

Determinants of Strategic Utilization of Information Systems: A Conceptual Framework

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Abstract—Information technology and information systems have been generally recognized as one of the greatest human inventions of modern times. Information system (IS) is an organized combination of people, hardware, software, communication networks and data resources that collect, transform, and disseminate information in an organization [38]. As IS are being developed and deployed, research on their strategic utilization have been continuously studied by researchers and scholars. Accordingly, various models and frameworks have been proposed to evaluate the strategic utilization of IS. However, past researchers have paid little attention on factors that contribute towards strategic utilization of IS. Against this concern, this paper attempts to provide a conceptual understanding of the contribution of organizational, technological and environmental factors on the strategic utilization of information systems measured in terms of product differentiation, cost leadership and growth advantage. Based on the proposed model, several propositions are formulated as a basis for the study that will follow.

Index Terms—technological factors, organizational factors, environmental factors, information systems, strategic utilization

I. INTRODUCTION

Information technology (IT) and information systems (IS) have been generally recognized as one of the greatest human inventions of modern times. When it was first conceived, its original intention was to automate manual and pre-computer mechanical processes. At presents, IS have significantly matured and their roles and functions have been extended to support business strategies, business processes, and organizational structures and cultures of an enterprise. Information system is an organized combination of people, hardware, software, communication networks and data resources that collects, transforms, and disseminates information in an organization [38]. IS could be categorized as Transaction Processing Systems (TPS), Management Information Systems (MIS), Decision Support Systems (DSS) and Expert Systems (ES). Within the category of MIS various types of IS exists to support functional business operations which include Human Resource Information Systems, Marketing Information Systems, Accounting Information Systems and Financial Information Systems,

to name a few. Realizing the benefits of IS, business enterprises regardless of sizes, have and continue to diffuse IS into their business operations. As these IS are being developed and deployed, research on their strategic utilization have also received substantial interest by researchers and scholars. Accordingly, various models and frameworks have been proposed to evaluate the strategic utilization of IS. While studies on the strategic utilizations have been vastly investigated, researches focusing on their determinants or antecedent factors have received little attention. Against this background, this paper attempts to provide a conceptual understanding on the effect of antecedent factors on strategic utilization of IS. The proposed model extends the Technological-Organizational-Environmental or TOE model [57] and applies it in the context of strategic utilization of IS.

II. THE PROPOSED MODEL

Fig. 1 depicts the proposed framework for studying the effect of technological, organizational and environmental factors on strategic utilization of IS. The framework is conceptualized based on previous work of others ([4], [19], [21], [43], [58], [67]). The dependent variable which is strategic utilization of IS is measured through the dimensions of product or service differentiation, cost leadership and growth advantage. The independent variables are technological factors, organizational factors and environmental factors. The dimensions of technological factors are IS facilities, IS structure, IS competency and user-technical support. The dimensions of organizational factors are firm size, top management support, functional integration, slack resources and information intensity. The dimensions of environmental factors are environmental uncertainty and external pressure.

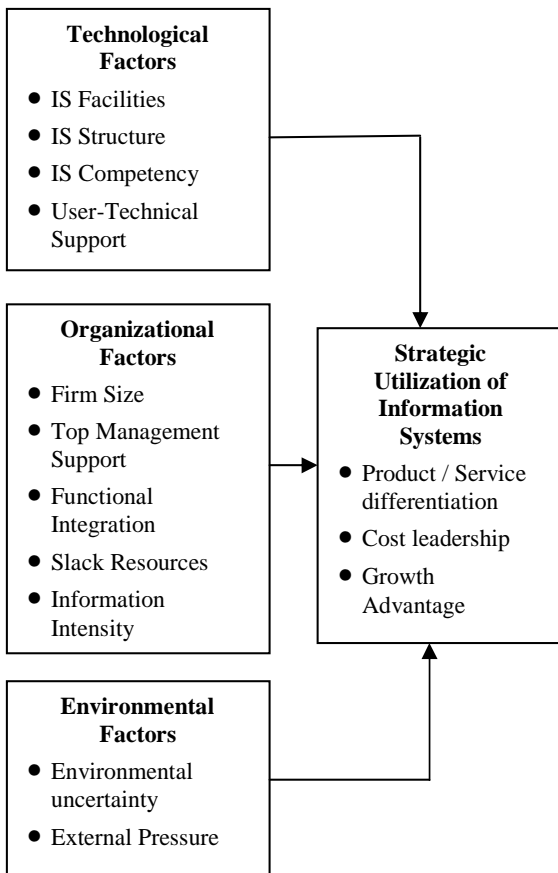


Figure 1. The proposed model

A. Strategic Utilization of IS

The literatures on IS suggest that when IS is being utilized strategically for gaining competitive advantage, then the IS is termed as 'strategic information systems' or SIS. This term started to surface during the 1980's when researchers have started to realize the strategic role and functions of IS. Accordingly, various models and framework have also emerged to describe the situation of strategic utilization of IS ([9], [21], [30], [31], [39], [42], [53], [65]). The root of these models and framework mainly stem from the classical Porter's Competitive Advantage [42]. Porter claims that the principal types of competitive advantage are low cost producer, differentiation, and focus. An extended work of Porter was done and identified five different modes of strategic utilization of IS being product / service differentiation, cost leadership, innovation, growth advantage and alliance [65]. Hence, building upon the previous work [42 and 65], the proposed model in this paper will adopt three modes of strategies i.e. product / service differentiation, cost leadership and growth advantage. Similar approach was also adopted by a researcher [21].

B. Product / Service Differentiation

Differentiation bases exist can be classified into four major groups i.e. (i) product in terms quality, features, options, style, brand name, packaging, sizes, services, warranties, returns (ii) price in terms of list discounts, allowances, payment period and credit terms (iii) place in terms of channels, coverage, locations, inventory, transport (iv) promotion in terms advertising, personal selling, sales promotion and publicity[6]. Hence, IS can be utilized to support or improve the firm's product / services through these various attributes. For instance Computer-Aided Design can facilitate designers to develop unique and quality product design; e-commerce and Customer-Relationship Management systems (CRM) not only expand market coverage but also enhance after-sales services and customer relationships; the Internet and World Wide Web provides a low-cost but effective marketing tool for product / service advertisement and promotion campaign.

C. Cost Leadership

Cost leadership strategy enables a business enterprise to become the lowest cost producer of products and services in the industry. Overall cost leadership is achieved by a firm that is able to maintain the lowest costs of production and distribution within an industry. These low costs will translate to profit margins that are higher than the industry average. Some of the conditions that are conducive to support a cost leadership strategy include an on-going availability of operating capital, good process engineering skills, close-management of labor, products designed for ease of manufacturing and low cost distribution. To this effect, the use of specialized IS known as Enterprise Resource Planning system (ERP) is the most appropriate. ERP is an integrated software solution used to manage a company's resources. ERP software attempts to integrate business processes across departments onto a single enterprise-wide IS. The major benefits of ERP are improved coordination across functional departments and increased efficiencies of doing business. Other immediate benefits include reducing operating costs, such as lower inventory control cost, lower production costs, lower marketing costs and lower help desk support costs.

D. Growth Advantage

IS can be strategically utilized to help enterprise achieve growth advantage. This approach can be materialized through (i) product growth, which may involve length i.e. new products of the same kind as existing ones; depth i.e. variants to existing products (e.g. additional options which can be selected by customers when buying a desktop); and width i.e. new products which complement existing ones (ii) functional growth i.e. by performing additional business functions [12]. Often this is through 'vertical integration' along the industry value-chain, which may provide benefits from direct control over supply, distribution or service, such as cost reduction, quality assurance or reliability. Sometimes the new functions are support services, such as the gathering and delivery of industry statistics; (iii) geographic growth, by

acquiring from additional locations, or selling into additional locations (iv) lateral growth, by applying excess capacity, by-products or expertise, in order to address new marketplaces. The utilization of different types of IS such as TPS, MIS, DSS and ESS can facilitate the achievement of the aforementioned approaches. In essence, all of these ISs facilitate enterprise information and knowledge management which are crucial in ensuring product / service growth. Both DSS and ESS are extremely helpful in assisting managers in their decision making processes relating to product / services growth matters.

III. TECHNOLOGICAL FACTORS

The technological factors of the TOE framework relates with the perceived characteristics of technology. However, in our proposed model, we tend to deviate from these perceived characteristics definitions and define the technological factors as the organizations' technological infrastructure and capabilities. Similar approach was adopted by past studies [4, 19]. Based on an extensive literature review, the technological factors that are found to have impact on IS utilization, IS effectiveness or IS adoption include IS facilities, IS integration, IS structure, IS competency and user-technical support.

A. IS Facilities

IS facilities relates to organizational IS infrastructure. IS infrastructure is generally considered to be the foundation of shared IS capabilities that enable the development of IS applications and the support of business processes [66]. Hence, they defined IS infrastructure as a set of IS resources and organizational capabilities that are shared across the organization and that provide the foundation on which IS applications are developed and business processes are supported. Many studies have shown that IS facilities are influential in determining the success of IS adoption and implementation ([4], [18], [19]). An empirical study also indicates that IT infrastructure is essential in determining the extent of IS implementation (i.e. TPS, MIS, DSS, data warehouse, network management etc). IS facilities is said to be related to IS effectiveness i.e. utilization [11]. To this effect, this study posits that: *IS facilities are significantly related to strategic IS utilization.*

B. IS Structure

IS structure refers to the extent to which IS are structured or dispersed throughout an organization. It also relates to the degree to which IS is centralized or decentralized. Centralized IS denotes that the allocation of all IS resources to one particular business unit that provides IT services to the whole firm [17]. In contrast, decentralized IS gives individual business units autonomy over their own IS resources without any major considerations over other units unless it is essential to the overall organization policy. Previous studies on IS effectiveness has shown that decentralized IS environment is strongly related to IS use and success [4, 19]. A strong relationship between distributed IS structure and IS usage was found [4].

Another study in an e-government computing environment found strong co-relation between distributed IS structure and four dimension of IS effectiveness i.e. information quality, systems quality, service quality and perceived usefulness [19]. Against this background, we argued that distributed IS structure is conducive for strategic utilization of IS in terms of product / service differentiation, cost leadership and growth advantage. Therefore the present study posits that: *IS structure is significantly related to strategic IS utilization.*

C. IS Competency

IS competency refers to skilled workers working cooperatively in cross functional teams embracing different kinds of technologies. It was identified that IT personnel flexibility should be well-versed in the combination of technical competencies, boundary competencies and functional competencies [8]. Technical competencies denote a set of measures of technical capabilities such as programming, understanding software development process and knowledge of operating systems. Boundary competencies relates to the importance of IT personnel having skills and knowledge to assume roles outside their area of training or original competencies which include project management and business process support. Functional competencies is concerned with the ability of the IT personnel to understand the business processes they are to support and apply the appropriate technical solution to a given business problems. IT personnel facilitates boundary spanning and help organization react to changes as well as providing necessary connectivity and modularity that enable rapid organizational response to changes [11]. In the same research, the findings reveal that IT personnel contribute significantly to the extent of IT implementation [11]. Accordingly, this study posits that: *IS competency is significantly related to strategic IS utilization.*

D. User Technical Support

Technical user support deals with the technical support and help given to users in terms of operating the IS in the organization. The identified elements among the critical user support include participating in design planning, software upgrades, IS staff response time, improved personal productivity, user training, documentation, development support, hardware standards, hardware upgrades, system downtime, system response time and cost-effectiveness [51]. Diverse studies have demonstrated the contributing role of user-technical support in ensuring successful IS adoption and utilization. A study hypothesizes and empirically proves that technical user support is significantly correlated with IS success operationalised in terms of systems quality, information quality, perceived usefulness and user satisfaction [19]. In an earlier study, positive contribution of technical user support on IS utilization is discovered [4]. Similarly, other studies also recognized the importance of technical user support in ensuring personal computer utilization ([33], [63]). Based on the preceding

discussion, the study posits that: *User technical support is significantly related to strategic IS utilization.*

III. ORGANIZATIONAL FACTORS

Based on our review of the literature, the organizational factors that are found relevant and have contributing effect towards strategic IS utilizations include firm size, top management support, functional integration, slack resources and information intensity.

A. Firm Size

Organization business size is defined as the number of equivalent full-time salaried employees in the organization. The adoption literature proposed that scope and size are important organizational factors for technology adoption [48, 58]. A meta-analysis conducted revealed that firm size is one of the most researched factors in organizational adoption of technology [13]. Past studies have shown that the bigger the size of the firm, the greater the possibilities of implementing computer and internet technologies ([7], [50], [56]). Other studies have also found that firm size is strongly associated with the implementation of ERP [54], e-commerce [47] and web services [10]. Studies conducted in Malaysia also confirmed that firm size has contributing effect on technology implementation ([4], [22], [29]). The reason why larger organizations are more inclined towards technology adoption could be associated with their resource capabilities. Financial performance was found to be closely related to firm size [15]. However, it was argued that organizational size *per se* has no compelling rationale linking it to innovation adoption; rather it serves as a proxy for other variables, such as slack resources, education and professionalism, specialization, and scale [58]. Nevertheless, based on aforementioned empirical evidence, we still argue that firm size has positive influence on strategic utilizations of IS. Consequently, it is hypothesized that: *Firm size is significantly related to strategic IS utilization.*

B. Top Management Support

Top management support of information systems refers to the degree to which top management understands the importance of the IS function and the extent to which it is involved in IS activities [44]. The role and impact of top management support has been vastly researched in diverse IT/IS implementation setting. Past studies done in Malaysia have shown that top management support is influential in ensuring the success of the implementation of internet [25], public management information systems [4,19], Enterprise Resource Planning [46], and accounting information systems [24]. Other studies that were done elsewhere but also recognized the importance of top management support include open source software [16], inter-organizational systems [34] and executive information systems [5]. High degree of managerial support for IS / IT implementation will not only demonstrate commitment and continuous support for the project but

also develop conducive implementation environment by providing necessary resources such as time, space, equipment and people. Researchers also suggest that when vision or goals are shared within the organization community and continually communicated and supported by senior management, it will lead to clear common objectives toward technological advances. Thus, in light of the above discussion this study hypothesizes that: *Top management support is significantly related to strategic IS utilization*

C. Functional Integration

The organization is divided into multiple divisions or departments through a process of differentiation, [27 cited in 52]. Differentiation transpires due to the need of organizational units to focus on a different set of conditions outside of the firm coupled with the needs to specialize. Specialization leads to differences in attitude of managers, along the four dimensions of goals, time orientation, interpersonal orientation, and structural formality [14]. Hence, specialization increases the challenge and problems of functional integration. However, another research found that the best performing organizations are both highly differentiated and highly integrated [27]. A study alleges that functional integration is required because (i) functional unit often depends on each other for inputs (sequential or reciprocal dependence) (ii) functional unit often needs to cooperate to execute distinct parts of a process (iii) integration can mean more efficient sharing of resources and the development of organizational standards (iv) functional integration helps support process integration because the functional or departmental managers are better able to coordinate their decisions with respect to process execution [52]. The same study suggest that among the mechanism of which functional integration can be achieved is through the use of e-mail and other collaborative software [52]. The literature suggests that the term functional integration is sometimes equated with the term business synergy. For instance, The term business synergy is used to define as the degree of interdependence among the various business units and functions [66]. The authors argued that one of the indicators of business synergy is the extent of cooperation and coordination among business units and functions that are required for developing new product or services. Further, they assert that increased similarity and interdependence among the various product lines across business units demand more extensive coordination and information sharing. Based on the aforementioned arguments, the study hypothesizes that: *Functional integration is significantly related to strategic IS utilization.*

D. Slack Resources

Slack resources refer to the degree to which a pool of resources is perceived to be in excess [23]. In most studies organizational slack resource refers to financial slack as well as slack in human resources [32]. Slack resources aid in the implementation of an innovation in three ways (i) contributes to technical and organizational

preparedness through previous expenditures (ii) acquire resources that aid in implementation, such as securing the services of managerial or technical talent from a consulting firm (iii) pursue more risk (such as adopting more radical innovations) due to the cushion of assets that will lessen the blow of a failure should it occur [36]. Slack resources safeguards organization could be from any possible fatal hazards due to the rapidly changing environment [26]. Only organizations that have slack resources can afford costly innovations, can absorb failure, and can explore new ideas in advance of the actual need [13]. However, past studies on variety of IS adoption and implementation produced mixed results. While an insignificant relationship was found [23], others reported positive relationship [4,37,19]. However, in the context of present study we still argue that slack resources are important in ensuring strategic utilization of IS. Hence, it is posited that: *Slack resources are significantly related to strategic IS utilization.*

E. Information Intensity

The concept of information intensity was firstly proposed by Porter [41]. They suggest that information intensive products are generally more complicated to order or use, and require more accompanying information. The level of information intensity of the product or service is highly related with the degree to which the information is present in that product or service. It was found that the information intensity of products or services offered by an organization have a bearing on the adoption of IT-based innovation [28]. Firms with high information intensity will have greater need for and opportunities to exploit IT compared to other firms [66]. The greater the information intensity, the greater the likelihood that the organization will depend on IT for its operations [41]. Past studies have shown the contributing effect of information intensity on the adoption and usage of email [3], business-to-business [62], mobile internet [2], and ERP [64]. Based on the supportive empirical evidence, this study hypothesizes that: *Information intensity is significantly related to strategic IS utilization.*

IV. ENVIRONMENTAL FACTORS

Past studies have investigated various environmental factors that contribute to the adoption and implementation of various IS / IT. Among the factors explored are environmental uncertainty and external pressure.

A. Environmental Uncertainty

The degree of uncertainty in the environment can arise from heterogeneity of products and services, dynamism of the environment, and perceived environmental competitiveness in the environment [32]. Environmental heterogeneity creates the need for organizations to compete less on cost effectiveness due to many dissimilar products/services, but more on innovation and differentiation of products and services [42]. Environmental dynamism refers to the rate of product/service changes in the industry as well as the

unpredictability of the actions of suppliers, customers and competitors. Environmental competitiveness refers to the severity of competition in an organization's marketplace reflected by hostility or threats faced by the organization in gaining access to the markets of scarce resources or customers. It is argued that in order to function in highly uncertain environments, organizations engage in greater sensing and search, and hence uncertainty has been found to be positively related to technological adoption and utilization [49]. The study further assert that adoption and utilization decision, in particular, is likely to be viewed as a way to cope with uncertainty, as it provides a structured means of sensing the environment, gathering information, identifying alternatives, and quantifying unknowns. Thus, greater uncertainty in the industry environment should be positively related to technological diffusion and infusion. Diverse studies have shown the contributing effect of environmental uncertainty on IS adoption and utilization. A group of telecommunication technologies was studied and found that environmental uncertainty showed significant relationships with usage [18]. Likewise, in another study, it was found that positive contribution of environmental uncertainty was on executive information systems usage [45]. On the ground of these findings and preceding discussion, the study at hand posits that: *Environmental uncertainty is significantly related to strategic IS utilization.*

B. External Pressure

A study found that external pressure is the influence on the firm from the organizational environment via competitive pressure and imposition by trading partners [20]. External pressure can stem from a variety of sources, including competitors, the government, consultancy firms etc. [64]. The term mimetic pressure is use to describe the pressure caused by two situations i.e. the prevalence of a practice in the focal organization's industry and the perceived success of organizations within the focal organization's industry that have adopted the practice [55]. If a firm's competitors, suppliers or customers are adopting and some types of IS or IT, this results in pressure for non-adopters to also adopt similar IS. This pressure is caused by the perception that adopters will have certain competitive advantages by using certain systems. Depending upon the intensity of the pressure, the type and need for implementing IS varies across organizations. Various studies have shown that increased external pressure in the marketplace has been a major force propelling companies to adopt and utilized various kind of IT / IS such as e-business ([23], [60], [68]) eXtensible Business Reporting Language or XBRL [59], e-government [61], electronic information sharing [1], mobile internet [2] and ERP [64]. Against this background, this study also anticipates that increase competitive pressure on the organization should also result higher level of IS strategic usage. To this effect, it is hypothesized that: *External pressure is significantly related to strategic IS utilization.*

V. SUMMARY

The testable propositions presented in this paper offer an opportunity for further investigation on the effect of technological, organizational and environmental factors on IS strategic utilization through variety of research designs and settings. Clearly, survey research designs employing IS managers as respondents would best match the requirements for validating the proposed framework. Further, prospective researchers intending to adopt the model should also consider incorporating additional dimensions of technological, organizational and environmental factors. The proposed model should be of interest to both IS practitioners and academic community. For the practitioner community, the model will enhance their understandings on the factors that contribute towards IS strategic utilizations. For the academic community, the proposed model provides ample research opportunity to validate i.e. to support or refute the proposed propositions. Findings of such study can be incorporated into the teaching of IS implementations in the IS curriculum.

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