A SURVEY OF E-BUSINESS IMPLEMENTATION IN THE US CONSTRUCTION INDUSTRY

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SUMMARY: *Construction is known for its conservative attitude towards adopting new technologies. Today, many contractors have Enterprise Web Sites or use Project Specific Web Sites (PSWS) to share information with other partners, customers and suppliers. Industry players have formed various industry specific marketplaces to unite the buyer with the seller in cyberspace. This study examines whether the construction industry has redefined its way of doing business based on e-Business. The study focuses on determining the level of adoption of e-Business within project management systems by general contractors. The development of business transactions such as e-Procurement, e-Marketplace, trade exchange, and business strategies such as project collaboration, project management, Customer Relationship Management (CRM), and knowledge/data management are discussed, taking into consideration such issues as availability and reliability in the current business environment, with their advantages and disadvantages.*

KEYWORDS: *e-Business; e-Marketplace; e-Procurement; Globalization; Internet*

1. INTRODUCTION

1.1 Background

At $3.4 trillion annually, construction is the second largest industry in the U.S. The total cost of replacement of real estate exceeds $21 trillion in the U.S. alone. The Internet is changing the way business is done in construction. Despite the immaturity of the technology and its short history, e-Business initiatives are already transforming industries and becoming a key component. The Web has become a source for information, goods, and services, and a means of communication. This paper reports on a survey conducted to assess the construction industry's attitudes and perceptions with respect to e-Business. The questions were designed to find out how far the construction industry respondents have advanced in the implementation of e-Business applications, what type of companies use e-Business transactions, and to what extent they use these applications. The survey is focused on the company size, geographical distribution, revenue, e-Business transaction use, and e-Business investments and future plans for e-Business implementation. The study is based on a combination of mail and web-based responses from 20 corporations out of 91 organizations selected from the 2001 Engineering News Record Top 400 Construction Companies. The businesses surveyed represent project management and construction services companies throughout the U.S. The respondent companies varied in terms of annual revenues, workforce size and geographic region of operations.

To survive and succeed in today's business world, companies of any size, public or private, from any industry, from leaders to start-ups, feel the need and the pressure to develop strategies to catch up with Information Technology (IT). Cisco, Lands End, Dell, Ford, GE and various other companies have become role models for e-Business transformation. From CEO to human resource manager (HRM), corporations have started to use e-Business terminology such as "Customer Relationship Management," "e-Procurement," "portal," "on-line reverse auction," and "e-Marketplace" in their everyday business processes. A new way to find new markets,

discover or create new sales channels and get closer to customers and business partners through communication channels is enabled by e-Business. It automates business transactions and the information flow between organizations. Applications of e-Business allow the organization to provide better, faster and cheaper service.

Figure 1 shows a summary of the savings and efficiencies that are derived from the application of e-business in construction. New business trends force the industry to deliver a better product with enhanced customer involvement and satisfaction. To achieve this critical goal, businesses have to expand their market to the world, so that every player in the industry becomes highly developed in their niche market. Producing the best quality product and achieving the highest level of customer satisfaction requires all the team players to work jointly on their project through Internet tools. This will improve the quality of the end product satisfying the client, and will also improve the efficiency of product development satisfying the project team. The construction industry derives improved efficiencies out of e-Business besides just cost cutting. Figure 2 shows the relationships between various e-Business initiatives in the construction industry.

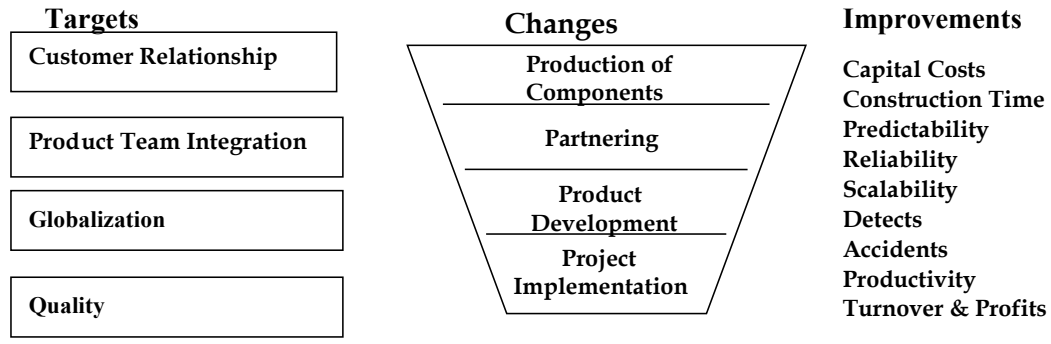

Figure 1: Effects of e-Business on the construction industry (BuildOnline 2000).

1.2 e-Business Offerings

e-Business enables transactions to take place online, thus increasing the accuracy and efficiency of business transaction processing while optimizing business processes. It condenses business cycle times, reduces cost, and improves customer service. It also allows the organization to do business with its partners. It eliminates obstacles between corporate and business partners or customers. It enables partners and customers to communicate and share information via the Internet, and it is used to serve customers, and provide the right information to the right people at the appropriate time. Market transparency for its customer-corporations, suppliers, customers, partners and marketplaces is created by e-Commerce.

Global construction projects come in different partnership formats such as joint ventures, outsourcing, and subcontracting or local representatives at the project location. This brings a new level of complexity to the industry: communication; different relationships; partnering; new markets; and global business standards and rules (Tucker 1997). For example, Bechtel, which is one of the largest construction companies in the U.S. (Engineering News Record

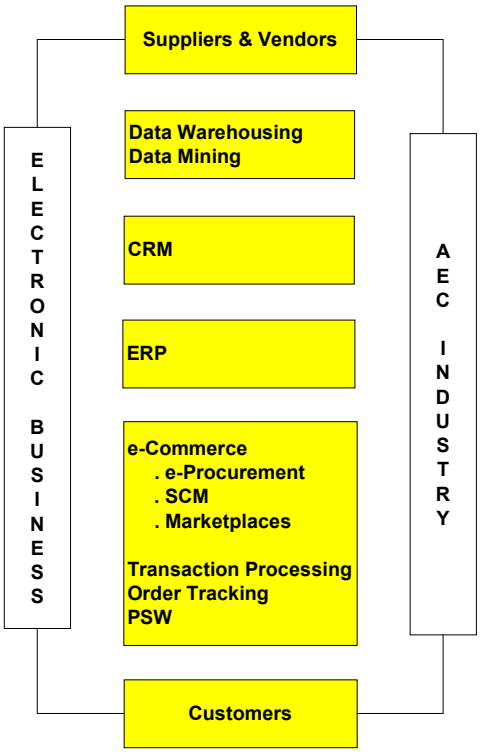

Figure 2: e-Business system diagram for AEC.

Top 400 2000), exhibits a well-defined global structure. It has 41,000 employees working in 66 different countries. Bechtel booked $14.5 billion in new business for 2000 and had $14.3 billion in revenue (Bechtel 2001)

2. US CONSTRUCTION INDUSTRY

2.1 Impact of e-Business

E-Business is growing at a very fast pace in our world. It has impacted businesses as well as governments. People do not write traditional letters to each other anymore, they communicate through the Internet. You can acquire permits, or visas online from governments. e-Business has expanded the construction market while making the world smaller.

Globalization, communication and collaboration are becoming easier with the advancements in information technology. Business is becoming global with cheaper, faster, and better quality of service. This will increase the global competition within the technologically advanced companies. This competition shapes the business culture and it requires business processes that are fast, specialized, personalized, flexible, functional, reliable, and customer-centric. Companies need to have a well-structured business culture in order to survive in the new digital business world. Business culture is a mindset that an enterprise develops over time that lays the foundation for sustaining a competitive advantage in its particular business environment (Wolf 2000).

2.2 e-Procurement

Despite the fact that construction is mainly a service industry, a majority of its activities require material handling and assembly functions. e-Procurement is critical to construction because it involves a number of partners on each project who all have the need for inventory management in order not to delay the project nor to tie space and money on excess inventory while also complying with specifications and other variables (Pheng and Meng 1997). Beyond the obvious transaction cost savings and access to suppliers, e-Procurement can offer product standardization, quality assurance, inventory management and the opportunity to manage material flows down the value chain (i.e. the contractor having input in subcontractors choices, the owner having input in contractors choices, etc.).

The best practices of the procurement processes in the construction industry are based on searching for vendor databases and comparing the products based on relevant technical and cost factors as well as detailed,

uniformed, standard documentation (Opentext News 2001). Figure 3 shows the benefits of e-Procurement as ranked by Sanders et al. (2001). Sanders et al. determined that e-Procurement saves up to fifteen percent (15%) of total purchase cost. It lowers the internal requisitioning cost by automating the internal requisitioning process. Companies reduce personnel costs and time inefficiencies with requisition approval and order processing. e-Procurement automates the workflow of procurement/resource management processes, which reduces the cycle time of purchases, decreases stocking requirements, and lowers inventory management costs. Finally e-Procurement applications enable enterprises to manage long-term relationships with suppliers. These relationships can be leveraged to create an enterprise-wide buying environment with the most favorable conditions.

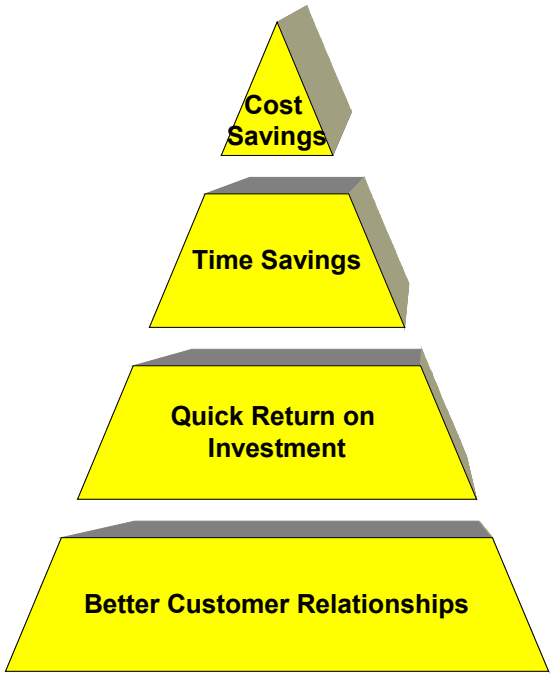

Figure 3: Benefits of e-Procurement to the construction industry.

Most analysts believe that long-term relationships with suppliers are one of the most important benefits of e-Procurement. According to Biz2Biz (2001) the average cost per purchase order runs from $75 to $150. In addition, e-Procurement reduces administrative costs significantly, from 60% to as much as 90% and it also reduces maverick buying or off-contract purchasing.

2.3 e-Marketplace

The e-Marketplace is a new business model that has emerged recently that allows companies to communicate, collaborate, and conduct business more effectively. Hurwitz Group estimates that between 800 and 1,000 e-Marketplaces were in existence in the year 2000 (Hurwitz Group 2000)**.** e-Marketplaces are also known as: B2B, vertical hub, online exchange, e-market, infomediary, metamediary, electronic market, Internet market, I-market, digital marketplace, digital exchange, net hub, virtual store, virtual marketplace, vertical hub, e-hubs, private exchange, vertical exchange, and horizontal exchange.

It is important to know that virtual marketplaces (e-markets) can be organized in two different ways either horizontally or vertically. Horizontal markets are those that provide a common service across many industries such as financial services, benefits management, and maintenance, repair and operating equipment procurement process management. The vertical marketplace is a vertical portal that refers to a web site which aggregates disparate content and services of interest to a particular industry and makes it available for industry members, for example, Bidcom, provides timely information about legal, insurance and regulatory issues that affect the industry, industry business news, updated information on product technologies, and details about information systems as well as Requests For Proposals (RFPs). A vertical marketplace in the construction market should provide an application-based service, such as home-finance calculators for the construction industry. At the same time, it should create efficient virtual markets for goods and services that industry participants both use and produce such as Buzzsaw, Bricsnet, etc.

The technology for e-Marketplaces is based on commerce infrastructure and supply chain capabilities such as buy-and-sell capabilities, supply-chain planning, execution, negotiation, and dynamic pricing arrangements. It needs to be secure, reliable, and available for all the users at any time. The security should be simple and it should guarantee that all information is kept confidential. It should validate users and control access to resource and information data. The data input and update should be complete and accurate. An audit trail must be maintained and made available to all e-Marketplace participants.

The e-Marketplace conducts business transactions using trading arrangements such as auctions, reverse auctions, or exchanges among multiple users. A virtual market is not only a medium for selling goods or services, it also integrates information flow from multiple locations. Virtual marketplaces are structured around software to enable sourcing and negotiation (Enos 2001). One of the benefits of e-Marketplaces is that they add value to the enterprise by increasing revenues and decreasing costs while improving customer service. In addition they deliver new varieties of revenue opportunities while decreasing the direct costs of sales (Raish 2000).

In a virtual marketplace, users can improve sales and distribution while at the same time reducing their inventory levels. In addition, virtual marketplaces provide new distribution channels for access to customers worldwide. Accordingly, users can develop new marketing channels while attracting repeat customers with improved access to products and services (Hoque 2000).

The US construction industry is fragmented among general contractors, subcontractors, architects, engineers, laborers, and developers. The top eight companies in terms of market share control less than twenty percent of the industry while by contrast the top companies in automotive industry control over seventy-five percent of all trade within the industry (Luening 2000). “The fragmented industry is one of the biggest challenges facing marketplaces” says Steve Kafka (Sanders et al. 2001), “marketplaces should streamline the industry to drive out the inefficiencies.” But most of the marketplaces for the construction industry provide only auctions and procurement tools and services.

AMEC, Bovis-LendLease, Hochtief and Turner, and Skanska, leading international engineering and construction companies, started an open and independent global business-to-business venture known initially as AECVenture (2001). It is the first global e-Marketplace in the construction industry. Its goal is to revolutionize the entire Architectural, Engineering and Construction (AEC) industry by linking global and regional portals in an innovative business model. The portal provides an integrated range of marketplace, collaboration, project management and other specialized tools using an Application Service Provider (ASP) model that promotes greater efficiency and effectiveness. It succeeded with twenty-five percent cost savings after it was fully operational (Potter 2001). However, in February 2001, Bovis-LendLease withdrew from AECVenture and indicated that it believed that the participants in construction are not ready, neither technologically nor culturally, to participate in e-Marketplaces.

According to analysts all these providers jumped into the industry before it was ready for e-Commerce (Rakow 2000). Recently, Aeonware (AEON Virtual Shopping Services, Inc.) and MPS eCOM GMBH announced that approximately 100 new Internet marketplaces for the building industry and 10,000 new shops would be developed. This will be a substantial addition to the existing construction virtual marketplaces. Some analysts seem to think that the construction market is big enough for all the players.

2.4 An example of e-Business practices in the construction industry

Bechtel is aggressively leveraging online technology and other innovative technology applications to become more powerful in the digital world. Bechtel is investing in Internet Technologies to streamline internal operations and communications within the organization and with partners and clients globally. To make the best use of cutting-edge technology, Bechtel is developing information systems and implementing e-Business initiatives from procurement, collaboration, document management, engineering and design solutions, and e-Commerce.

Online procurement is conducted through the Bechtel Procurement System (BPS). Bechtel Procurement Personnel send their needs (material requisitions, specs, drawings, scope statements, and commercial terms) out to the bidders via the Web.

The following are some statistics related to Bechtel’s procurement in the year 2000 using the Web:

- Spent $1.2 billion through a Web-based RFQ (Request For Quotes) tool, approximately twenty-five percent of the total 2000 procurement.

- Spent $300 million through Bechtel Purchasing Systems (BPS), approximately six percent of total purchase orders.
- Spent $250 million through an online reverse auction tool, which is provided by an outside vendor, FreeMarkets, which is a substantial increase from the $6 million spent in 1999. Pipe, valves, heat exchangers, vessels, columns, pumps, heat recovery steam generators, insulation and safety supplies are the goods that are auctioned.

Bechtel, for example, by leveraging its electronic Request For Quotes (RFQ) has been able to redirect its content, research and data towards its sourcing, bidding, and contract processes thus shortening its contract negotiation process (Bechtel 2001).

3. E-BUSINESS ASSESSMENT SURVEY FINDINGS

In order to determine the degree of implementation of e-Business in the US construction industry, an e-Business assessment survey was created. The survey was distributed to a random sample of 91 companies out of the 2001 Engineering News Record Top 400 US Contractors ranked by gross annual revenue who had a WWW presence. In addition to the demographic information about the 20 respondents, selected results of the survey are presented within the following four study areas: adoption of e-Business, communication tools usage, e-Business initiatives, and their prioritized goals for e-Business.

3.1 Survey Demographics

The survey demographics looked at include the job function of the respondents, the size of their workforce, and the geographical distribution of their operations. Figure 4 shows the distribution of respondents by job functions. The high number of executives (35%) responding to the survey indicates that senior management is more involved in their construction company's e-Business decisions than the Information Technology Consultants, or e-Business Strategists/Analysts, the second largest group of respondents to the survey.

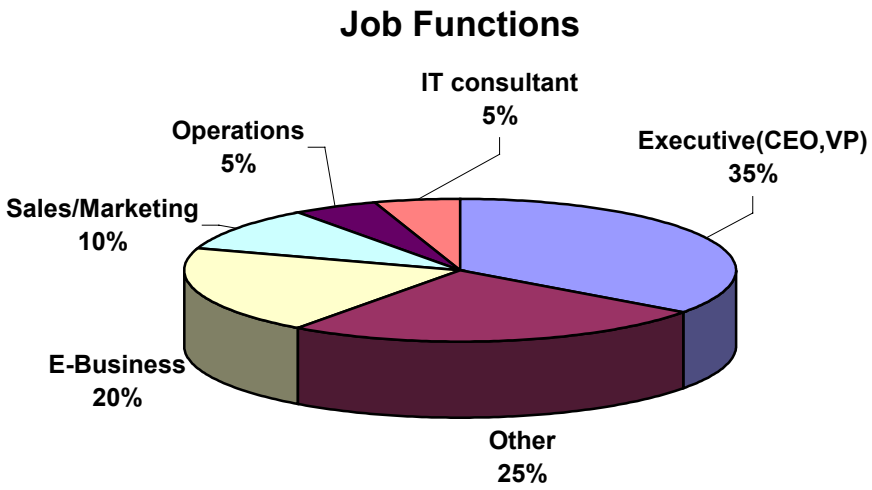

Figure 4: Respondents' job functions.

Figure 5 shows the workforce size distribution among the respondents to the survey. Fifteen percent (15%) of the respondents reported over 1000 employees, 40% had 501-1000 employees and 45% had 100-500 employees. The responses also indicated only 10% of the respondents had global operations, while 60% operated in several locations in different states, and 30% percent operated in several locations in the same state. Ninety percent (90%) of the respondents operated in multiple locations in the same state, different states, or multinational locations.

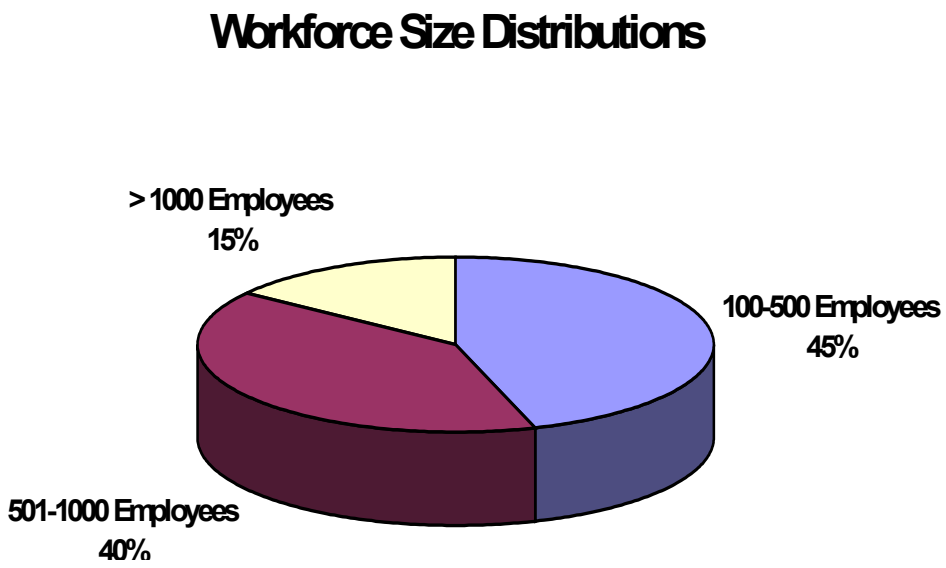

Figure 5: Respondents' workforce size distributions.

3.2 e-Business implementation

While there is still doubt whether e-Business initiatives fit the fragmented construction industry, the respondents indicated that construction companies do adopt e-Business applications. The rate for e-Business adoption among the respondents was 82.3 %, which shows that the organizations that are included in this survey have implemented some type of e-Business initiative. Figure 6 shows the distribution of e-Business initiatives that have been adopted by the respondents.

The most used e-Business application among the respondents with a 70% selection rate was project management, followed by Extranet/Intranet (65%) and Internet infrastructure (60%). The construction industry needs more than one solution that has to be specific for each of the various types of building projects, locations, collaboration methods, and project management systems used. IT departments in the organizations create specific solutions for their businesses. The survey results indicate that the respondents are looking for project management tools to simplify their business processes, to reduce the transaction cycle and to cut costs.

The survey respondents used Extranets/Intranets to speed up the communication within the organization, and with partners, and suppliers via Extranets. The survey is based on companies that have a Web presence, so it is not surprising that most of the respondents have developed an Internet infrastructure. However, the variety of possible systems within their overall business models and a greater need for process and technology standards are causing businesses to proceed cautiously. Most of the accounting systems are automated internally, without integrating the workflow.

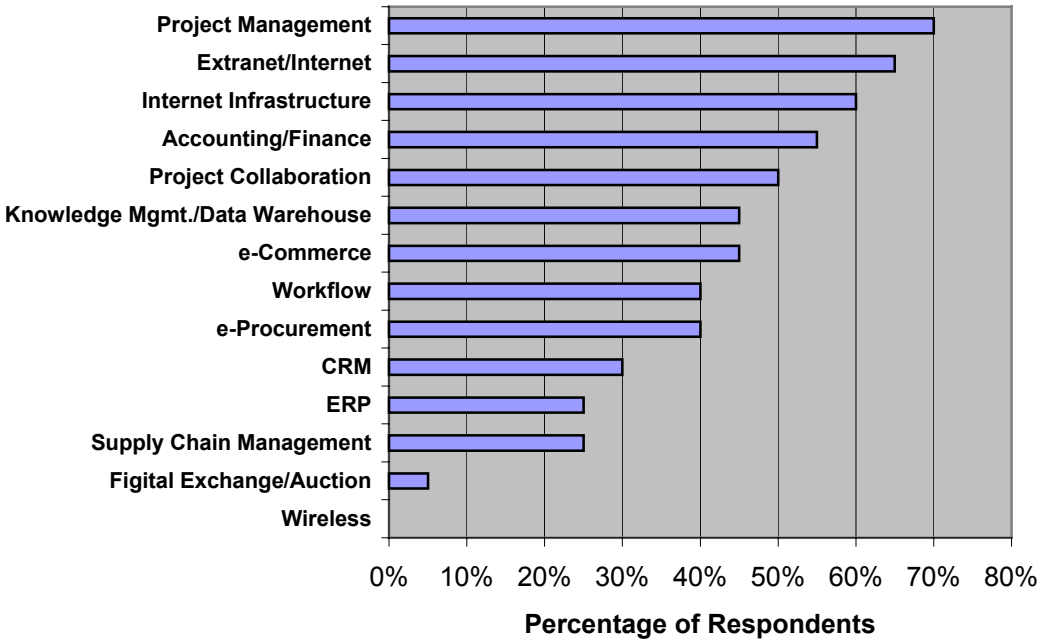

Figure 6: Respondents' adoption of e-Business applications.

Table 1: Commonly adopted e-Business practices in the US construction industry.

e-Business Initiatives	n	%
Project Management	14	70
Extranet/Intranet	13	65
Internet Infrastructure	12	60
Accounting/Finance	11	55
Project Collaboration	10	50
E-Commerce	9	45
Knowledge Management/Data Warehousing	9	45
e-Procurement	8	40
Workflow	8	40
Customer Relationship Management	6	30
Supply chain Management	5	25
Enterprise Resource Planning	5	25
Digital Exchange/Auction	1	5
Wireless	0	0

Note: 1. Respondents are able to select all that apply.

2. 82% e-Business adoption rate among respondents.

A significant number of respondents (see Table 1) used project collaboration tools, which speed up the communication and deliver a continuous workspace and exchange capability to the users. Surprisingly, e-Commerce, e-Procurement, and data warehousing were not that critical to the respondents although e-Procurement, and e-Commerce save costs and reduce transaction cycles while knowledge management organizes and standardizes the forms, and documents, reducing time and cost and simplifying their business processes. According to this study, of all other e-Business initiatives, collaboration, e-Procurement, and data warehousing, are very crucial to the construction industry. This survey demonstrates the lack of a match between e-Business initiatives and construction industry expectations. Most users deploy these applications just because there is no other strategy that fits their businesses. The construction industry needs different e-Business solutions and there is no one solution that fits the entire industry. If industry minds are set to simplifying the business process and improving productivity and quality, more than just producing cost savings in a short time, e-Business will reshape the construction industry for the better.

Although digital exchange pre-supposes a healthy return coupled with a small risk factor, it is not widely accepted by the construction industry. Most construction transactions are still done manually and blueprints and specifications are still delivered to project partners in paper format. None of the respondents used wireless technology and from the survey responses it looks like although they have been using mobile phones, they had not yet implemented data exchanges using wireless technologies.

The survey respondents were asked about their involvement in adopting e-business applications in order to determine the current status and deployment of e-Business applications in the construction industry. The high rate (82.3%) of e-Business adoption by the respondents indicates that the construction industry actually uses e-Business applications and it shows that the construction industry is also receptive to the emerging Internet Technologies. The fact that project management tools are the most popular e-Business initiative among the respondents indicates that the construction industry needs standardized documentation software that automates the daily workflow. The industry needs to establish a standard, which is exchangeable and which consists of reusable information thus helping the industry avoid rework. The respondents' selection of Extranet/Intranet as the second most popular practice indicates that the respondents communicate through the Internet and exchange data and store information using portals. Standardization, electronic forms, the automation of forms, and exchange of data seems like the most crucial issues for the construction industry. The construction industry needs to adopt intelligent business processes and data warehousing where all data can be stored at one portal, and distributed to the responsible parties of the project.

The fact that 45% of respondents adopted e-Commerce (see Table 1) indicates that the construction industry already has long and customized relationships with their suppliers. The product prices do not fluctuate like in other industries; so many companies do not see the need to adopt business transaction applications, which automate the procurement process. It is believed that the relationships between suppliers and the customer will be changed with e-Procurement tools. This is a misconception; e-Procurement only simplifies the selling and buying process and shortens the transaction cycles. An executive from a general contractor remarked: "Although we do not do any purchasing, I wish that we had more control over it, and that we would be able to monitor the procurement by subcontractors on a project".

3.3 Communication tools

The aim of the question "What type of connections do you have with your suppliers, partners and customers?" was to discover not only the ways the respondents communicated within their organizations, and with their partners, and suppliers, but also to determine the extent of Internet usage for communications, exchange of data, and business transactions by the respondent's answers to this question.
Figure 7 shows the distribution of communication tools usage among the participants. Over 80% of the respondents used e-mail for communication with their partners and suppliers. The distribution of responses indicates that most of the companies that participated in the survey still use the traditional way to communicate within their organization, and with their partners and suppliers. Phone and fax are the most commonly used communication and data exchange tools. E-mail use has improved during the last five years. However, communication in person still remains an important requirement in these businesses. This result indicates that communication should be both on and offline to be more effective. A majority of the respondents to the survey (55%) also indicated that they used Electronic Data Interchange (EDI) for transactions.

The survey results also indicated that some of the respondents participated in private marketplaces. One of the executives of a project Web site provider noted that the use of private marketplaces is limited to e-mail and updating documents only. Companies are attempting to use XML and EDI, and to participate in private marketplaces more and more. The complexity associated with business processes in construction will be simplified and standardized by these emerging technologies.

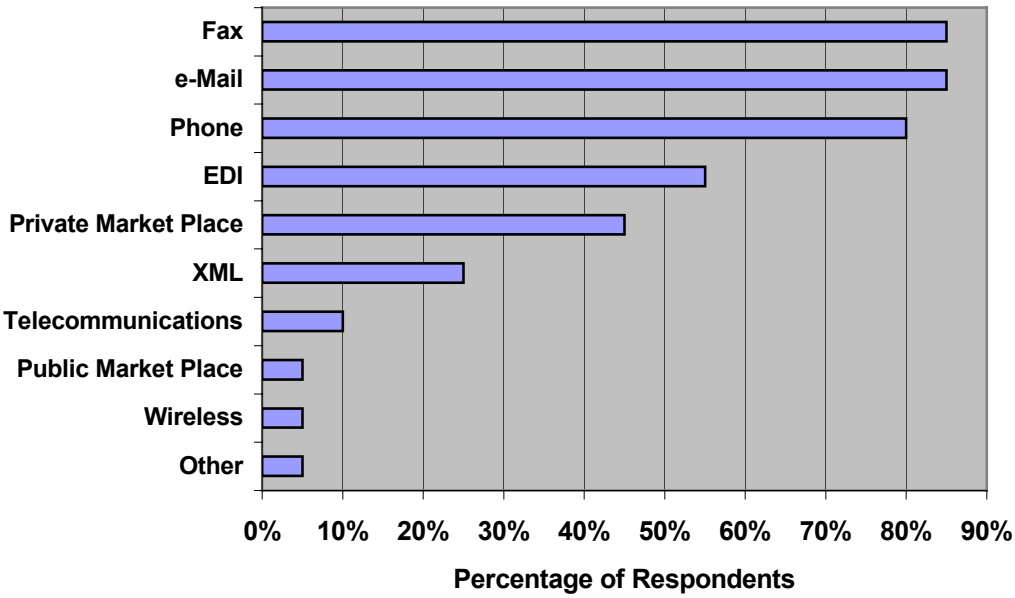

Figure 7: Respondents' connectivity to customers and suppliers.

3.4 e-Business initiatives

The question "Which of the following Internet-related IT initiatives are you currently or plan to be involved in?" was designed to discover the e-Business efforts in the construction industry. The question was asked to determine the needs of construction companies in terms of e-Business initiatives. The question covers current practices and future plans such as procurement, supply chain, transaction processing, e-Commerce, Project Development, Project specific Web Site, Intranet, Extranet, e-Markets, order tracking, partnering, and communications, to find out what the industry really needs. Over 90% of the respondents answering this question indicated that they were interested in implementing e-Business initiatives. This high response rate also indicates that the construction industry is willing to implement e-Business solutions. The higher rate of response to this question than to the question about current e-Business implementation indicates that the respondents are planning on adopting suitable e-Business solutions in the near future.

Most of the respondents were focused on improving the performance of their business processes and the overall project quality by adopting project management, project development, communication, and e-Commerce tools. Emphasis was placed on synchronizing the workflow within the partners and customer needs, delivering the best quality of product to the right place at the right time just as expected. The respondents indicated a desire to have standards for automated workflow. Figure 8 shows the distribution of current and future planned use of several e-Business initiatives by the respondents in the US construction industry.

Communication among partners is very important in a project life cycle. The companies that responded indicated that continuous communication is crucial for project development. They will or have currently adopted these tools to improve the efficiency of the workflow and simplify their operating processes. The construction industry is a very complex industry with fragmented partners. The survey responses indicated the respondent's perception that the use of communication and project management and development tools would improve work efficiency. In conclusion, these initiatives are considered to be the most necessary for the construction industry to fully implement e-Business.

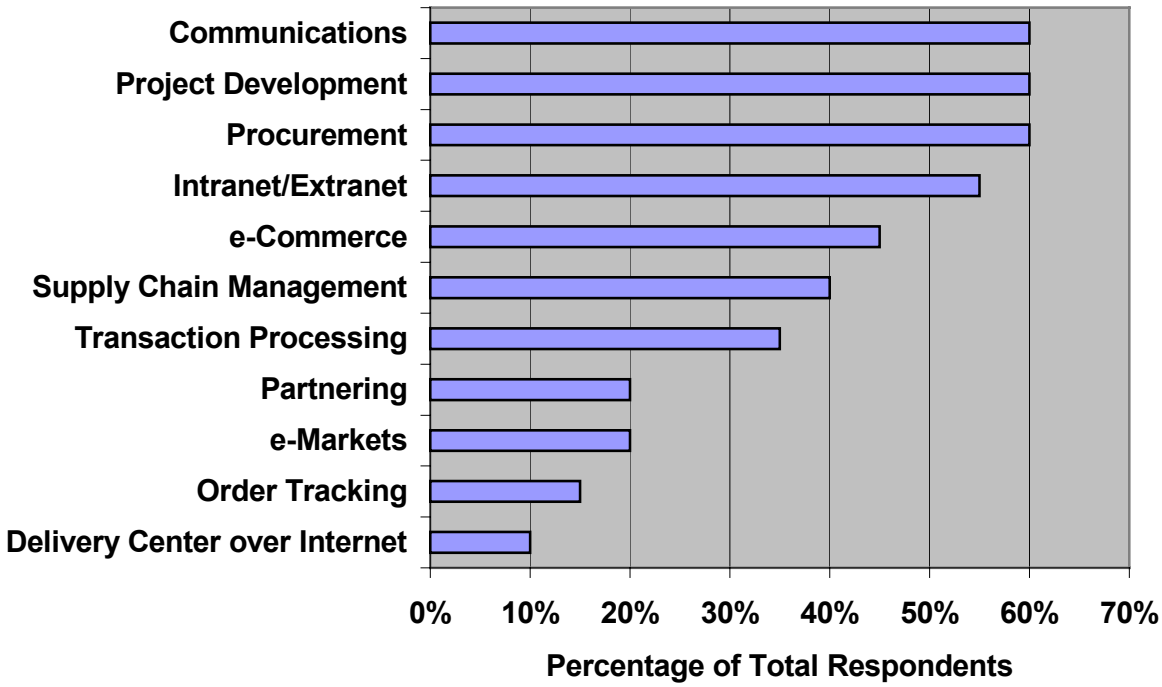

Figure 8: Respondents' e-Business initiatives.

The fact that project management is the most selected answer option in this question indicates that documentation, information sharing, labor, and resource management are the most crucial systems that need to be organized, simplified, and standardized in the construction industry. The survey also indicates that the respondents have or will adopt e-Procurement and e-Commerce initiatives for their business. In conclusion, the survey responses indicated that the respondents are aware of the benefits of these tools and that they are open and flexible to adopting tools that enable them to improve the efficiency of their business processes.

3.5 The US construction industry's prioritized goals

The respondents were asked about their priorities based on their perception of the benefits of e-Business. The goal of the question was to determine what the construction industry expects from e-Business and how it plans to use e-Business initiatives to improve business processes and simplify operations. Table 2 shows the ranking of priorities and the response rate indicating how the respondents currently use or plan to use e-Business initiatives.

Figure 9 shows the distribution of the prioritized goals of companies that responded to the survey. The survey results indicate that communications and customer relationship management (CRM) are the major areas of strategic concern for the construction companies.

The top three e-Business areas cited were "increased communications", "increased predictability and performance", and "reduced defects". These responses show that the construction industry respondents are not only concerned with cutting costs and increasing profits in the short term, but that they also want to implement well-structured e-Business solutions with new value offerings such as enhanced customer relationship management, better communications, and better quality products.

Table 2: Respondents' priorities based on e-Business.

Priorities based on business goals (1) = Least important (5) = Most important	Freq. of (5)	Ave.	Min.	Max.	Rank
Increased communications	13	4.9	4.0	5.0	1
Enhanced customer relationship Mgmt.	12	4.9	4.0	5.0	2
Increased predictability	10	4.7	4.0	5.0	3
Increased productivity	9	4.6	4.0	5.0	4
Reduced defects	6	4.1	3.0	5.0	5
Innovation of product	4	3.9	3.0	5.0	6
Accurate transactions	3	3.7	2.0	5.0	7
Reduced capital costs	5	3.5	2.0	5.0	8
Reduced travel costs	2	3.5	2.0	5.0	8
Expansion of partnership	3	3.5	2.0	5.0	10
Improved industry standards	1	3.2	1.0	5.0	11
Expansion of geography	3	2.8	1.0	5.0	12
Transparent market	1	2.8	2.0	5.0	12

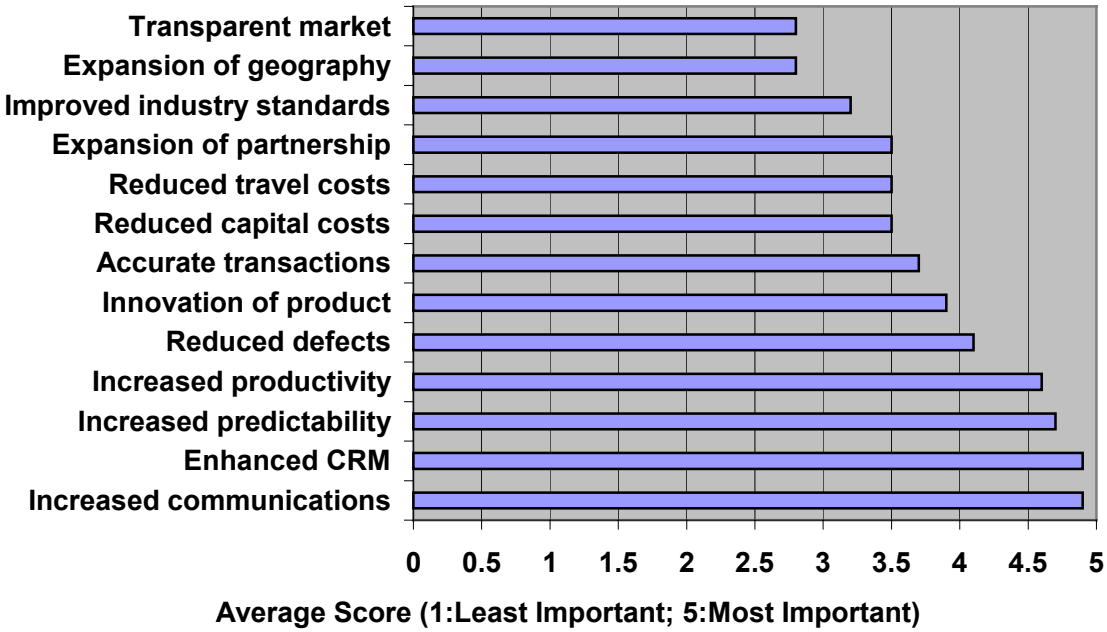

Figure 9: Respondents' prioritized goals.

The construction business is global in nature, and it is managed by decentralized business systems because of its multiple locations. In fact, the responses to this question show that some of the US construction industry respondents have not yet fully recognized the geographical expansion and standardization of the industry. The reason behind this might be that the construction industry responded late to the e-Business trend, so that the industry's business rules and competition has not yet experienced the change.

4. CONCLUSIONS AND RECOMMENDATIONS

e-Business has the potential to benefit everyone, consumers, businesses and governments. The primary promises of e-Business are in the areas of cost savings, revenue growth, market expansion, and customer satisfaction. e-Business aims to make business processes more efficient, responsive and of better quality. It adds new values to traditional business with the goal of creating a better business environment. Ideally, the Internet presents a medium to negotiate bulk prices, to purchase hard to find products, to collaborate with partners and suppliers, and to create a market that expands well beyond traditional regional boundaries

The e-Business Assessment Survey used in this study showed that the US construction industry respondents are actually receptive to Internet Technologies and that they are willing to implement e-Business solutions that are

designed specifically for the construction industry. However, as indicated by the perceptions of the respondents to the survey, the US construction industry has been slow in embracing technologies into its "brick and mortar" businesses because of a lack of suitable e-Business initiatives and tools designed specifically for the construction industry. The survey responses and interviews also indicate that technology vendors are trying to implement e-Business solutions that are designed for the manufacturing industry in the construction industry. Because construction is a very complex industry consisting of short-term relationships with unsynchronized workflow, software vendors lack industry expertise.

Although there are many e-Business initiatives that fit the US construction industry, the push is towards other initiatives, which the US construction industry does not value as much, such as e-Commerce, and e-Procurement. The survey results show that the US construction industry, as represented by the respondents, is aware of the e-Business initiatives that fit it, and that it does not implement the e-Business initiatives that are not suitable for its project systems. This has led to the popular perception that "the US construction industry is not receptive to e-Business" or "e-Business does not fit the construction industry". However, e-Business does fit the construction industry: collaboration, project integration, project management, documenting, order tracking, transaction processing, and data warehousing are initiatives and tools that fit the construction industry. In conclusion, every industry needs specific solutions for their business model. e-Business is not any different than ordinary business itself, it is the use of Internet technologies to succeed in business.

Future research should be aimed at the discovery of e-Business initiatives that fit the construction industry, and a methodology to determine the return on investment from their implementation should be established. In addition, it is recommended that a comparable study be undertaken across international boundaries to determine e-business implementation in the construction industry outside the US and to compare those results with those presented in this study.

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