* (Appleton, 1997), often delivering less than 60% of what was expected (Zuckerman, 1999). In addition, ERP systems have been blamed for poor organizational performance and lower earnings, e.g., Hershey, AeroGroup, Snap-on (Asbrand, 1999; Girard and Farmer, 1999; Hoffman, 1998; Osterland, 2000). *Second, efforts invested in ERP implementations are often much larger than originally estimated*. For example, ERP implementations in companies with revenues of more than $500M were, on the average, more than 200% late and more than 170% over budget (Zuckerman, 1999). Some estimates indicate that 90% of SAP implementations are late (Williamson, 1997). Even more disappointingly, a disconcerting number of organizations have abandoned or terminated their ERP projects before their completion, and many implementations have been outright failures, e.g., Kodak, Sobeys, FoxMeyer Drug (Davenport, 1998; Financial Times, 1998; Jesitus, 1997; Pereira, 1999).

This paper addresses these two issues. First, to provide a theoretical foundation for ERP implementation research, the present paper develops a definition and a framework for the construct of organizational integration. This is motivated by two considerations. One consideration is that research on ERP implementation is still in its early stages (Klaus, Roseman and Gable, 2000), and needs to be grounded in theory. The other consideration is that with recent widespread implementations of integrated software packages (i.e., ERP), B2B and B2C e-commerce models that emphasize business process integration, and views that identify integration as a significant "mega-trend" (Bowersox, Gloss, and Stank, 2000), integration is, both for the research and practitioner communities, of

significant present and future interest. In fact, a search in the ABI/Inform database of all articles having integration in their titles yielded averages of 68, 188, and 465 articles per year, for the periods 1980-85, 1986-1992, and 1993-2001, respectively. Yet, despite the widespread interest regarding this topic, integration continues to be poorly conceptualized.

Second, a research model is developed which explains ERP implementation efforts and benefits using the construct of organizational integration and its framework. Fundamentally, the paper argues that the most significant benefits of ERP implementations mainly accrue from improvements in the level of business process integration. Technological integration is viewed as a prerequisite and facilitator of the organizational changes that bring about important benefits. Moreover, lower-than-expected benefits are thought to result from insufficient improvements in business process integration. Further, it is argued that the effort required to implement ERP systems depends on the level of improvement in organizational integration, a construct made of two components: business process integration and technological integration. In addition, ERP projects that are late and over budget are thought to result from a lack of attention to this factor and/or from difficulties in conceptualizing the link between implementation efforts and improvements in organizational integration. Finally, the paper discusses the practical and research implications of the framework and the research model.

The Construct of Organizational Integration

A Definition

The concept of integration has been a central focus in different domains, including those of management, strategy, production/operations management, and IS (e.g., Chandra and Kumar, 2001; Chiang, Lim, and Storey, 2000; Dearden, 1972; Glouberman and Mintzberg, 2001; Lawrence and Lorsch, 1967; Orlicky, 1975; Venkatraman and Kambil, 1991). In strategy, the conceptual roots of the term integration can be traced to Fayol's (1949) notions of cooperation and coordination. The use of this term and its conceptual influence is often identified with Lawrence and Lorsch (1967) who defined integration as "… the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's tasks…" (p. 34). According to these authors, integration reflects how harmoniously, and in coordinated fashion, different departments of an organization work together. Consistent with this view, in the strategy literature, the concept of integration is used to describe coordination of activities, that is, the management of the dependencies between activities (Glouberman and Mintzberg, 2001).

The concept of integration encountered in other literatures shares certain commonalities with the perspective in strategy. For example, in the production, operations, and logistics literature, integration is seen as the coordinated management of information, material flows, plant operations, and logistics through a common set of principles, strategies, policies, and performance metrics (Chandra and Kumar, 2001; Lee and Billington, 1993). In the innovation literature, integration has been used to represent how well the activities of the innovation process (e.g., R&D, manufacturing) are interconnected and tightly

coordinated (Cooper and Kleinschmidt, 1987; Dosi, 1988; Ettlie and Reza, 1992; Florida and Kenney, 1990; Nelson, 1986; Whitney, Defaris, Gustavson, Graves, Abell, Cooprider, and Pappu, 1988). In IS, the concept of integration has been viewed from at least two perspectives. From a technical perspective, integration has been used to describe the interconnectedness of IT and the extent to which an information system's data elements share a common conceptual schema (Goodhue, Wybo, and Kirsch, 1992; Chiang et al., 2000). According to this view, integration represents the extent to which different IS are interconnected and can talk to one another. In the second perspective the notion of integration represents the extent to which business processes of two or more independent organizations are standardized and tightly coupled through computers and telecommunications technologies (Dan, Dias, Kearney, Lau, Nguyen, Parr, Sachs, and Shaikh, 2001; Malone, Crowston, Lee, Pentland, Dellarocas, Wyner, Quimby, Osborn, Bernstein, Herman, Klein, and O'Donnell, 1987; Srinivasan, Kekre and Mukhopadhyay, 1994; Swatman and Swatman, 1992; Truman, 2000; Venkatraman and Kambil, 1991; Venkatraman and Zaheer, 1990). A third perspective, similar to the one in strategy, also exists where integration represents the extent of coordination and cooperation existing within IS project teams, as well as between these and the organization's users and departments (Barki, Rivard and Talbot, 2001).

However diverse the different conceptualizations of integration may be, in essence they are not too far away from the everyday, dictionary definition of integration which describes it as the blending, coordinating or coupling of elements into a whole (Merriam-Webster, 2001). Basically, an integrated system is one where different elements of the system are linked together so that it behaves as a coordinated unit or whole. The notion of tight coupling is also frequently used to describe the linkages that exist between the elements of highly integrated systems.

Similar to the notion of coupling (Orton and Weick, 1990), responsiveness and distinctiveness are also seen as being key characteristics of integration. However, while coupling occurs when elements are highly responsive but not distinct (tightly coupled), or highly distinct and highly responsive (loosely coupled), we suggest that integration can only occur when elements are both responsive and distinct. Highly integrated processes are made of distinctive activities that are highly responsive to one another in such a way that they form a unified process. For instance, integrating R&D with manufacturing does not imply that R&D will be merged into the manufacturing department or function (thus losing distinctiveness), but rather that they will remain separate entities working closely and tightly together to form a unified process. The human body provides an excellent example of a highly integrated system. While each part is highly specialized and distinct, they are also highly responsive to each other. When one eats or drinks, the brain automatically coordinates the different organs to digest the food or liquid. Similarly, walking, or any other physical activity, necessitates the tight coordination of highly specialized parts. Thus, the body is a unified whole made of highly specialized and distinct parts. Also, different from coupling, is the notion that integration results in a unified whole rather than coupled or coordinated elements.

To provide as broad a definition of integration as possible, while at the same time to keep the commonalities among its different conceptualizations, we propose to use the term ***organizational integration***, defined as *the extent to which all processes and technologies of the entire value chain of an organization constitute a unified whole*. As such, the construct of organizational integration reflects the common, and ultimate aim of all integration efforts, regardless of their disciplinary origin. After all, each integration perspective, be it supply chain integration from a production logistics perspective, or IT hardware and software integration from a technical perspective, is essentially a partial means to a common, ultimate end: that of making different parts and elements of an organization behave as a unified whole. Thus, the term organizational integration seems to better represent the various interpretations of the concept of integration in the business literature.

Note that, by including all the processes of the entire value chain of an organization, the proposed definition encompasses both within and across-firm integration. It also encompasses an organization's business processes and technologies (i.e., both an organization's production technologies, as well as its IT hardware and software), as they all need to be integrated for making the organizational system behave as a whole. Note also that, the proposed definition considers the entire value chain of an organization, and as such can accommodate the different perspectives espoused in different literatures which, individually, have focused on only parts of the value chain, be it business or technical. Thus, it provides a broad, yet comprehensive foundation through which the construct of organizational integration can be viewed and analyzed.

Drivers, Benefits and Barriers

The characteristics of today's competitive environment put a great deal of pressure upon organizations for greater levels of organizational integration. The geographical expansion of competition and markets that are increasingly global create a greater need to integrate operations around the world. In addition, many of today's customers increasingly expect products to fit their specific needs, as well as requiring faster delivery times. Satisfying these demands frequently entails tightly linked supply chains with a multitude of suppliers and distributors. Further, firms are more and more concentrating on core competencies, sub-contracting or outsourcing other parts of their operations, which in turn can also lead to tight couplings between their business processes. Moreover, increasing numbers of strategic alliances between business partners such as just-in-time inventories, also require that operational processes of otherwise independent firms be tightly coordinated. Finally, increased reliance on e-commerce business models requires not only well-integrated technological infrastructures, but also the integration of an organization's processes with those of suppliers of products and services, as well as with those of their distributors (Radding, 1998).

In addition to the pressures of the business environment, organizational integration also provides companies with sizeable potential benefits. For example, integration has been found to lead to significant and difficult-to-imitate strategic advantages based on improved manufacturing productivity and overall firm competitiveness (Barney, 1991;

Chalmeta, Campos, and Grangel, 2001; Ettlie and Reza, 1992; Whitney et al., 1988). Integration is also thought to provide important operational benefits by more tightly coupling activities across the value chain. Williamson (1985) argues that integration of functional processes can lead to lower production costs through savings in transportation, inventory, and energy (e.g., thermal economies), and that integration into peripheral activities (e.g., forward into distribution, backward into suppliers and raw materials, and lateral into components and parts) can generate significant economies of scale and of scope. Malone, Yates and Benjamin (1987) suggest that integration of value added activities can save time, reduce errors in entering data, facilitate the coordination of activities between design and manufacturing, and reduce total inventory cost. Empirical evidence indicates that better integration of business processes in the value chain such as R&D, manufacturing, and sales, can lead to products and services that are more attuned to the market (Dosi, 1988; Nelson, 1986; Whitney et al., 1988), with better communication and inter-functional synergy leading to greater new product success and higher rates of innovation (Cooper and Kleinschmidt, 1987; Florida and Kenney, 1990), to significant reductions in shipment discrepancy levels (Srinivasan et al., 1994), and to more rapid design and delivery of products, lower inventory cost, and higher throughput (National Research Council, 1986).

Others also suggest that integration can facilitate the redesign of a firm's economic production and exchange relationships, and enable new forms of industrial organizations such as network enterprises and virtual firms (Clemons and Weber, 1990; Kambil and Short, 1994; Venkatraman and Kambil, 1991). In fact, organizational integration might not only facilitate the transformation of traditional firms into virtual or network firms, but it might also be a key to the efficient operation and management of dot-com companies (Venkatraman, 2000).

No doubt fueled by the pressures of the new competitive environment, as well as the hoped-for benefits of integration, it is not surprising that firms have been striving to achieve higher levels of organizational integration. During the last couple of decades, these efforts have particularly focused on the development or implementation of integrated software solutions. Well known examples of firms which gained important competitive advantages through such efforts include: American Airlines, which used its SABRE reservation system to achieve integration with travel agents and increase their switching costs; Baxter Health care, which electronically integrated itself with many hospitals through its ASAP system; and Federal Express, which integrated most of its important clients into its processes by giving them access to its order processing, dispatching, and tracking systems.

However, achieving higher levels of organizational integration appears to be far from being simple and easy. For one thing, implementing integrated software and achieving organizational integration are not necessarily the same thing. Software such as ERP systems are frequently advertised as providing a seamless integration of a range of industry best-practices. However, integrating a multitude of organizational processes and technologies entails much more than the purchasing of an ERP software as their

implementations often require major transformations and adjustments to the software, to the organization, or both (Markus and Tanis, 2000).

These difficulties may in part stem from what Hitt, Hoskisson, and Nixon (1993) identified as the three main barriers to inter-functional integration. First is functional specialization, which impairs the ability to achieve overall understanding and coordination, and reduces the efficiency and effectiveness of communicating information across functions. Second, and related to the first barrier, is the presence of distinct frames of reference among people who work in different functions, as manifested by their individual cognitive biases, heuristics and tacit knowledge. Moreover, the communicating of information and coordination of activities across functions is rendered more difficult by their different languages, which tend to be specialized, hermetic, and non-standardized. Third, certain power and political considerations are also likely to interfere with inter-functional integration (Brown, 1978; Stephan and Stephan, 1985). For example, some managers might feel that participation in integration activities could result in reduced resources for their units. Similarly, sharing information, which is a prerequisite to integration, might also be seen as a potential threat to functional territoriality. Those who control information might not only be reluctant to share it, but they might also use it to further their political agendas and increase their organizational power, further countering integration efforts. In fact, research evidence indicates that those who controlled information about computing in organizations used it to further increase their control over IT and reinforce their power basis (Pinsonneault and Kraemer, 1993; 1997).

Given the strong competitive pressures that drive organizations towards greater degrees of integration, the wide range of benefits that greater organizational integration can potentially generate, and the difficulties that organizational integration efforts usually entail, a better understanding of this concept is needed. The next section of the paper provides a research framework of organizational integration as a useful step in that direction.

A Research Framework

The definition of organizational integration provided earlier encompasses a wide range of processes and technologies. Clearly, these processes and technologies can be grouped in different ways, resulting in different taxonomies. One such taxonomy is depicted in Table 1 where a first-level grouping is made by separating within-firm processes and technologies from those external to the firm. These two categories of processes and technologies can further be split into two second-level categories according to whether they pertain to the primary value chain activities of the firm (labeled Operational in Table 1) or the support activities of the value chain (labeled Functional in Table 1). Also, processes and technologies that are external to the firm can be directed forward into distribution, backward into supply, or lateral into parts and/or components (Williamson, 1985). These types or levels of organizational integration are shown in the first two columns of Table 1.

Organizational integration type	Definition	Inter-dependency types	Org. integration barriers	Org. integration mechanisms	Implemen-tation effort	Potential benefits of Org. integration
Internal (intra-firm)	Integration within a firm					
Operational	Integration of successive stages within the primary value chain (workflow) of a firm	(R), (S)	(FS), (FR), (PO)	(SW), (SO), (SSK), (SN)	High	* Products more attuned to market * Higher product quality * Lower production costs * Lower inventory levels * Greater new product success * Higher innovation rate * Faster design to market cycle * Higher manufacturing productivity
Functional	Integration of administrative or support activities of the value chain of a company	(R), (E), (S), (F)	(PO)	(DS), (SO), (SN)	Low	* Downsizing * Lower administrative overhead cost * Higher decision quality

External (inter-firm)	Integration across at least two indepen-dent firms					
Operational						
Forward	Integration of successive value chain stages into distribution and/or retail	(R), (S)	(FS), (FR)	(SW), (SO), (SSK), (SN)	Medium	* Higher switching costs * Higher barriers to entry * Faster introduction of new products * Faster delivery of products * Higher revenues
Backward	Integration of successive value chain stages into supply	(R), (S)	(FS), (FR)	(SW), (SO), (SSK), (SN)	Medium	* Faster introduction of new products * Higher switching costs * Higher barriers to entry * Lower shipment errors * Lower inventory costs * Higher product quality
Lateral	Integration of successive stages of the value chain into compo-nents or parts	(R), (E), (F)	(FS), (FR)	(MA), (SW), (SO), (SN)	Medium	* Higher switching costs * Higher barriers to entry * Lower cost of production * Higher manufacturing productivity
Functional	Integration of support or administrative activities of the value chain across firms	(R), (E), (S), (F)	(PO)	(DS), (SO), (SN)	Low	* Downsizing * Lower administrative overhead costs * Higher decision quality

Table 1- Organizational Integration, Implementation Effort and Benefits

Interdependency types in organizational activities

- *(R)* *Redistribution***:** (Sharing, Pooled) (Polanyi et al., 1957; Malone et al., 1999; Schaniel and Neale, 2000; Thompson, 1967).
- *(E)* *Exchange***:** (Polanyi et al., 1957; Schaniel and Neale, 2000).
- *(S)* *Sequential***:** (Flow, Reciprocity, Stage, Fate Control) (Dean and Snell, 1991; Polanyi et al., 1957; Malone et al., 1999; Schaniel and Neale, 2000; Thompson, 1967; Victor and Blackburn, 1987).
- *(F)* *Fit***:** (Behavioral Control, Reciprocal) (Malone et al., 1999; Thompson, 1967; Victor and Blackburn, 1987).

Barriers to organizational integration (Hitt et al., 1993)

- *(FS)* *Functional specialization***:** impairs the ability to achieve overall understanding and coordination; also reduces cross-functional communication efficiency and effectiveness.
- *(FR)* *Frames of reference***:** members of different functions usually have distinct cognitive biases, heuristics and tacit knowledge, and specialized language, which impair the communication of information and the coordination of activities.
- *(PO)* *Political considerations***:** power games and the fear of losing resources may interfere with cross-functional integration.

Mechanisms of organizational integration (Mintzberg, 1989, Glouberman and Mintzberg, 2001)

- *(MA)* *Mutual adjustment* refers to people or units adapting to each other as their work progresses.
- *(DS)* *Direct supervision* occurs when someone who does not do the work is responsible for coordinating it.
- *(SW)* *Standardization of work* refers to the standardization of the procedures and the tasks.
- *(SO)* *Standardization of output* refers to the standardization of the results or the consequences of the work.
- *(SSK)* *Standardization of skills and knowledge* refers to the standardization of training and the expertise of people.
- *(SN)* *Standardization of norms* refers to the standardization of values, beliefs, and expectations.

Implementation Effort needed to achieve organizational integration is a function of the degree of increase or improvement desired in organizational integration, the types of interdependencies that will need to be managed during the implementation, the barriers to organizational integration, and the organizational integration mechanisms employed

It is important to note that each organizational integration type shown in Table 1 consists of two key dimensions: the integration of that level's business processes and technologies. For example, the Internal-operational organizational integration level, labeled Operational in Table 1, consists of (1) the integration of the processes within the primary value chain, and (2) the integration of the technologies the organization employs within its primary value chain, including the hardware, networks, software, and data bases that are being used.

Organizational integration can also involve different types of interdependencies between organizational elements. *Redistribution* integration, also labeled sharing (Malone et al., 1999) and pooled interdependence (Thompson, 1967), occurs when multiple activities or processes use the same resource. Resources are sent to a center and from the center to units (e.g., inventory, budget) (Polanyi, Arensberg and Pearson, 1957; Schaniel and Neale, 2000). *Exchange* integration occurs when two or more units willingly exchange goods/information for other goods/information, or for money, and neither is required to transact with the other after the completion of the exchange (e.g., B2B or B2C e-commerce) (Polanyi et al., 1957; Schaniel and Neale, 2000). *Sequential* integration, also labeled flow (Malone et al., 1999), reciprocity (Polanyi et al., 1957; Schaniel and Neale, 2000), and stage (Dean and Snell, 1991), occurs when a unit requires and uses a resource produced by another unit (e.g., production line, inventory and manufacturing). Victor and Blackburn (1987) named this interdependence "fate control", that is, B is said to have fate control over A when A, to be able to perform its tasks, requires an action from B. A is thus highly dependent of B's actions. Finally, *fit* integration, also labeled reciprocal interdependence (Thompson, 1967) and behavioral control (Victor and Blackburn, 1987), occurs when more than one unit jointly produce a unique resource (e.g., car manufacturing, computer manufacturing, or assembling parts to make a finished product) (Malone et al., 1999). The different interdependencies are depicted in the third column of Table 1.

Different types of integration (i.e., internal-operational, internal-functional, external-operational-forward, external-operational-backward, external-operational-lateral, external functional) are likely to entail different types of dependencies between activities. For instance, integrating the operational processes within a firm is likely to require the redistribution and sharing of resources (e.g., goods, raw material, finished products, information), as well as an improvement in the sequential interdependence and, on some occasions when a product or service is jointly provided, in an improvement of the fit interdependence between activities and processes. Alternatively, forward external integration is likely to require a redistribution of resources, that is, sharing resources among partners, and an improvement in the sequential dependence between partners. The higher the number of integration types a project entails, the greater will be the number of interdependencies that will need to be managed, thereby requiring more effort.

Changes in levels of organizational integration are likely to encounter barriers such as functional specialization, different frames of reference, and political considerations, discussed earlier in the paper. Overcoming each barrier is likely to require additional efforts. For example, modifying the level of operational integration (e.g., integrating the R&D, manufacturing, and sales processes) within a firm is likely to meet with functional

barriers (e.g., due to the fact that the integration effort is trying to couple people with different frames of reference), and with political barriers (e.g., when each group perceives threats to its autonomy). The main barrier to integrating functions within a firm is likely to be political, rather than due to specialization or different frames of reference. The more barriers that need to be managed during an organizational integration project, the greater the effort that will be needed. The different barriers likely to be encountered with each type or level of integration and interdependency type are shown in the fourth column of Table 1.

Different mechanisms that can be used to achieve integration include mutual adjustment, direct supervision, standardization of work, standardization of output, standardization of skills and knowledge, and standardization of norms (Mintzberg, 1989; Glouberman and Mintzberg, 2001). The suitability of each of these mechanisms is likely to vary according to type or level of integration. For example, integrating a firm's operations is likely to require some mutual adjustment (to allow for the redistribution, exchange and fit interdependencies), as well as the standardization of work, output, skills and knowledge, and norms to allow for the sequential interdependence between different stages of the business process to occur. The integration of functions within a firm is likely to require some standardization (e.g., of outputs, norms) so that information can be communicated across functions, and direct supervision of the integrated activities. Hence, here again, the more mechanisms that are required to achieve organizational integration, the greater the effort that will be required. The different integration mechanisms that are thought to be required by different integration types are shown in the fifth column of Table 1, while the sixth column provides hypothesized levels of effort that will be required in achieving each type or level of integration.

Finally, the last column of Table 1 provides a list of hypothesized potential benefits that can be obtained by achieving each integration type or level. Only a few empirical studies have examined organizational integration achieved through IT, and its effect on firms. Venkatraman and Zaheer (1990) investigated the effects of electronically integrating 70 insurance companies with their independent brokers in the property and casualty market, and found that while this integration increased the number of new business policies sold, it had no significant effect on operational effectiveness (i.e., premiums, commissions) or on operating efficiency (i.e., number of policies processed). Kambil and Short (1994) used a role-linkage perspective to study the effects of integration on the tax return and tax filing marketplace in the USA. They found that integration allowed the automation of existing routines in filing taxes, which served to reduce costs or improve the quality of services. Also, new information sources provided by integration, jointly with routinization of roles and better coordination between partners, enabled new ways of managing dependencies between roles (i.e., actors in the business network). Truman (2000) studied 48 insurance companies and found that interface integration (i.e., integration between EDI systems and internal systems) was associated with lower administrative and professional employee staffing, but was not significantly related to error rates or to the delays in claim payments. Finally, in a study of 193 vendors of Chrysler and 2746 shipments, Srinivasan et al. (1994) found that the level of EDI internal integration (i.e., supplier capability to electronically receive information from Chrysler and directly map it

into its own internal systems) was associated with significant reductions in shipment discrepancies.

Overall, the existing empirical evidence on organizational integration achieved through IT is relatively limited and suggests that while some benefits were observed, they were quite limited both in nature and in size. For example, most studies found more limited impacts then hypothesized (Venkatraman and Zaheer, 1990; Srinivasan et al., 1994; Truman, 2000). It is possible that the relatively limited effects observed to date results from the fact that the levels of organizational integration that were attempted or achieved were of limited scope (e.g., too few functions) and reach (e.g., too few stages in a given process). For instance, Venkatraman and Zaheer (1990) examined inter-organizational integration, but not internal integration. Srinivasan et al. (1994) and Truman both studied interface integration, ignoring the degree to which a given system and process was integrated internally, within the firm.

In essence, the organizational integration framework of Table 1 identifies a number of key constructs for studying organizational integration: organizational integration, inter-dependency, barriers to organizational integration, mechanisms of organizational integration, effort needed for, and benefits provided by, organizational integration. In addition, the framework of Table 1 delineates possible relationships between these constructs and their sub-categories. Organized in this way, Table 1 provides the broad outlines of a research program for studying the construct of organizational integration in different contexts. This is illustrated in the following section by developing and presenting a research model of ERP implementation that is based on this framework.

Organizational Integration and ERP Implementation: A Research Model

It can be argued that, by lowering barriers to integration, integrated information technologies such as ERP can be key tools that firms can deploy to achieve greater organizational integration. The implementation of ERP systems typically requires that cross-functional languages and terminology of an organization be standardized so that a common, organization-wide database can be built. Further, ERP implementations also entail an infrastructure that allows access to information across levels and functions. This can also facilitate the sharing of information that is necessary for better coordination and integration of the activities of an organization's value chain (Dean and Snell, 1991; Hitt et al., 1993). In addition, by allowing efficient and effective communication across functions, ERP can lead to a better overall understanding of business processes that run through different functions. Providing better and more complete information about the operations of the firm can also allow managers to more efficiently integrate business processes and functions. For example, in a study of two organizations over ten years, one with highly integrated IT and the other with less integrated IT, Pinsonneault and Kraemer (2002) found that managers in the more integrated-IT organization were able to streamline operations, integrate functions, and downsize the company more efficiently than managers in the less integrated-IT organization. They explain this finding by noting that integrated-IT organizations provided managers with better information about their

operations and allowed them to better identify where slack resources existed. When faced with strong environmental pressures to streamline operations (i.e., major reduction in revenues), managers of the integrated-IT organization were thus able to more efficiently extract and use the slack resources, strategically downsize the company, and maximize operational efficiency and productivity while minimizing operating costs.

Thus, a highly integrated information system seems to be both a prerequisite for, and a facilitator of, organizational integration. Given their importance to organizations, the challenges their implementations present, the numerous research questions they raise, and the paucity of empirical research on the subject (Esteves and Pastor, 2001), there is a need to better understand the ERP phenomenon in organizations. By using the construct of organizational integration and the framework described in the first part of the present paper, a research model of ERP implementation was developed and is presented in Figure 1, linking two ERP implementation outcome constructs, ERP implementation effort and ERP benefits, to organizational integration.

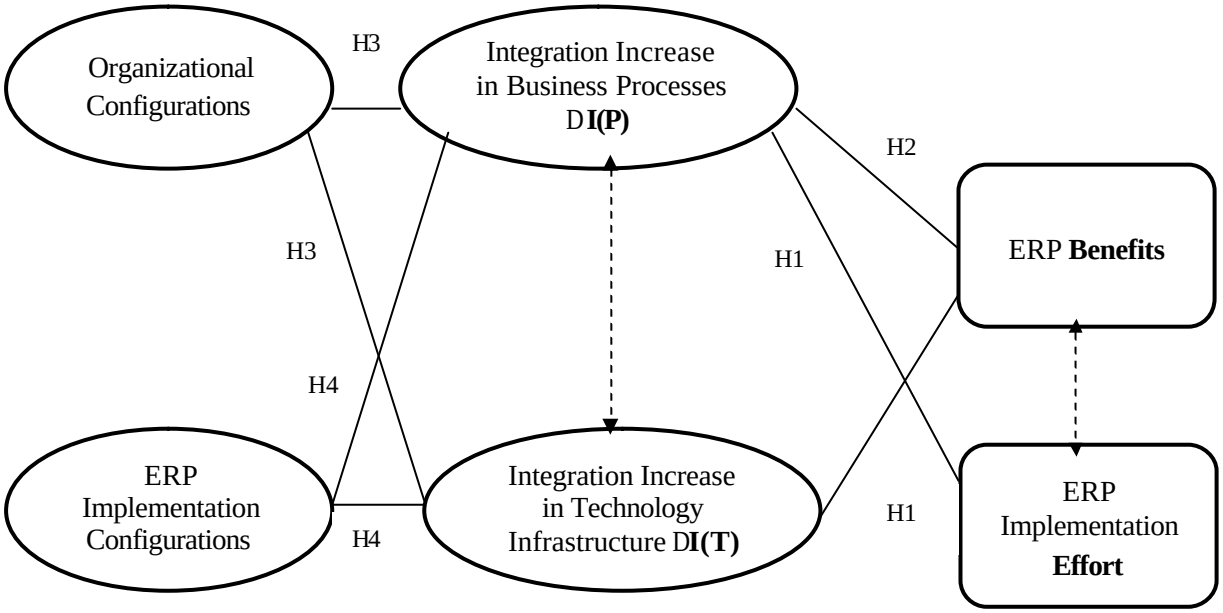

Figure 1 – Predicting ERP Implementation Effort and Benefits

◄- - - -► Dashed line indicates link not examined in the present paper

ERP Implementation Effort and Benefits

ERP systems have the potential to provide full integration both internally and externally, across partners. Their potential for organizational integration is far-reaching and unprecedented, as they are precisely designed to provide a comprehensive integrative structure and the ability to integrate all aspects of a business (Klaus et al., 2001; Scott and Vessey, 2001). In other words, integrating different organizational elements is essentially what ERP systems try to achieve and why they exist in the first place. In addition, much of the effort in implementing ERP systems goes to achieving increased levels of organizational integration as indicated by estimates suggesting that the cost of ERP software is only around 30% of the $66 billion for the whole ERP market (AMR Research, 1999). The remaining 70% of this amount is thought to be for the ERP implementation and business process reengineering expenditures. This suggests two observations. First, because of their potential to achieve higher levels of organizational integration, ERP systems are likely to generate substantial benefits. Second, a close relationship is likely to exist between the improvement or increase achieved in organizational integration and the amount of effort expended in the implementation of ERP systems.

Thus, implementation effort is likely to be directly related to the types of organizational integration involved, the amount of improvement in each type, the number and type of interdependencies that exist, the main barriers faced, and the number and type of mechanisms that will need to be managed during implementation. This is also consistent with recent empirical results which found ERP implementation efforts to be related to the number of modules implemented and the number of users involved (Francalanci, 2001). We therefore hypothesize that ERP implementation effort will depend on the change in the overall level of organizational integration that the implementation will bring[2]. Here the term effort refers to the overall cost of an ERP implementation in an organization including technology infrastructure costs, business process reengineering and organizational change costs, as well as the costs of the ERP system itself[3]. Hence, the first hypothesis of the research model:

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[2] It should be noted that, since a key objective of ERP systems is to make organizations more integrated, the change in organizational integration from pre to post implementation can be assumed to be positive.

[3] The relationship hypothesized to exist between organizational integration and effort is in some ways analogous to that between order and energy in thermo dynamics where, to make a physical system more organized or more orderly (or to reverse their natural tendency to become more disorderly/less organized over time), input of energy is required. Organizational integration is in a sense related to the amount of order or organization existing in a company: greater integration reflects increased cooperation and communication between different elements of a firm and as such reflects a higher level of order or organization. Thus, it is not unreasonable to think that if we want to increase the extent to which different organizational elements work together as a coordinated whole, then we would need to put in some effort, as such elements can not be expected to naturally become coordinated by themselves. Consequently, in order to increase an organization's level of integration (i.e., its degree of order) an input of effort (i.e., energy) would be needed. Stated differently, the effort to implement an ERP system in an organization is thought to essentially depend on how much more integrated the organization's business processes and technology infrastructure become following the implementation.

H1: The greater the change in organizational integration, $\Delta I(P)$ and $\Delta I(T)$, resulting from the implementation of an ERP system, the greater the implementation effort, E, required, where

$\Delta I(P) = I(P)_{t+1} - I(P)_t$ [i.e., the post and pre ERP implementation difference in the integration levels of the organization's business processes]; and

$\Delta I(T) = I(T)_{t+1} - I(T)_t$ [i.e., the post and pre ERP implementation difference in the integration levels of the organization's production and information technologies].

The larger the gap between the degree of organizational integration before and after an ERP implementation, it is likely that the greater the benefits obtained will be. This is based on the thinking that most significant benefits of ERP are not likely to come from the system itself (i.e., which integrates the IT infrastructure and the information across the organization), but from managers using the ERP to facilitate and improve organizational integration, which, as presented in the *Integration: Drivers, Benefits, and Barriers* section of the paper, can generate substantial organizational benefits. While closing large integration gaps are likely to generate significant organizational benefits, they are also likely to pose significant challenges, requiring substantial effort for successful implementation, as hypothesized in H1 above.

Further, each type of integration is likely to generate specific benefits. For instance, empirical evidence indicates that greater integration of operational processes can lead to products and services that are more attuned to the market (Dosi, 1988; Nelson, 1986; Whitney et al., 1988), better communication and inter-functional synergy, and higher new products success and innovation rate (Cooper and Kleinschmidt, 1987; Florida and Kenney, 1990), significant reduction in the level of shipment discrepancies (Srinivasan et al., 1994), and more rapid design and delivery of products, lower inventory cost, and higher throughput (National Research Council, 1986). Better integration of functions can reduce the overhead cost and improve overall decision making quality by providing better information to managers (Pinsonneault and Kraemer, 2002), and better integration of peripheral activities (external integration) can improve revenue (Venkatraman and Zaheer, 1990), reduce errors (Srinivasan et al., 1994) and potentially provide competitive advantage by fostering strategic alliances, increasing switching cost, and increasing barriers to entry. Hence, the second hypothesis of the research model of Figure 1.

H2: The greater the change in business process integration $\Delta I(P)$ resulting from the implementation of an ERP system, the greater the benefits, B, obtained.

Antecedents of $\Delta I(P)$ and $\Delta I(T)$

The research model of Figure 1 depicts two antecedent constructs of $\Delta I(P)$ and $\Delta I(T)$, organizational configurations and ERP implementation configurations, respectively.

Organizational Configurations

The notion of organizational configurations is a well accepted and useful way of describing broad patterns that reflect alignments of a large number of organizational characteristics. The strategy literature defines organizational configurations as forms of alignment between organizational environment, strategy, structure, and process, with a relatively small number of stable configurations accounting for a large percentage of firms (Ketchen, Combs, Russell, and Shook, 1997; Miller, 1990; Mintzberg, 1979). Organizational environment is typically characterized by levels of competition, degree of change, infrastructure (physical, social, and legal), technology, size, and age. Organizational strategy is thought to be reflected by an organization's market scope, strategic advantages and competitive policies. Organizational structure is seen to be described by the roles, procedures, routines, power relations, and hierarchies used. Finally, strategy-making is seen as a key process factor that reflects human attributes such as the values, goals, and ideologies of top management. It is generally agreed that these four variable classes align themselves in relatively enduring patterns resulting in a small number of organizational types. For example, Miller (1990) identified bureaucracy, adhocracy, simple form, and diversified form to represent four theoretically prominent, empirically supported, and different prototypical configurations of formal organizations.

Bureaucracies are characterized by factors such as "… a rule-bound, formalistic culture; a production-line technology and its standardization, routinization, and efficiency-driven staff of technocrats; or a stable environment that rewards efficiency rather than innovation." (Miller, 1990, p. 776). On the other hand, seen as opposites of bureaucracies, adhocracies strive to be adaptive to their uncertain and frequently changing environment, often have customization and innovation as the firm's strategy, are responsive to changing customer wishes, and are characterized by strategic and structural flexibility (Miller, 1990; Mintzberg, 1979).

It should be noted that bureaucracy and adhocracy are "pure" forms of organizational configurations, and that numerous variations and different configurations may exist, as well as emerging new forms such as virtual organizations. In addition, Miller's framework characterizes organizations in general, not in the context of ERP implementations. For example, while organizational culture is not prominent in Miller's framework, evidence suggests that it may play an important role in ERP implementations (Soh, Kien and Yap, 2000; Stewart, Milford, Jewels, Hunter, and Hunter, 2000). As such, the organizational characteristics currently used to define different organizational configurations may need to be modified in order to better adapt them to ERP contexts.

Organizational Configurations and Organizational Integration

A number of observations provide support for the general hypothesis that the constructs of organizational configuration and organizational integration are related. For example, Beekun and Glick (2001) suggest that, the defender and reactor types (Miles and Snow, 1978), being more internally focused and lacking focus, respectively, are likely to have fewer exchanges with other organizations. This means that these two configurations are likely to have lower levels of external integration. Additional support for this linkage can

be found in Davenport (1998) who observed that "… by providing universal, real-time access to operating and financial data, [ERP] systems allow companies to streamline their management structures, creating flatter, more flexible, and more democratic organizations. On the other hand, they also involve the centralization of control over information and the standardization of processes, which are qualities more consistent with hierarchical, command-and-control organizations with uniform cultures" (p. 127). Davenport goes so far as to suggest that the reason why ERP systems first emerged in Europe can be found in the more rigid and centralized organizational structures of European companies.

Arguments similar to those above are also made by Bancroft, Seip, and Sprengel (1997) who suggest that decentralized organizational structures that frequently change are inappropriate for ERP systems. Along the same lines, Markus and Tansik (2000) identify company growth (e.g., Dell Computer: Slater, 1999), strategic flexibility (e.g., Visio: Koch, 1997), and decentralized decision-making style (e.g., Kraft Foods: Bashein and Markus, 2000) as a major set of reasons for non-adoption, partial adoption, or discontinuation of ERP systems. Finally, Beekun and Glick (2001) report having found a relationship between degree of routineness in organizational workflows (which can be seen as a characteristic of certain organizational types) and patterns of coupling among organizational actors.

These and similar findings reported in the literature suggest that the construct of organizational configuration (i.e., its type), defined as the particular patterns in which organizational strategy, structure, environment and process variables are aligned, is a key determinant of the organizational integration of a firm prior to the implementation of an ERP system. For example, a centralized, standardized, and routinized bureaucracy can be thought as already being, ceteris paribus, more integrated than a decentralized and strategically more flexible adhocracy. Being more integrated to start with, ERP implementations in bureaucracies are thus likely to require, ceteris paribus, less effort than they do in adhocracies (and perhaps consequently be relatively easier to implement, and ceteris paribus, lead to greater success in bureaucracies than in adhocracies). In other words, how big an increase a given ERP implementation will result in the organizational integration level of a firm is likely to depend on where that organization is prior to the ERP implementation effort, which in turn is determined by that organization's characteristics, as aggregately represented by the construct of organizational configurations. Hence, the third hypothesis of the research model of Figure 1.

> **H3**: Organizational configurations influence the change in organizational integration, $\Delta I(P)$ and $\Delta I(T)$, resulting from the implementation of an ERP system.

ERP Implementation Configurations and Organizational Integration

As mentioned above, how much more integrated an organization's business processes and technologies become following an ERP implementation is likely to depend on where the organization's starting point was prior to the implementation. The notion of organizational configurations was suggested as a useful way to describe such starting points. The

construct of ERP implementation configurations can be thought of as another major determinant of the change in organizational integration that will ensue following the implementation of an ERP system. Similar to the concept of organizational configurations, the notion of ERP implementation configurations suggests that a relatively small number of stable patterns characterizing types of ERP implementations may exist. For example, the vanilla, middle-road and comprehensive taxonomy suggested by Parr and Shanks (2000) can be viewed as one way to describe ERP configurations. The three types or configurations they describe are based on ERP implementation characteristics that include their physical and technical scopes, and the extent of business process reengineering they entail. As such, the notion of ERP implementation configurations can represent and/or specify organizational end points or targets of an ERP implementation, as these essentially describe where the organization will be following the implementation, as well as how it will get there. Consequently, to the extent that it reflects broad patterns or types of such organizational integration end points, and mechanisms of achieving them, the construct of ERP implementation configuration is likely to be a major determinant of both $\Delta I(P)$ and $\Delta I(T)$, that is how much more integrated an organization's business process and technology infrastructure will be following the implementation. Hence, the fourth hypothesis of the research model of Figure 1.

> **H4**: ERP implementation configurations influence the change in organizational integration, $\Delta I(P)$ and $\Delta I(T)$, resulting from the implementation of an ERP system.

Implications and Conclusion

The proposed definition of organizational integration includes both the business processes and the technologies of the entire value chain of an organization. It therefore provides a conceptually broad construct with which to study technology implementations in general, and ERP implementations in particular. As the construct is comprehensive, it avoids the shortcomings of more narrow perspectives of integration which "... study ERP systems in isolation from other systems investments" (Markus, 2001, p. 1) and for which "... the integration of [computer] systems becomes their central preoccupation, while the integration of the enterprise is only ever mentioned anecdotally..." (Alsène, 1999, p. 26). As such, the construct of organizational integration provides a clear, and much needed conceptual foundation for technology implementation research and practice. The broad perspective suggested by its proposed definition also implies a focus shift for both research and practice when implementing and when studying technology innovations, and in particular ERP implementations.

According to the framework depicted in Table 1, a key determinant of the organizational benefits and the effort required in implementing technology innovations is the change or increase in organizational integration these implementations bring. For practitioners, this points to organizational integration as the key driver of organizational benefits, with IT and ERP systems being important means to that end, but not ultimate solutions by themselves. In addition, if organizational integration change, ΔI, is as central to organizational benefits as suggested here, then its assessment becomes important for evaluating

the potential benefits of a proposed implementation, as well as the effort it will require. As assessing ΔI would require measuring organizational integration both before and after implementing technology innovations, a good understanding of the organizational context where the implementation will occur becomes highly important.

The above implications of the framework of Table 1 are also relevant for researchers. The framework highlights the need, especially for ERP implementation research, to expand its focus from integrated systems to integrated organizations. It also suggests new avenues and preliminary propositions for future research. For example, according to Table 1, organizational integration and organizational benefits can be viewed as having a relationship that is mediated by different interdependency types, barriers to organizational integration, mechanisms of organizational integration, and the effort invested in the implementation. Investigating the relationships between organizational integration and these and other potential intermediary variables, as well as their impact on organizational benefits, can provide fruitful research avenues. Also, a key assumption underlying much of the literature on integration is that more integration leads to improved performance. While this assumption may hold under certain conditions and over certain time periods, it may not be a universal truism. Highly integrated systems share many characteristics with high interconnectivity complex systems such as multiplicity in their constituent elements, interdependence, tight coupling, and dense webs of causal connections among them, as well as causal feedback loops. Systems possessing such characteristics can be vulnerable to unexpected changes or shocks to one of its parts leading to abrupt and unexpected nonlinearities, poor system performance, or disastrous results (Homer-Dixon, 2001). This suggests that future research could investigate highly integrated organizations which exhibit such behaviors and the effect of different complexity reduction mechanisms (e.g., adding more slack to the system, increasing its redundancies) in countering the potentially negative effects of increased organizational integration.

The ERP experiences of the past decade have made it increasingly clear that "... systems integration is not well understood in the IS field, it is not the subject of much IS research..." and that it "... must become a major focus of IS teaching and research" (Markus, 2001, p. 2). We think that the definition of organizational integration, its accompanying research framework, and the ERP implementation research model proposed in the present paper provide useful tools in this endeavor.

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