A framework for information systems planning for e-business

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Keywords

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Abstract

E-business information systems are computer applications that leverage intra- and inter-firm process and systems integration. Considering the growth and strategic importance of e-business, while it is important for organizations to carefully plan for and architect e-business systems, none of the existing information systems planning models is adequate for the task. An e-business architecture planning model is developed by identifying 12 generic e-business models and three axes on which drivers of the information architecture needs of e-business firms fall. Sowa and Zachman's information architecture is augmented to further facilitate e-business information systems architecture planning.

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Introduction

In the last few years, the Internet has emerged as an important medium of commerce. The global reach and interconnectivity of the Internet have spawned new business models and radically transformed existing ones. The beginnings of e-business can be traced to interactive Web sites that allow people to send and receive information from a company's Web server. Starting from Web browsers, much technological advancement has made the Internet a platform of choice for information systems in organizations. In a recent survey, a third of the 100 respondents said that their organizations use the Internet in 10-25 per cent of their business critical applications (Baer, 1998). It is expected that within the next three years the Internet will be the dominant platform for business applications in almost all organizations.

The use of the Internet for enterprise applications has created a new breed of information systems called the e-business information systems (EBIS). E-business information systems are computer applications that use the Internet technology, its universal connectivity and the capabilities of the Web browser to integrate business processes within and beyond an enterprise. The use of the Internet technologies to manage information is a substantial improvement over traditional information systems and conventional uses of the Web (Applegate, 1995; Hsu and Pant, 2000; Venkatraman, 1994). E-business information systems allow transactions to be conducted in an integrated and enlarged information space by removing constraints imposed by diverse computing platforms, networks, and applications (Isakowitz and Fabio, 1998; Lederer and Sethi, 1998). The Internet and the Web technologies not only allow automation of inter-organizational processes, but also allow individual users to interact with organizational information systems in novel ways and at very low cost.

E-business information systems are strategic assets as they enable new business models. For the pure dot.com firms, the EBIS is often the business and the capabilities of the systems dictate the business services offered by these firms. For the brick and mortar

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firms, EBIS are the *locus* of their efforts to transition from an old economy business model to the new economy business model. In both types of organizations, these systems themselves could earn economic rents if recent trends in patenting business processes continue. Hence, it is important for organizations to carefully plan for and architect e-business systems, understanding that the nature of these systems is quite different from those of traditional inter-organizational information systems. However, limited research has been done in the area of e-business systems planning. Existing IS planning models were developed prior to the advent of the Internet. It is thus not surprising that these models fail to explicitly consider the forces that shape organizational growth and success in the new economy and hence may not address the information systems planning needs of e-businesses.

In this paper, we develop an information systems planning model for e-businesses that explicitly takes into account the information management challenges that organizations face today and how the Internet technologies can be used to address some of these challenges. Drawing from economic theories, we identify three axes on which drivers of the information architecture needs of e-business firms fall. These include inter- and intra-organizational integration, timeliness of information exchange within and between organizational entities and the need for creating and sustaining a global community of customers, business partners and suppliers. We posit that e-business models vary on these three axes and that these variations have to be accounted for in planning the information architecture of an organization.

We review current information systems planning models and identify their shortcomings in addressing the planning needs of e-businesses. We synthesize economic theories to develop the theoretical foundations of our e-business classification framework and then develop the classification framework itself. The use of our framework is then illustrated by specifying how the widely used Zachman's information architecture framework can be augmented to address the planning needs of e-businesses. We conclude by discussing the use of our planning framework and identify directions for future research.

Review of information systems planning models

Existing planning models can be broadly classified into impact and alignment models (Vitale *et al.*, 1986). Impact models focus on the potential impact of information technology on organizational tasks and processes and use this as the basis to identify opportunities for deploying information systems. Alignment models, on the other hand, focus on aligning the information system's plans and priorities with organizational strategy and business goals.

Michael Porter's value chain analysis is by far the most widely used impact model. According to Porter, "every firm is a collection of activities that are performed to design, produce, market, deliver, and support its product". These activities can be represented using a value chain. Value chain analysis helps in identifying key value-adding processes that could be made more effective using information technology. As a planning methodology, value chain analysis is too abstract as it does not provide specific guidelines for designing an information architecture, nor does it provide guidelines for systems development and implementation (Porter and Millar, 1985). Moreover, over the past year, there has been a strategic shift from thinking about value chains to value hubs where the "linear" value chain perspective has evolved to a "hub-centric" model, i.e. e-marketplaces. This shift in thinking has been largely driven by two factors: the competitive pressures to respond to a direct selling strategy initiated by companies like Dell, and the maturation of the Internet and related technologies. These changes limit the applicability of the original value chain model for information systems planning for e-business.

Popular alignment methodologies include critical success factors, business systems planning (BSP) from IBM, strategic systems planning, information engineering (Martin, 1989) and method/1. Critical success factors (Rockart, 1979) methodology focuses on identifying key information needs of senior executives and building information systems around those key needs. The emphasis on senior management's information requirements is based on an organizational control model of critical decisions being made by informed executives. However, the control

in e-business is more diffused, autonomous and often occurs outside the organization. This reduces the usefulness of this methodology for EBIS architecture planning.

BSP combines top-down planning with bottom-up implementation and focuses on a firm's business processes to derive data needs and classes. Similarly, strategic systems planning methodology stresses functional area analysis to identify the data architecture, which is then used to design information systems. Information engineering provides techniques for building enterprise, data, and process models. These models are combined to form a comprehensive knowledge base that is used to create and maintain information systems.

Experience of organizations suggests that these methodologies tend to be too detailed, time-consuming, and expensive. The roots of these methodologies can be traced to systems development practices of the 1980s. Since then new paradigms such as component based development have come into use. These paradigms place less emphasis on building applications from scratch and stress a factory approach of assembling pre-packaged components to create application systems. Hence, organizations often find methodologies such as BSP too rigid and unsuitable for the highly compressed development cycle times that prevail in e-business applications development. Moreover, EBIS planning requires addressing how diverse systems and platforms will be integrated to meet organizational requirements. The alignment methodologies fail to explicitly address such integration issues because they are from an era when organizations created their own information systems and cross-platform integration was not a primary need.

In Table I we summarize salient features of these planning models and identify their shortcomings when applied to the context of EBIS architecture planning. These shortcomings are in part because of the significant shifts in business practices and technological capabilities in the last few years. In addition, some of the planning models do not have strong theoretical roots, which makes it difficult to augment them to suit new contexts. In the next section, we draw from economic theories to identify the key factors that should shape the architecture of e-businesses systems.

Theoretical foundations of information systems planning for e-business

We develop a framework for e-business information architecture planning that allows organizations to explicitly focus on the unique information management needs faced by e-businesses. Based on theory, information integration, timeliness of information exchange and creating a community of users are identified as important axes on which e-business need to position their information architecture requirements. Theoretical underpinnings of these three dimensions have their roots in the economic theories that posit the role of information and information systems in a firm's products, services, and processes.

Transaction cost theory explains the economics of information and information systems. The originator of this theory, Ronald Coase (1937), argued that, contrary to assumptions that transactions through exchange mechanisms are homogeneous, real-life transactions are more complex and involve transaction costs. A key concept in production is the firm, which is an economic institution that transforms factors of production into consumer goods and services. The firm operates within a market, but it is also a negation of the market in the sense that it replaces the market coordination with coordination through explicit command and control. How an economy operates and which activities are organized through markets and which activities are organized through firms depends on various transaction costs involved. Markets reduce transaction costs as people dealing through market mechanisms do not need to negotiate and enforce individual contracts, nor do they need to acquire and process information about alternatives. Generally, the less organized the market, the higher the transaction costs.

It is suggested that integration of organizational and inter-organizational processes (including customer processes) significantly reduces transaction costs (Hoffman and Hsu, 1993). Integration with outside agents also results in increased risk to firms. Firms have tended to avoid such transaction risks either by becoming vertically integrated or by reducing coordination with external partners. However, information technology has the ability to lower coordination costs without increasing the associated transaction risks, leading to more

Table I Information systems planning frameworks

Framework	Salient features	Inadequacy for EBIS planning
Value chain analysis	A form of business activity analysis Helps in devising information systems which increase profit Concentrates on value-adding business activities	Does not define a systems architecture Has limited applicability for e-business planning
Critical success factors	Used for identifying key information needs of an organization and its managers	Does not define a systems architecture Is outdated Ignores value adding aspects of information systems Has limited applicability for e-business planning
Business systems planning	Combines top-down planning with bottom-up implementation Focuses on business processes Data needs and data classes are derived from business processes	All four methodologies, BSP, SSP, IE, and Method/1, suffer from the following disadvantages: Outdated Focused on internal data processing needs of firms Focused on building proprietary information systems Fail to address systems integration issues
Strategic systems planning	A business functional model is defined by analyzing major functional areas of a business Data architecture is derived from the business function model The data architecture is used to identify new systems and their implementation schedules	
Information engineering	Provides techniques for building enterprise, data, and process models These models are combined to form a comprehensive knowledge base that is used to create and maintain information systems	
Method/1	A layered approach: Top layer is methodology, middle layer is techniques supporting methodology and the bottom layer has tools supporting techniques Techniques supported: DFD, matrix analysis, functional decomposition, focus groups and Delphi studies Supported by CASE tool Foundation	

outsourcing and less vertically integrated firms (Clemons *et al.*, 1993). This has led to new ways in which organizations can structure themselves as they start to rely more on cooperative marketplaces for transactions that otherwise would have been conducted through proprietary channels.

The potential to lower transaction costs by using information technology presents a significant strategic opportunity that organizations must exploit to succeed in the new economy. While EDI networks and proprietary platforms have been used to create virtual marketplaces in the past, these platforms are generally more expensive and less ubiquitous than the Internet (Angeles, 2000). In fact, e-businesses are attempting to use the Internet to seamlessly integrate enterprise systems, databases, and workflows across organizational boundaries and planning frameworks. These organizations must explicitly account for the technical and organizational challenges involved in effective information integration, using Internet technologies in their information architecture development strategies.

The second theoretical underpinning for our framework comes from the economic concept of network externalities or network effects. This effect explains how the value of a product or service increases as the number of users of the product or the service increases. Metcalf stated this law as "the usefulness, or utility, of a network equals the square of the number of users" (Downes and Chunka, 1998). For example, the more the number of people who use a software, a network, a standard, a game, a book, or a Web site, the more valuable it becomes and, in turn, the more new users it attracts. Thus, it is

reasonable to assume that the greater the number of people, machines, and networks that interact with one another through an e-business information system, the higher will be its value. In general, a higher value will be achieved by e-business systems that create global communities of customers, business partners and suppliers.

In designing the information infrastructure, organizations must try to build in capabilities to develop, sustain and rapidly grow a user community. Communities grow through positive feedback, which is self-perpetuating. On the other hand, negative feedback can lead to a community not reaching a critical mass necessary to make it an economically attractive business asset. Thus, organizations have to pay particular attention to creating the informational resources and flexible ways to create, share and disseminate these resources throughout the community. Moreover, issues such as interface design take on added importance when an organization needs to rapidly build a user community to sustain its e-business model.

Information is an agent of coordination and control and serves as the glue that holds together organizations, franchises, supply chains and distribution channels. Along with material and other resource flows, information flows must also be handled effectively in any organization. Organization structures, distribution channels and supply chains are traditionally optimized to simultaneously handle both resource flows and information flows. For example, distribution outlets are designed for delivery of both product information and the physical product being sold. Economists contend that there are some fundamental ways in which information differs from other organizational resources, and those differences form the basis of some of the emerging e-business models (Shapiro and Varian, 1999; Evans and Wurster, 1997). Evans and Wurster (1997) suggested that the deconstruction of old business models is fundamentally one of separating information flows from physical flows and organizing differently to handle each of these flows. E-tailers, for example, explicitly separate the information flows from the physical flows and handle them separately. Such separation is expected to release value that has hitherto been suppressed because of sub-optimal design of organizational systems. Often the informational component of the business is valued higher than the rest of the business, as is evident from the recent stock market valuations. The auto exchange created recently by General Motors, for example, was valued at $40 billion, which was higher than the market valuation of General Motors itself.

Such valuation is in part because separation of the informational component of a business provides opportunities to turn information into a product or service. Information can be sold for profit or given away free (in lieu of some other benefit) and the economics of such business models is very attractive due to the unique characteristics of information products. First, information is costly to produce but has nearly zero marginal cost to reproduce. Second, sharing information results in value enhancement for both the sender and the receiver of the information. Third, information goods and services must be priced based on the value they hold for users and not based on the costs of producing/reproducing the information. These characteristics make selling information products a relatively scalable and high-margin business.

Whether information is used for control and coordination or sold as a product, its value is dependent on its half-life. Half-life of information refers to how quickly the information becomes dated or obsolete; some information has a higher half-life, while other has a very short half-life. For example, news and stock quotes have a shorter half-life than commentaries and analytical reports. We often hear claims like "modern businesses must operate in real-time". But this "real-time" itself has a different connotation for different businesses and for different kinds of information flows, products, and services. In some cases, information must be exchanged in absolute real-time, while in some other cases information sharing can be, and even should be, delayed. For example, weather portals will need to exhibit a very high temporality of information, with a need to update information in real-time, while a Web site like Lycos maps need not refresh information for a very long time. The half-life of information is a function of its timely dissemination and sharing. Consequently, how quickly information needs to be exchanged between processes becomes an important information infrastructure design issue.

In summary, the economics of e-business suggests that the information management

needs of firms should be shaped by business needs to integrate processes, exchange information in a timely manner, and create positive network externalities. Our analysis suggests that, while information integration, timeliness of information exchange and building user communities are beneficial, they entail business risks and costs. Table II is our summary of potential benefits and risks when organizations emphasize each of the three dimensions in designing their information systems. We argue that there are potentially several information infrastructure design strategies that organizations could pursue by carefully positioning their e-business model on the three dimensions identified here. For example, an e-tailing outlet can pursue a strategy of tight integration with its wholesalers (e.g. Amazon) or merely provide a storefront to customers without extensive backend integration. Similarly, the business may pursue the objectives of creating user communities to varying extents. These choices will have non-trivial implications on the design of the information infrastructure of e-businesses.

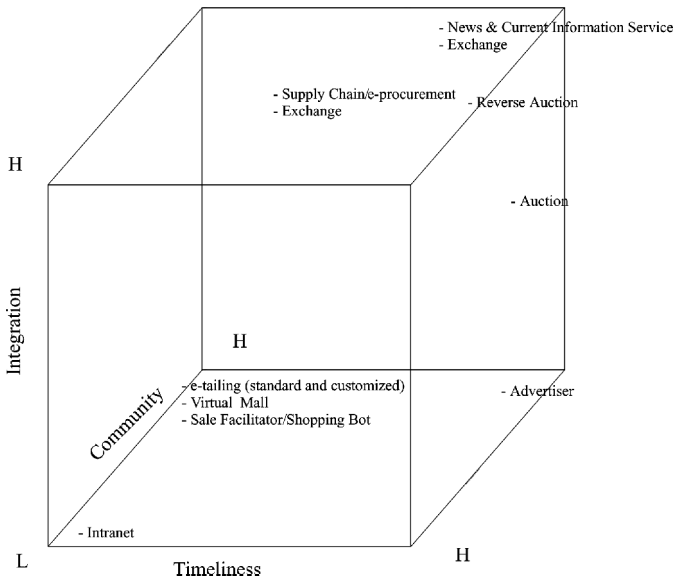
A framework for classifying e-business models

As discussed in the previous section, e-businesses vary on the extent of process and system integration (internal and external), timely information dissemination and the creation of a community of users. Figure 1 depicts a framework for classifying e-businesses using these three dimensions. There are two aspects of process and systems integration, internal integration and external integration. Internal integration refers to integration of processes and systems with an organization, and external integration refers to integration of processes and systems with other business partners. External integration is further conceptualized in terms of its breadth and depth. Depth of integration measures the extent to which an e-business integrates with the systems and processes across its value chain, i.e. the degree of integration across a vertical channel. Integration breadth, on the other hand, measures the number of partners with whom an e-business must link horizontally to support its business model. For example, the

Table II Benefits, costs, and risks of EBIS characteristics

Characteristic of EBIS	Benefits	Business costs and risks
Integration	Productivity gains from re-engineered processes	High cost of integrating systems, processes, and applications
	Cutting paper trail	Difficulties in agreeing with business partners on service descriptions, linking computers and databases
	New products and services become possible due to information sharing (e.g. frequent flyer program of American Airlines)	Dependence on suppliers
	Better customer service	Quality may suffer if suppliers are not good quality
	Quick response to market conditions	Use of others' resources. Hence need for a high level of trust
	Available-to-promise mode of manufacturing, i.e. products are driven by customer order and not made-to-stock, resulting in reduced inventory buffers and better utilization of resources	Competition may decline (among different departments and business units as well as among suppliers)
	Higher velocity of products and services	Possible anti-trust law violations
	Product and service customization	
Timeliness	Productivity gains	Information overload – may result in deterioration in quality of decision and lack of perspective on issues
	Customer satisfaction	Business partners may not be ready
	Better decision making	High cost of providing information
	Quick response to market conditions	Increase in choices for customers, which may raise their expectations and put strain on a firm
	Better utilization of resources	Panic effect (e.g. Stock Market crash of 1987)
Community	Sense of belonging, which may tie-in customers to buying a company's products or services	Negative information may get disseminated among community members
	Higher customer satisfaction	Inferior quality of information
	Timely feedback	Loss of organizational control over what customers may discuss
	Ideas for new products and services	
	Customers help themselves – reduction In support functions	

Figure 1 Classification of e-business models



supply chain/e-procurement model will need to possess a higher depth of integration. A truly integrated Web-based supply chain system will also be well integrated internally with the enterprise resource planning (ERP) and customer relationship management (CRM) systems of a firm (LaMonica, 1999; Mecker, 1999).

Figure 1 depicts that information can be exchanged in real time, almost in real time or in a delayed fashion. Real time information exchange requires that information be updated instantaneously with zero latency, while nearly real time sharing could tolerate some latency. Real-time information updates will be necessary in e-business models for delivering news, stock market quotes and time-sensitive information such as flight availability and hotel reservations. Nearly real-time information updates will be appropriate for models where inventory status information is exchanged between trading partners. On the other hand, businesses that employ the online music and video-on-demand portals can wait to update their information until they are ready to provide a new song, video, or game to their customers. Thus, delayed information sharing would suffice for these businesses.

The spirit of community and relationships between its members are what makes a virtual community a valuable business asset. The fractal depth of a community measures the degree to which the community can be segmented (Hagel and Armstrong, 1999). Communities with greater fractal depth can be segmented in many ways into smaller cohesive groups. The deeper a community can be segmented, the more value it holds for advertising and marketing purposes. For example, a travel Web site might be able to segment its user community by geography, travel destinations, reasons for traveling (business, culture, hobby, sports) and type of travel (air, cruise, road, rail). Fractal breadth refers to the ability of the community to migrate to arenas that bear no relation to the community's original focus (Hagel and Armstrong, 1999). For example, Amazon is attempting to lure a community of book buyers to migrate into arenas such as home electronics and toys. Communities that have greater breadth offer more value because of the opportunities it creates for product bundling and cross-selling.

The framework proposed here is useful for identifying variations in the information management needs of different e-business models. Understanding these variations can allow planners to focus on specific systems capabilities needed to meet the information needs of an e-business. We have identified the key e-business models that are currently being used by organizations and their information management needs. An e-business organization could use one or more of these models in developing its offerings. For example, Amazon's business model is a combination of an e-tailing (standard products) and a supply chain model. On the other hand, the model of marketstreetmall.com, which is a storefront for a few north-country stores, is a simple e-tailing (standard product) model. Dell's model is a combination of e-tailing (customized product) and a supply chain model.

Each model occupies a niche on the cube of Figure 1. Planners need to understand their e-business in terms of the underlying model(s) and the information management requirements thereof. In Table III we briefly describe the key e-business models and their information requirements. These models are also positioned on the cube in Figure 1.

How does such classification help in planning for EBIS architectures? In the next section we answer this question by mapping the above classification framework on to the popular information architecture model put forth by Sowa and Zachman (1992).

Table III E-business models

Business model	Description and examples	Information flows and requirements
e-tailing (standard product)	Businesses following this model offer a standard product like a book, CD, cosmetics, apparel, etc. for sale on the Web. Examples: Amazon (combines this and the supply chain model), Covergirl.com, CDNow.com, etc.	Basic information flows are: displaying product information, entertaining customer queries and orders, validating credit card information, completing customer query or sale. Systems supporting this model at a minimum should have moderate to high breadth of integration. However, integration depth could be low. Delayed information update is sufficient in most contexts. The necessity of creating a user community will depend on the extent to which user generated content is necessary and influential in driving sales
e-tailing (customized product)	Businesses following this model offer a product (that the customer can customize) for sale on the Web. This model was pioneered by Dell and has been adopted by many other sellers of PCs, laptops, workstations, etc.	Basic information flows are: displaying product information, entertaining customer queries, letting customers configure their order, validating credit card information, completing customer query or sale. Systems supporting this model must have features that allow customers to tailor a product or service to their specific needs. In contexts where customers are businesses, such customization will require meshing processes supported by the e-tailer with those of their customers. So these systems should have moderate to high integration depth. Integration breadth will depend on the type of accessory services such as links to related products and services provided at the Web site. Delayed information update is sufficient in most contexts
Virtual mall	This model relies for its success on presenting to customers a number of products for sale from one portal. Examples: Yahoo! Shopping, MarketStreetMall	Basic information flows are: displaying product information, entertaining customer queries and orders, validating credit card information, completing customer query or sale. Systems supporting this model will have high integration breadth since links to a number of e-tail systems have to be provided in order to offer the product variety that is typical in a mall. Typically, integration depth is low because the mall only serves as a referral point and actual transactions are conducted through the e-tail systems of the organizations. Information update has to be nearly real-time. Organizations offering competing products might respond in real time to promotions of competitors. Malls in the physical world serve a dual purpose of selling goods and providing a place for people to commune and get entertained. So features to create and sustain a community of visitors is important for a virtual mall
Sale facilitator/shopping bot	The success of this model depends on attracting a large number of potential customers to a Web site. Incentive for people to go to a Web site could be either to earn cash/reward or to find the lowest price for the article that they are looking for. Examples are pointclick.com which rewards people browsing the site by giving them cash for the number of sites they visit and mysimon.com which searches the Web for lowest price for a desired item	Basic information flows for pointclick.com are simple hyperlinks to various Web sites from the portal. The portal needs to have the added capability to track user accounts, credit them, and periodically mail cash earned by them. mysimon.com relies on search technologies that make use of artificial intelligence to search for lowest prices on specific articles. Integration breadth is high for these systems. Timeliness for these systems will also be high, as they will be required to search for the most current information. The need for creating and sustaining a user community is critical, because the value of these sites is largely dependent on its user community

(continued)

Table III

Business model	Description and examples	Information flows and requirements
Advertiser	This model depends on giving away something free to people visiting a Web site and earns revenue from advertising dollars. A slight variation on the "sale facilitator" model, businesses following this model provide a free service or product to people visiting the Web site. Examples include: download.com (free software), hotmail.com (free e-mail), efax.com (free fax on the Internet) dailpad.com (free long distance calling) and freeinternet.com (free access to Internet and other services)	Information flows and systems requirements vary from being very simple to highly complex. While download.com provides hyperlinks to ftp sites of different software providers, hotmail.com, efax.com and dialpad.com rely on advanced systems and technologies that manage individual user accounts. Ability to attract a large user community and being able to segment them effectively are critical to customize incentive offerings. Hence, these systems have to deal with communities with high fractal depth. Information has to be updated on a nearly real time basis. Integration of processes across the value chain is not critical and hence low integration depth is sufficient
News and current information dissemination services	This model relies for its success on making available some service free on the Web. Popular examples are weather.com, Lycos Maps, and newspaper and TV channel Web sites such as cnn.com, abc.com, and nytimes.com	Timeliness of information and the ability to attract, build and sustain the interest of a user community are critical systems requirements. Information has to be refreshed in real time. One way to attract a broad user community is to provide a variety of accessory services, necessitating a high breadth of integration
Service	This is a popular business model on the Web. Businesses create portals for offering different services like stock brokerage services (e*trade, e-schwab, discoverborkerage, dljdirect, etc.), online banking (wellsfargo), travel services (expedia, go, travelocity), education (ecollege, author's online course, www.cusbdl.clarkson.edu), and many more	Portals that provide successful services are fairly complex and handle the full range of information flows from customers, internal flows, and flows with external partners. Integration depth is high because of the need to execute transactions across the value chain seamlessly. Information has to be refreshed in real time since the half life of information in many contexts such as stock prices is very low
Supply chain/e-procurement	This model makes use of the ubiquitous connectivity of the Web to enhance and replace existing EDI linkages between business partners. Examples include Dell's supply chain with its partners and many such initiatives	Information flows and systems requirements that support this business model are usually fairly complex. The complexity of systems increases as integration depth increases (i.e. more processes and more partners in a value chain are made part of a system). How quickly the information has to be updated depends on various contexts, but generally nearly real time refresh cycles are sufficient. Also, moderate levels of community effect will be adequate
Exchange	This model makes use of the ubiquitous connectivity of the Web to bring buyers and sellers of industrial goods on to the same portal. The portal works on the principle of matching buyer's demand with supplier's supply in a two-way interactive manner. Popular examples of this emerging model are AutoXchange, eSteel, Chemical Exchange and Meat Exchange	Information flows and systems requirements that support this business model are usually fairly complex. This complexity is a result of the number of buyers, sellers, and the number of items that are traded on such exchanges. Exchanges typically facilitate transactions and hence require high integration depth to connect processes down a value chain. Since exchanges also bring a number of buyers and sellers together, integration breadth is also high. How quickly the information needs to be updated depends on a context, but generally nearly real time refresh cycles are sufficient. Since these systems rely for their success on a number of buyers and sellers coming together, community effect is also high

EBIS framework as a systems planning tool

John Zachman (1987) introduced a framework for designing information systems architectures that has been widely adopted by the IS community. Extended in 1992 with Sowa, this framework maps real world information requirements into the information system's space in a systematic manner. It does so by focusing on five perspectives of an information system, namely: those of planners, owners, designers, builders, and subcontractors. Planners are investors in the systems who are interested in the overall scope of the system; owners, on the other hand, are involved in daily routines of the business and are interested in enterprise models. Designers are systems analysts concerned with systems models, and builders and subcontractors are technical personnel interested in building the system and its components without being concerned with the overall context or structure of the system. Each one of the above five stakeholders is concerned with six building-blocks of systems, namely: data, function, network, people, time, and motivation for the system. Combining the above five views with the six aspects of information systems, the framework presents 30 different perspectives of an information system and identifies tools, methods and techniques appropriate for tasks pertaining to each perspective. Since the focus of this paper is on systems planning we will concentrate on the planner's view of the information systems architecture (ISA).

The primary focus of Sowa and Zachman's model in discussing data issues for planners is the list of things important to the business (e.g. product, part, supplies, equipment, promotions, and customer orders). We argue that data issues for EBIS planners will vary depending on the position of the planner's business model on the cube of Figure 1. An e-business model high on all three integration-timeliness-community (I-T-C) dimensions can expect to handle a high data volume and data that they do not own or create. Consequently, data compatibility, standard, and translation issues will be important. Furthermore, issue of ownership of data will be important. High trust between business partners will be needed to resolve data ownership issues. For business models placed in the lower left hand corner of Figure 1 (low on I-T-C dimensions), data will be largely internal to an organization. Also, since the data need not be updated in real time and are not used by external entities, response time, data ownership, and security issues will not be easier to resolve than in the case of systems for business models that are high on the I-T-C dimensions. Instead, data quality and efficiencies in porting data from legacy systems and Web-enabled platforms will assume importance.

Under the functional focus, the Sowa and Zachman model stresses the analysis of business processes, and the planner's main focus is on decisions about processes that a business can automate under budget, time, and resource constraints. For EBIS architecture planners, process issues become important for systems of certain types. For business models that are high on the I-T-C dimensions, planners need to concern themselves with the processes that an organization performs and those of its business partners and customers. Furthermore, they will need to make a strategic decision about redesigning business processes jointly with their business partners. For example, organizations designing an integrated supply chain will need to identify how their ordering and procurement processes integrate with those of their suppliers. In redesigning the supply chain, the planner will need not only to deal with technology issues, but also to take into account organizational factors such as supplier resistance to change and cost sharing for technology infrastructure. Customer processes also get altered in significant ways as customers interact directly with the EBIS in conducting their transactions. This has significant implications for systems interface design and the design of support systems for customer relationship management. For business models that are low on the I-T-C dimension, prioritizing internal processes to be automated will be an important issue. While potentially all the information handled by an organization should be accessible through Web interfaces, such total transformation from legacy platforms to the Internet is likely to take time. In the interim, choices regarding what data get shared through the Web have to be made by taking into account the critical information sharing needs of the firm as dictated by the position of the firm's business model in Figure 1.

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The network building-block of the information architecture focuses on the locations where business operates and how those locations will be linked electronically. The planner, thus, is concerned with decisions about hardware, software, and networking equipment that the business can commit to network different geographical locations. Network issues are very important for planners of EBIS architectures as well. Besides location, the planners should be concerned with bandwidth available to transport data. For business models that rely on global EBIS (e.g. global supply chain applications), it will become necessary to explicitly consider connectivity, cost, and bandwidths available in other countries. Bandwidth issues will also become significant when the business model depends on building a user community. Bandwidth requirements often may be difficult to predict or may be dependent on the traffic volume triggered by specific events. Two prominent instances in which a business model suffered due to inadequate bandwidth are:

(1) when the *Encyclopaedia Britannica* opened its portal to the public free; and
(2) the recent hosting of the Victoria's Secrets swimsuit show live on the Yahoo! Portal.

In both the cases bandwidth demand far outweighed its availability, which resulted in adverse publicity. Multi-media applications, though attractive, can often frustrate people trying to access them over slow data pipes. A simple solution like providing a text only version of a Web site often goes a long way in helping people navigate a Web site without feeling frustrated. For e-business models that are low on I-T-C dimensions, bandwidth and connectivity issues will be quite different as EBIS that enable such models will reside over a simple corporate intranet. Important issues for planners in such contexts will center on setting corporate standards for how information will be formatted and distributed over the intranet. For example, larger organizations will need to create multiple internal Web servers. Number and ownership of these Web servers will be an important planning issue. Also, the planners will need to ensure uniformity of page layout and control the content of pages so that bandwidth is utilized appropriately.

An important planning issue is understanding how people critical to a business are likely to interact with the information systems and what their information needs are. The Sowa and Zachman framework recommends that such analysis also needs to be extended to software agents that automate tasks performed by people. In e-business, it is likely that human interaction with computer systems will be high, because people (such as customers) who traditionally had a human interface with the organization must now rely solely on computer interfaces. Hence design of interfaces becomes an important planning issue. Some successful portals provide 24×7 customer support. For example, portals carsdirect.com and landsend.com provide online text and voice chat facilities to communicate with a customer service representative. Further, implementing e-business models could be empowering to some people in the organization but could de-power others. For example, a salesperson visiting an industrial client can log on to the company's portal from the client's premises and configure and commit his/her order on the spot. On the other hand, the discretionary authority of a purchase manager in a business that employs a supply chain/e-procurement model will be much curtailed. Additionally, such business models also affect organizational dynamics at a global level in the sense that some functions that were previously performed through well-defined hierarchies are now performed through market mechanisms. For example, different exchanges like auto, chemical, and steel will significantly affect purchase dynamics. Anti-trust issues in such situations also become important, as shown by the recent investigation of the department of justice of the meat exchange (Sullivan, 2000). For business models that are low on the I-T-C dimension, people issues will be important as well. Planners will need to address the organizational issues that stem from adopting new business models. Such issues include authority structure for and the frequency of posting information on a local intranet, and policies regarding acceptable use of communication technologies like bulletin boards and online chat.

The temporal dimension in the Sowa and Zachman model considers how the frequency of business events influences system

requirements. It is expected that a higher event frequency would require more organizational resources to respond effectively to the events. Organizational events have states and time cycles associated with them. For example, a customer order is an event that is fulfilled in a cycle. The enterprise design challenge is to produce a schedule of events and states that maximizes the utilization of available resources, while at the same time satisfying the external commitments. E-business models, generally, are expected to accelerate business events. For example, one of the goals of supply chain/e-procurement model is to increase the velocity of material flows. The effect of implementing such models is that event frequencies are increased without adding buffers. Planners should now take into account the visibility they need to provide to upstream and downstream processes and organizational entities to enable them to effectively substitute information for buffers. Timely information exchange will be affected by the availability of appropriate computing resources and business practices at all entities in the supply chain. Planners must anticipate technological, organizational and cultural impediments to information exchange and create mechanisms to address these deficiencies.

However, real time event cycle may not be necessary for all e-business models. Generally, planners should pay attention to the business value of information and make strategic decisions about what information to provide to customers, when to provide it, and at what price. For example, some businesses provide stock analysis to their customers instantaneously at a premium price, while the same information is provided with a delay at a lower price. Furthermore, for business models on the low end of the timeliness scale, planners will need to ensure that information is not updated more frequently than is necessary and thereby avoid information overload.

In the Sowa and Zachman framework, the primary focus of issues under the "motivation" category is how business goals and strategy of an organization influence its information architecture. In traditional information systems planning, business strategies are somewhat removed from systems strategies. In most cases, business strategies are formulated first and information systems strategies are aligned with business goals. Planning for e-business, on the other hand, must explicitly consider the possibility that technology can drive business strategy. For many business models in Table III, the portal itself is the business (e.g. e-tailing, information products and services, services). Success of these firms depends on their ability to expand the scope of their business by leveraging their technology infrastructure. For example, while Amazon started as a bookstore, it has now used its infrastructure to sell CDs and home electronics. This technology-centric strategy is relevant for business models that are low on the I-T-C dimension as well, because the technology infrastructure is an important communication channel in these organizations. In these organizations, planners need to ensure that internal Web pages and bulletin boards are aligned with the corporate culture, strategy, and thinking.

Discussions

In this paper, we focused our attention on identifying key factors that determine the information requirements of e-business. We drew from economic theories to develop a three-dimensional framework for classifying e-business models. The classification framework clearly delineates how each of these models varies on its information management requirements. Furthermore, we augmented the Zachman's information systems architecture model to serve as a framework for planning EBIS architectures.

The framework developed here adds to IS research and practice. Paucity of validated planning models makes it difficult to provide guidelines for practice in an area of vital importance to e-businesses. While a few e-business systems planning models have been put forth in recent years, each of these models has its own weaknesses. For example, the industry framework for e-business (Kalakota and Whinston, 1996; Kalakota and Robinson, 1999) is a broad-based framework that examines the significance of technologies in e-business. The focus of this framework is to explain e-commerce technologies and their capabilities. The framework lacks sufficient details to serve as a tool for EBIS architecture planning. Similarly, the Zwass framework (1996) is a general-purpose model focused on

the nature of e-commerce infrastructure, services, and products. This framework also fails to address the concerns and requirements of information systems architecture planners. While the Raghunathan and Mandey (1999) framework focuses on the information architecture for e-commerce and is useful in aligning e-commerce information systems to business needs, it fails to adequately address how the overall architecture of e-business systems should be planned and designed.

We do not claim, nor is it the intent of this paper, to address all the shortcomings of existing planning frameworks. Rather, we had a more modest goal of developing an e-business architecture planning framework that is anchored in economic theories. Researchers are encouraged to critically evaluate the three dimensions identified here and in the process refine the framework proposed here. Although we have addressed the core dimensions of EBIS in this paper, a few questions still remain unanswered and would form the basis for future research. For example, future research could extend our framework to another four stakeholders (owners, designers, builders, and sub-contractors) in the Sowa and Zachman framework. Another area of future research is to develop the economics of EBIS in a more quantitative fashion and come up with criteria and models for financial evaluation and justification of such systems. Considering the fact that significant resources are being invested in creating e-business information systems, such research could have considerable significance for practitioners.

While there are economic arguments for creating EBIS that are well integrated internally and with external partners, in practice there are many challenges involved in integrating diverse systems. A number of such problems have been articulated in the Delphi exercise of IT practitioners conducted in December 1999 (Delphi, 1999). It will be worthwhile to research the specific challenges and problems that organizations face in "Webifying" their ERP, procurement, customer relationship, supply chain, legacy, and other applications.

Besides being a research contribution, our framework also has significance for practitioners. Firms undertaking the task of EBIS architecture planning can use our framework in the following manner:

- Firms will need to identify their e-business model. A firm's e-business model could be one of the many models depicted in Table III, or, more likely, a combination of two or more of those business models.
- Identification of the business model will lead to positioning the firm on the I-T-C axes, which in turn highlights specific information management needs.
- Next, the architecture planners will need to evaluate the benefits and risks of their architectures by referring to Table II.
- The next step for planners will be to augment their data, process, network, people, time, and motivation issues to respond to requirements made by EBIS on these aspects of their architectures.

While we have outlined the broad steps in using the ideas presented in this paper, detailed methodologies are required to effectively guide planners in systematically evolving the information architecture for their organizations. We believe that the ideas put forth in this paper could serve as a useful starting point for developing a methodology for e-business information systems planning.

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