HOW E-COMMERCE IS CHANGINGTHE FACILITY MANAGEMENT PRACTICES OF BUILDING OWNERS

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"The corporate Ford of 2010 will look more like Cisco, a company that manufactures very little."

"Direct-to-the-assembly-line ordering will enable Ford to custom configure cars much the way that Dell custom configures computers."

--Forbes, July 17, 2000

The above quotation is an indication of how information technology is changing even old-line manufacturing organizations. The research reported in this paper was motivated by our desire to better understand how information technology and, in particular, the recent phenomenon of e-commerce, was influencing the design and construction industry. Since trends in the building industry are often determined by the desires and programs initiated by large building owners, we decided to focus our research on facility management organizations in Fortune-500 companies.

Previous Research

The Internet and the application of information technology have grown considerably in the past several years. Electronic commerce has evolved with unanticipated high growth rates and an increased focus on the potential of business-to-business e-commerce. The U.S. Department of commerce has estimated 1) that high-tech has driven more than a quarter of all economic growth since 1993 and 2) information technology sectors are growing at double the rate of the overall economy (David Henry et. al., June 1999). Predictions for growth in the business-to-business e-commerce have been tempered somewhat from enthusiasm of early 2000, but still are predicted substantial double-digit percent increases in growth for 2001. Others have reported that each year, inefficiencies, mistakes and delays account for $200 billion of the $650 billion spent on construction in the United States (Economist, 15 Jan 2000). Clearly this represents an opportunity to improve industry practices. Analysts have identified the AEC market as one ripe for information technology innovation. By one count, venture capital firms have invested $2.5 billion in 217 dot-com start-ups whose goal is to improve the effectiveness and efficiency of outmoded practices in the design and construction industry (Fisher, 2000).

Despite the recent growth of e-commerce, few research studies have begun to clarify the effect of this phenomena. Although there has not been much research conducted on e-commerce and facility management, there are several relevant studies related to strategy and information technology, need for coordination and information technology, and the role of information technology and the Internet on work process improvement.

Block and Segev (1996) studied strategy and IT by analyzing the impact of electronic commerce on the travel industry. This research defined electronic commerce as the buying and selling of information, products and services via Internet and the support for all kinds of business transaction over a digital infrastructure. It defined three layers of technology impact on companies 1) at their boundaries, 2) in their relation with partners, suppliers, and targeted customers, and 3) in their access to market. The study adapted Michael Porter's framework of competitive advantage and proposed a framework to analyze the effects of electronic commerce on the travel industry. The advantage of this approach is that it recognized that the introduction of electronic commerce is likely to impact an industry on several different levels of an organization. In an earlier paper, Porter and Millar (July-Aug 1985) outlined how information technology has an impact on competitive advantage.

Another study (Sanjeev Dewan et. al., September 1998) theorized that organizations that require more control and/or coordination are also likely to have a higher demand for the benefits that information technology may provide. They went on to suggest several hypotheses, including that the higher a company's level of diversification the greater the demand for IT investment, and the higher the level of vertical integration the lower the demand for IT investment. They tested these hypotheses by using data provided by annual surveys conducted by *Computerworld* between 1988-1992. Their results suggested that the level of IT investment is positively related to the degree of firm diversification, perhaps reflecting the greater need for coordination of assets within diversified firms.

Work group productivity and process improvement are two other areas that are heavily influenced by information technology. Ness and Teicholz (May 2000) reported on the increased importance of the World Wide Web on capital planning and management solutions. They noted that "the web-based CPMS [capital planning management systems] will be linked to e-business making it possible for a facility manager to see where the problem is, create the project to repair the problem, and order any materials necessary all from the comfort of his or her office."

Framework

The conceptual framework adopted by this research was an outgrowth of our review of prior research (above) as well as our earlier study that explored the role of information technology in facility management. In this study, business-to-business e-commerce was defined as conducting business communications and transactions among companies over the Internet. The basic premise in our earlier 1996 survey was that organizations adopt information technology in order to help achieve business goals. We used a similar premise in this survey: organizations that adopt e-commerce will achieve improved performance (see Figure 1). This model represents the prevailing "conventional wisdom" in the industry. While there may be other factors that influence performance (e.g., leadership or marketing), our focus was on issues associated with the use of e-commerce. Based on previous research, we also hypothesized that those organizations that systematically improve work processes would have greater success incorporating e-commerce solutions. Other factors that might influence results were hypothesized to be issues associated with organizational context and characteristics of individual respondents.

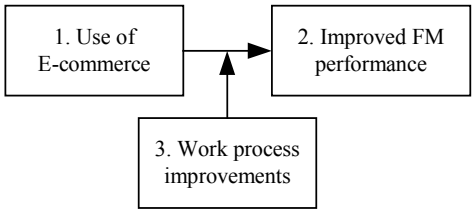

Figure 1. Research Model

Goals and Hypotheses

The purpose of this survey was to develop a rigorous and factual description of how e-commerce and web-based technologies were being utilized by large building owners (facility management

organizations in Fortune 500 companies). Through this understanding it would be possible to speculate about the future growth of e-commerce throughout the industry. An additional goal of the study was to learn how and under what circumstances e-commerce achieves success or failure in facility management organizations. Such an understanding could provide guidance to organizations that are considering venturing into e-commerce applications. Two hypotheses that we planned to test included:

H1: The use of e-commerce will result in improved facility management performance.

H2: Organizations that use systematic work process improvements will tend to be "early adopters" of e-commerce.

Methodology

The method selected for this research was a self-administered survey. Questionnaires were mailed in July 2000 to 1,714 facility managers from Fortune 500 companies who were also members of the International Facility Management Association (IFMA). The sample was designed to reach respondents who tended to manage large, complex facilities and who were considered professional facility managers by virtue of their membership in IFMA.

The questionnaire was designed to cover each of the five major categories described in our conceptual framework, including: the use of e-commerce in facility management organizations, level of satisfaction with current facility operations, barriers to the use of e-commerce, use of systematic work process approaches, and background information about the individual responding to the questionnaire and his/her organization.

As of October 6, 2000, 578 usable questionnaires were returned, for a response rate of 33.7%. A wide variety of IFMA industry groups responded, with the largest response from Vehicle Manufacturers (13%) followed by Telecommunications Service Providers (12%) and Investment Service Providers (11%).

Analysis: Current and Future Applications

Our survey results found that e-commerce is just beginning to emerge as a tool that is used to help manage facilities. The most frequent application of e-commerce today is to purchase supplies and materials on the web from a specific vendor. Almost 2 out of 10 respondents indicated that their department purchases supplies and materials on the web "a lot" (See Table 1). In addition to purchasing supplies and materials, the other top uses of e-commerce were accessing facilities manuals, publishing static project information on the Internet, purchasing supplies and materials through an Internet service that connects buyers and sellers, and taking interactive courses via the Internet.

Respondents have clear expectations that e-commerce in facility management will grow substantially over the next two years and that it will significantly affect facility management practices. Respondents anticipated that e-commerce use will substantially expand in every application category over the next two years, with percent increases ranging from 227% to 900% (Table 1). In addition, almost 1/4 said that they expected business-to-business e-commerce to change their facility management department "a lot" over the same time period. Only 2% said that they did not expect their department to change at all because of e-commerce.

Anaysis: The Impact of E-commerce on Performance

One of our hypotheses was that e-commerce is being used because organizations decided that it would improve their ability to manage facilities. However, our findings suggest that this may not be the case. Respondents felt that e-commerce has not resulted in a major improvement in their ability to more effectively manage cost or time issues. The "payoff" for investing in e-commerce has not yet been clearly demonstrated. Some agree or strongly agree that e-commerce has helped decrease the time to complete projects (55%) or that e-commerce has decreased the cost of purchasing supplies and materials (67%) (see Figure 2). However, a majority disagree or strongly disagree that e-commerce has decreased the cost of facility maintenance and operations (51%), decreased the total annual cost of

facilities (53%), decreased the cost of new construction projects (71%), or decreased the cost of space management (70%). It should be emphasized, however, that these opinions changed substantially when the next two years are considered, with a majority agreeing or strongly agreeing that e-commerce will help decrease both time and cost for all categories. As table 1 indicates, very significant increases in e-commerce use are projected.

Table 1. Respondents reporting use of e-commerce applications "a lot"

	NOW		in 2 YEARS		
E-COMMERCE APPLICATION	**PCT**	**N**	**PCT**	**N**	**PCT Incr**
Purchasing supplies and materials on the web from a specific vendor	18.0%	505	40.8%	553	227%
Accessing facilities manuals (e.g., maintenance or training) using the Internet	9.6%	505	35.4%	544	369%
Publishing static project information on the Internet	7.6%	478	19.4%	517	255%
Purchasing supplies and materials through an Internet service that connects buyers and	5.0%	488	19.4%	527	388%
Taking interactive training courses via the Internet	5.0%	492	27.4%	539	548%
Purchasing furniture on the Internet	3.0%	482	14.3%	521	477%
Managing projects using commercial, third party web sites	2.2%	488	11.1%	508	505%
Purchasing facilities services on the Internet	1.5%	484	9.4%	511	627%
Purchasing energy via the Internet	0.8%	447	6.5%	452	813%
Leasing commercial floor space via the	0.3%	460	2.7%	487	900%

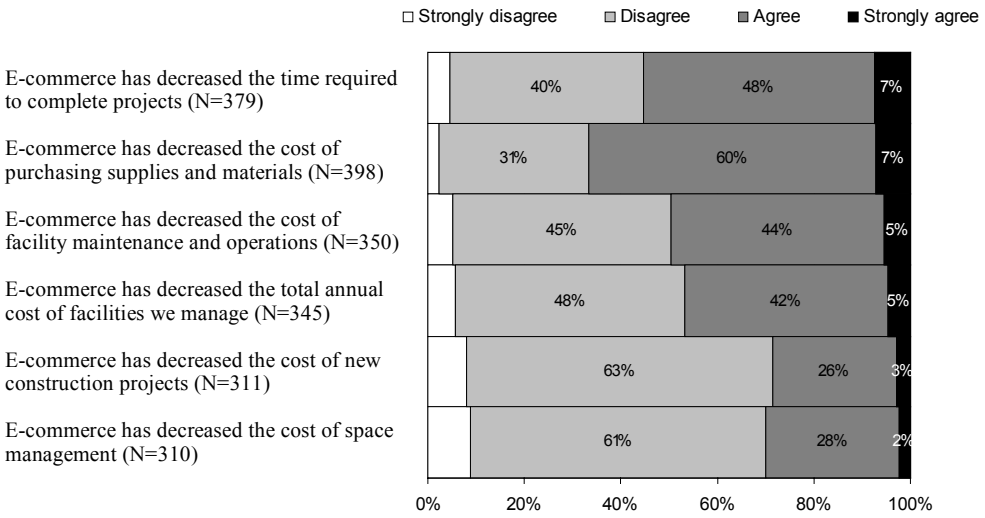

Figure 2. The Impact of E-Commerce on Facility Performance

Analysis: Work Process Improvements and E-Commerce

One of the hypotheses of this research was that those organizations that have implemented systematic work process improvement process will also tend to utilize e-commerce. We surmised this might be the case because e-commerce could be viewed as another method for improving work processes. We asked respondents about whether or not their facility management department utilized a number of management practices that are normally associated with process improvement. Responses showed that many facility management departments used one or more of these practices. Over half of the respondents strongly agreed that their company requires them to track total annual facility costs (Table 2). Other preferred management practices included customer satisfaction surveys, formal benchmarking studies, use of the national CAD standards, and ISO 9000 certification.

Table 2: Top-5 management practice used

MANAGEMENT PRACTICE	Agree	Strongly agree
Department is required to track total annual facility costs	41%	53%
Customer satisfaction surveys	48%	36%
Formal benchmarking studies	48%	24%
National CAD layer standard	49%	23%
ISO 9000 certification	38%	16%

Next, we conducted a bivariate analysis of the use of e-commerce and the use of work processes. The results are presented in Table 3. It appears there is some evidence to suggest that the use of certain work process are significantly associated with the use of e-commerce. Some of these associations are not unexpected. For example, it seems reasonable that those departments that closely collaborate with the company's management information systems department would tend to use e-commerce. Of somewhat more interest is the association between use of e-commerce and use of ISO 9000, use of continuous improvement processes, use of continual retraining of employees, and use of modeling work processes using charts. Further research would need to be done to learn if systematic management practices are good predictors of the effective adoption of e-commerce. Companies who adopt systematic work process analysis may also be good sources of information on "best practice" studies. Further, other organizations in the AEC community may find it useful to consider adopting some of these management practices.

Table 3: Association between use of e-commerce and systematic management practices

MANAGEMENT PRACTICE USED	SIGNIF
Department is required to track total annual facility costs	n.s.
Customer satisfaction surveys	n.s.
Formal benchmarking studies	n.s.
National CAD layer standard	n.s.
ISO 9000 certification	p <. 05
FM dept closely collaborates with MIS dept	p < .05
Use of continuous improvement process (e.g., total quality management)	p < .05
Use of workflow automation	n.s.
Employees are continually retrained	p < .01
Work processes are modeled using charts	p <. 001

Analysis: Barriers to the Use of E-commerce

Overall, 11% felt that implementing e-commerce was a big problem and one-half said that implementing e-commerce was somewhat of a problem. About 12% felt that implementing business-to-business e-commerce solutions was not a problem. The biggest specific problem in implementing e-commerce was reported to be the difficulty in integrating with legacy systems (Table 4). Other top problems included lack of a budget to invest in e-commerce, hard to customize software packages, cost of software upgrades, and cost of keeping building data current.

Table 4: Top-5 barriers to the use of e-commerce

BARRIER	A big problem	Somewhat of a problem
Hard to integrate legacy systems with e-commerce	25%	33%
The necessary budget to invest in e-commerce is not available	18%	24%
Too hard to customize software packages to meet your needs	16%	34%
Software upgrades are too costly	14%	31%
Hard to evaluate e-commerce using return on investment (ROI)	12%	42%

Conclusions

The findings of this survey indicated that e-commerce was just beginning to emerge as a tool that is used to help manage facilities. Respondents had clear expectations that e-commerce in facility management will grow substantially over the next two years and that it will significantly affect facility management practices. The study also found evidence to suggest that those organizations that had adopted systematic methods to improve work processes were more likely to be early adopters of e-commerce. Future research might use focus groups and best practice studies to better identify which management practices are helpful to achieving successful e-commerce implementations.

This study portrays attitudes among facility managers towards e-commerce. The data is suggestive of interesting trends and partially supports our hypotheses, but is not conclusive. This may be due to the immaturity of the use of e-commerce in facility management. As the use of e-commerce expands, future studies may be able to more accurately understand the factors that as associated with its successful implementation and use.

Acknowledgements

The authors of this study would like to acknowledge the financial support of the IFMA Foundation Corporate Circle of Contributors that made this research possible.

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