

Enterprise Information Systems and Strategic Flexibility

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Abstract

Strategic flexibility is a critical organizational competency in today's dynamic global environment. This paper explores the impact of enterprise information systems on an organization's strategic flexibility using the existing strategy and information systems literature to develop a theoretical model. Strategic flexibility is broken down into five first order constructs: Operational Flexibility; Human Capital Flexibility; Information Flexibility; Supply Chain Flexibility; and Financial Flexibility. These constructs are then used to develop a theoretical model and propositions of the impact of enterprise systems on strategic flexibility.

1. Introduction

Strategic flexibility (sometimes strategic agility) has been an important concept for researchers and practitioners for nearly three decades. With dynamically changing markets, increased outsourcing of business processes and global expansion of manufacturing, an organization's ability to rapidly adapt to keep pace with, and even exploit these changes is crucial to achieving and sustaining competitive advantage [23, 24, 33, 35, 52, 55]. The role of information systems in an organization's ability to achieve and sustain competitive advantage has also been well represented in the academic literature over the last three decades or more, and the strategic flexibility literature is no exception [33, 64, 66, 67]. Curiously absent in the strategic flexibility literature, however, is mention of a particular type of information system; the enterprise system. This absence is particularly interesting because due to the factors listed above, recent interest in strategic flexibility is increasing and at the same time enterprise information system deployment in organizations is also expanding [28]. This paper will examine the relationship between enterprise information systems and strategic flexibility in organizations, particularly what effect enterprise systems have on strategic flexibility. The question is important because while enterprise systems offer a great many well

documented advantages to organizations, such systems, particularly enterprise resource planning (ERP) systems are regarded as being relatively inflexible, specifically regarding business process execution [60]. The paper will proceed as follows: First strategic flexibility will be discussed from the literature. The definitions, features, limitations and contributions of strategic flexibility will be articulated, as well as the operationalization of the strategic flexibility construct in empirical studies. The impact of information systems on strategic flexibility will be abstracted from the literature and synthesized. Next will come a discussion of enterprise information systems and the role they play in organizations. A distinction will be made between ERP systems and enterprise application integration (EAI) systems which utilize and integrate individual components of "best of breed" enterprise systems from different software vendors. Following that will be a discussion of the actual or potential impact of enterprise information systems on strategic flexibility in view of developing theory.

2. Strategic Flexibility

The concept of strategic flexibility is manifest in several disciplines [10, 14, 53, 66]. Although the definitions of strategic flexibility vary from researcher to researcher, they are not markedly different. Sanchez [52] defines strategic flexibility as "*firm abilities to respond to various demands from dynamic competitive environments*" (p. 138). Lau [33] defines strategic flexibility as follows: "*Strategic flexibility refers to a firm's ability to respond to uncertainties by adjusting its objectives with the support of its superior knowledge and capabilities*" (p. 11). While these definitions are useful, we offer a modified definition:

Strategic Flexibility is the firm's deliberately crafted ability to recognize, assess, and act to mitigate threats and exploit opportunities in a dynamically competitive environment.

We believe this definition represents an accurate synthesis of current definitions while adding an important factor;

that of deliberateness. That is, strategic flexibility is not necessarily a “side-effect” of firm activities but can (and should) be an intentional focus of the firm. This has implications for practitioners and researchers alike, as we will demonstrate.

2.1. Strategic flexibility achievement and barriers

Evans [14] proposes four strategic maneuvers (two offensive and two defensive) to achieve flexibility. These maneuvers are focused around what he terms a “triggering episode,” i.e. an unanticipated contingency. The offensive maneuvers are pre-emptive (such as seizing initiative) and exploitive (such as reaping opportunities). The defensive maneuvers are protective (such as insuring against loss) and corrective (such as repairing damage)(p. 78). Sanchez [52] asserts that strategic flexibility depends both upon a firm’s resource flexibility and on the firm’s ability to flexibly apply those resources to alternative courses of action when necessary. This allows the firm to have strategic options when dealing with dynamic environments. Lau [33], dealing with strategic flexibility in the manufacturing industry, claims that flexibility is attained by focusing on developing skills such as knowledge, capabilities, and a flexible organizational structure, rather than particular techniques or programs. The concept of less rigid, flatter, more horizontal organizational structures appears often in the literature as necessary for attaining strategic flexibility [24, 33, 56, 65]. Another frequent theme in the literature for the achievement of strategic flexibility is the capability of key decision makers to access and analyze real-time organizational data to identify and exploit emerging trends [53, 54]. Shimizu and Hitt [54] identify three components of strategic flexibility: Attention, Assessment, and Action, and list barriers to these components, primarily organizational inertia, politics, and resistance to change (p. 48).

2.2. Strategic flexibility limitations

While the overwhelming majority of journal articles treat strategic flexibility as a distinct competitive advantage, it is not a panacea. Nor is flexibility considered an advantage in every organizational circumstance. Kulatilaka and Marks [31] suggest that flexibility may reduce a firm’s ability to compromise. Aggarwal [2] points out that achieving flexibility can be more costly than the resulting returns. Overall, the literature discussing the limits of strategic flexibility is sparse.

2.3. Strategic flexibility operationalization

Operationalization of the strategic flexibility construct in the academic literature is somewhat infrequent and inconsistent. Goodstein *et al.* [19], in a study of professional interests and strategic flexibility in the health care industry used external contracting as a measure of strategic flexibility. Grewal and Tansuhaj [22] used a four item survey instrument to measure strategic flexibility. The items are related to the firm’s building of excess resources (hedging), emphasis on benefiting from diversity and variability of their environments, and managing political, economic, and financial risks. Abbott and Banerji [1] measure strategic flexibility by three subcategories: market flexibility, production flexibility, and competitive flexibility (p. 2). Market flexibility refers to the ability of a firm to rapidly adjust its marketing efforts in a dynamic environment. Production flexibility is a firm’s ability to quickly make or provide competitively priced goods or services in most major world markets. Competitive flexibility is the firm’s ability to compete in an intense and uncertain environment. Zhang [66, 67] measures IS support for strategic flexibility, and firm performance, but does not attempt to measure strategic flexibility itself. He uses a survey method which focuses on production flexibility. Ramaraj Palanisamy [48] uses a 4 item survey instrument to measure organizational flexibility with the items being: (i) frequency of firm skill upgrades, (ii) frequency of proactive and reactive firm responses to competition, (iii) number of strategies oriented towards firm stability and growth, and (iv) frequency of firm technology upgrades by internal development and import. While the literature pertaining to research on manufacturing flexibility and associated measures is abundant [6, 9, 12, 18, 44], the research on flexibility in the service industry is relatively sparse. With many western economies becoming increasingly service oriented [4, 7, 46], we believe a broader measure of strategic flexibility is needed. We will address this in our theoretical development.

2.4. IS support for strategic flexibility

Weill *et al.* [64] assert that IT investments to achieve strategic agility are among the most important that senior executives will make. They suggest that independent technology investment decisions by business units, resulting in incompatible technologies and islands of automation are antithetical to strategic agility. Enterprise wide databases, communication networks and an integrated IT infrastructure are necessary, the authors suggest, to enabling strategic agility in an organization. Sanchez [52] mentions electronic data interchange (EDI), which allows for the real-time linking of the various stages of the manufacturing process as a characteristic of new information technologies which allow a firm to respond quickly to new opportunities. Enterprise systems,

particularly ERP systems certainly provide such functionality, suggesting that they may support a firm's strategic flexibility. Lau [33] suggests the augmentation of the workforce with advanced information and process technologies is critical to achieving strategic flexibility and enterprise systems certainly are able to fill this need. The integration of information technology with key business processes, knowledge diffusion, and the ability of IT to enable and foster collaborative interorganizational relationships allows firms to rapidly adapt to changing requirements and exploit emerging markets [51]. In two different studies, Zhang [66, 67] found that IS investments in support of strategic flexibility were positively related to firm performance, particularly firms operating in uncertain and turbulent environments. Likewise, Evans [14] suggests strategic flexibility is particularly important in high technology industries because of rapid innovation and market uncertainty in that area. Byrd and Turner [10] also suggest a link between IT infrastructure flexibility and firm competitive advantage. They have constructed and validated a survey instrument to measure IT infrastructure flexibility. The authors define IT infrastructure as follows:

“IT infrastructure flexibility is the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure.” (p. 172)

Reddy [49] suggests that while many firms seek competitive advantage through greater flexibility, the quality, size, and timing of their IT investments, particularly in legacy systems, may actually limit their ability to be competitively flexible. Ironically, acting quickly and decisively (a necessary aspect of flexibility) as an early adopter of a new information technology may, as Reddy points out, ultimately limit a firm's flexibility by tying it down to an expensive legacy system. Additionally Aggarwal [2] points out that many firms indulge in excessive technology investment to achieve unnecessary flexibility.

Extending this line of inquiry brings us to the concept of *information flexibility*. Ultimately, what a firm needs from its IT infrastructure is not just data, but information. Real time access to transactional data is useful only insofar as it can be retrieved and formatted in a meaningful way for immediate use. The same holds true for archival data and its potential as a source of information as an aid to analysis and decision making.

We will address information flexibility in the theory development section.

3. Enterprise systems

Integrated enterprise-wide information systems typically take two forms: Enterprise Resource Planning (ERP), and Best-of-Breed (BoB). ERP systems are single vendor software packages which provide best-practice business process functionality centered around a single database [38]. SAP and Oracle are considered the two leading ERP vendors on the market currently. ERP implementations typically require extensive business process reengineering (BPR) because although ERP packages are generally configurable to meet the specifics of an organization's industry, geography, organizational structure, among other requirements, they are considered inflexible with regard to business processes [29, 60]. Organizations typically have to restructure their processes to match the ERP package [11, 35]. Firms attempting to modify ERP systems to match their existing processes have often caused themselves a great deal of trouble, such as delaying implementation, increasing staff requirements, and hampering the upgradeability of the system [38]. ERP implementations are typically lengthy, costly and very disruptive to an organization [11]. Best-of-Breed systems are combinations of different software packages which provide more limited and focused functionality, such as one system for financials, one for operations, one for human resource management, and so on. Organizations mix and match what they consider to be the best collection of software packages to match their organizational needs [17]. These packages are then integrated using some type of middleware. BoB implementations are considered to be less disruptive to an organization, require less process reengineering, and allow for greater flexibility. However, because the packages come from different vendors there may be extensive compatibility and integration issues. Additionally maintenance and upgrades within a BoB system are likely to be more problematic than with a single vendor ERP system [38].

3.1. Enterprise integration

Enterprise systems are being implemented, in part, to overcome the functional silos created by incompatible departmental information systems. The need for integrated intra-organizational information systems is established and accepted. Many organizations are now seeking to establish integrated *inter-organizational* information systems. ERP systems were initially developed to provide internal integration [35, 63] and organizations seeking to use ERP systems to establish integration with other supply chain stakeholders, for

example, found such integration difficult [60]. Unless the different firms were using the same ERP system, integration efforts were hampered by system incompatibilities. Recent advances by ERP vendors have addressed this need. For example, SAP now has added optional Supplier Relationship Management (SRM), and Customer Relationship Management (CRM) modules to enhance the functionality of its popular R/3 ERP system. Enterprise Application Integration (EAI) technologies are also being used to create intra-enterprise and inter-enterprise integration [5, 60]. EAI software is typically a middleware solution which provides data and application translation and compatibility functions between heterogeneous enterprise software packages [15]. All of the enterprise systems connect to the EAI software rather than to each other in a point-to-point configuration [58].

3.2. Enterprise systems and strategic flexibility

Bresser and Harl [8] suggest that organizational interdependence and collective strategizing may lead to strategic inflexibility. They do suggest that vertical interdependence, such as an extended supply chain, is less prone to strategic inflexibility than horizontal interdependence between peer organizations. Conversely, Galbraith [16] suggests an increase in strategic alignments and joint partnerships, and a corresponding increase in decentralization and downsizing of physical operations of manufacturing facilities requires strategic flexibility. As articulated above, enterprise systems are being used to extend supply chain relationships and create what some are calling “virtual enterprises” [5]. Evans [14] proposes a protective maneuver against unexpected contingencies of securing secondary sources for components or other resources. Sanchez [52, 53] suggests that resource flexibility is achieved when there are alternative uses for the resource and the cost of switching resource use and the time it takes to switch the use of the resource is low. Lee *et al.*, [35] suggest that the generality of ERP business processes is a limitation to an organization’s flexibility, and that EAI better represents enterprise system supported strategic flexibility. Thus there appears to be a tension between certain inflexibilities built into enterprise systems, and potential flexibilities enabled by the use of enterprise systems. We will explore this further in the theory development section.

4. Theory development

As we have seen, modern global organizations face the dual imperatives to be as flexible as possible to achieve and maintain competitiveness, and to acquire and implement efficient, integrated enterprise and often inter-enterprise information systems [6]. Are these imperatives complimentary or contradictory? Is the adoption of a

uniform and ubiquitous information system antithetical to a lean, agile organization? Our research suggests that these important questions have not been adequately addressed in the current literature and so in this section we will propose a theoretical model for the purpose of moving towards empirical testing and advancing our understanding of the relationship between enterprise systems and strategic flexibility.

As we have seen from the literature, strategic flexibility is not a unitary concept. Previous attempts to conceptualize and operationalize strategic flexibility have been inconsistent. In view of developing testable propositions regarding enterprise system impact on strategic flexibility, we suggest five first order constructs which comprise strategic flexibility. They are:

Operational Flexibility: The flexibility of a firm’s production and / or business processes.

Human Capital Flexibility: The “flatness” of a firm’s organizational structure, and commitment to a culture of flexibility including knowledge sharing / management, cross-functional training, outsourcing, and other non-traditional work arrangements (eg: telecommuting).

Information Flexibility: The flexibility of a firm’s information system, particularly a firm’s ability to obtain required information from both its transactional and analytical systems. We have separated information flexibility into two sub-constructs: Reporting flexibility, which is a firm’s ability to extract and view relevant data from its transactional systems, and analytical flexibility, which is a firm’s ability to extract and utilize historical data from its data archives for analysis and decision support.

Supply Chain Flexibility: A firm’s ability to quickly and efficiently remove, add, and exchange information with its external supply chain partners.

Financial Flexibility: A firm’s resource commitment to, and ability to absorb the cost of exercising flexibility until it begins to pay for itself.

The resulting theoretical model is shown in figure 1.

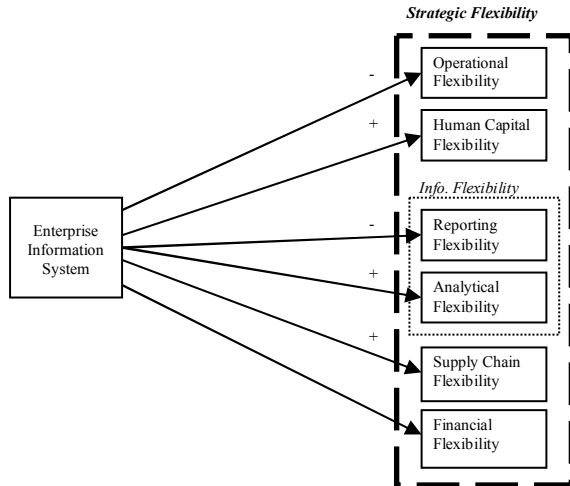


Figure 1: Theoretical model: Enterprise system impact on strategic flexibility

4.1. Propositions

The authors suggest that the five constructs represent a reasonable synthesis of what is found in the extant literature regarding organizational functions and processes which impact strategic flexibility and are impacted by the use of enterprise information systems. We also suggest that the proposed model is broad enough to be empirically tested in both the manufacturing and service industries. Using these five first order constructs comprising strategic flexibility, we suggest the following propositions and provide support from the literature:

Proposition 1: The use of enterprise information systems will negatively impact operational flexibility.

This proposition reflects directly upon the tension in the extant literature regarding the limitations of enterprise systems and their impact upon certain organizational flexibilities. That enterprise systems, particularly ERP systems, are relatively inflexible regarding business processes is well documented [29, 60]. BoB systems are considered more flexible in that they can be assembled to more closely match a firm's existing processes [17], but there is little to suggest that BoB systems components (e.g. a production system) are flexible within themselves. Also since ERP systems are the dominant type of enterprise system currently in use [38] we posit that enterprise information systems will negatively impact operational flexibility.

Proposition 2: The use of enterprise information systems will positively impact human capital flexibility.

Enterprise systems support a process orientation of organizations and also allow firms to cut out some middle management and create a “flatter”, more horizontal organizational structure [3, 11], which has been identified as a key factor in achieving strategic flexibility [24, 33, 56, 65]. For example, Purina Mills' ERP implementation allowed them to consolidate many of their business processes and reduce a number of employees in branch offices and in the accounting department [62]. Enterprise systems can also be used to promote knowledge management and knowledge sharing [27], enabling the development of knowledge and capabilities which are also instrumental in a firm's attainment of strategic flexibility [33]. Non-traditional work arrangements, such as telework and outsourcing give firms increased flexibility and cost reductions [61]. While there are obstacles to these arrangements, they have largely been ameliorated by information technology (ibid). Additionally, enterprise information systems offer nontraditional workers the same benefits as traditional workers, i.e.: real time access to a common data source and business transactions. With modern enterprise systems (and information systems in general), obstacles such as time and location are greatly diminished.

Proposition 3a: The use of enterprise information systems will negatively impact reporting flexibility.

Data is the core resource of any enterprise and enterprise systems generate massive amounts of data. Information flexibility in the form of reporting is highly desired but seldom realized without extensive custom report development. Enterprise systems come with basic reporting capabilities but these are often inadequate for extracting and viewing the information needed by individual organizations [45]. Such systems often result in firms being “data rich and information poor” [37]. Third party reporting software or custom report developing is often employed to overcome this deficit.

Proposition 3b: The use of enterprise information systems will positively impact analytical flexibility.

Although decision support is not historically high on the list of reasons why firms adopt enterprise systems, many firms are reporting that such systems do in fact enable decision support [26]. Aggregated historical data generated by ERP systems and stored in data warehouses are used for data analysis to support decision making processes such as demand forecasting and capacity planning. [36] Kumar and Van Hillegersberg [32] suggest that the data collected by ERP systems will provide the

platform for decision support, data mining, and executive information systems (p. 5).

Proposition 4: The use of enterprise information systems will positively impact supply chain flexibility.

As firms enter the global marketplace, they must have information systems which support their endeavors. IT strategies must be linked with business strategies [21, 25]. In the 1980s, before the widespread proliferation of integrated enterprise systems, Hewlett Packard realized the value of global supply chain modeling for inventory reduction and improved order fulfillment [34]. Modern enterprise systems are very robust in supply chain modeling and planning capabilities. Dell Computer Inc., employing a best of breed strategy [57] uses their enterprise system to create “virtual integration,” i.e. using enterprise information systems to blur the lines between supply chain partners to create a virtual enterprise [41]. Enterprise system enabled information visibility within the supply chain, such as in the Dell model, greatly enhances supply chain flexibility [39, 40]. In a dynamic environment, supply chain flexibility depends upon a firm’s ability to quickly reconfigure inter-firm linkages [13]. Enterprise systems can provide the rich knowledge transfer and information exchange capabilities which make such dynamic reconfiguration possible [20].

Proposition 5: The use of enterprise information systems will have no effect on financial flexibility.

The case for increased firm performance tied to enterprise systems is established in the literature. However increased firm performance from the use of ERP systems is not universal [47]. Also, what a firm decides is an appropriate amount of net working capital to support flexibility and how that excess capital is realized will be very different among the firms and difficult to link to enterprise systems.

It is important to note that the “use of enterprise information systems” in the preceding propositions refer to the post-implementation stage of enterprise system use.

5. Future Research

This paper is the first stage of research in progress. The next step in this research is to operationalize these variables, transform the propositions into formal hypotheses for the purpose of empirical testing. Next it will be necessary to identify target organizations to provide sample data. Global industries in dynamically competitive environments such as the computer /

electronics or automobile industries would be appropriate populations to sample. Survey research with supply chain, human resource, information systems, and operations managers as key informants is our proposed methodology. Survey research is an accepted and frequently employed method for conducting information systems research [43] as long as scientific rigor is maintained in the instrument development and administration process [42, 50]. Surveys are also often used in research into strategic flexibility [6]. Statistical analysis using OLS regression will be used to identify the relationships between the dependent and independent variables. Confirmatory factor analysis can then be used to determine whether the suggested first order constructs do in fact constitute a single second order construct, i.e. strategic flexibility. Kassim and Zain [30] used this type of analysis in a similar study of organizational agility. Swafford *et al.*, [59] also used a similar approach in a study of value chain agility. The proposed model suggests a direct relationship between enterprise systems and strategic flexibility, but we expect that empirical testing may yield additional insights into potential moderating and mediating factors.

6. Contribution

This paper synthesizes concepts from the current IS and strategy literature to investigate the impact of enterprise information systems upon strategic flexibility. Little empirical work has been done on strategic flexibility and the operationalization of the strategic flexibility construct is inconsistent. We propose breaking down strategic flexibility into 5 first order constructs which will be easier to operationalize and will work across both manufacturing and service industries. Additionally, we begin to explore the link between enterprise information systems and strategic flexibility and introduce a theoretical model for empirical testing.

7. Conclusion

Enterprise information systems are seen as a competitive necessity across many industries, especially those operating in a global and dynamically competitive environment. The impact of these systems upon a firm’s ability to compete in such an environment has important implications for managers. What enterprise systems should we implement? Should we purchase an integrated ERP package or integrate functionally specific packages to gain more flexibility? Will the gains achieved by standardization of workflow and other business processes be outweighed by potential inflexibilities in other areas? The answers to these types of questions will help firms best utilize enterprise systems in support of their objectives.

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