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AN EXPLORATORY STUDY OF WEB-BASED ELECTRONIC COMMERCE APPLICATIONS

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ABSTRACT

This study explores the use of the Web in electronic commerce (EC) applications and proposes a framework for classifying such applications. The framework is based on three widely used models of organizations that identify application categories. The ability of each of these models to classify thirty common EC applications was then examined. The Value Chain model provided the best schema and is used as a basis for the proposed framework.

This new framework was evaluated with the observed EC applications from a random sample of Fortune 500 firms. The results of this classification process are presented along with an industry analysis of the observations. The analysis suggests that adoption of particular EC applications can be explained both by the nature of the industry and the nature of the application.

The framework and tests suggest fruitful avenues for future research. In particular, testing a broader set of firms and refinement of the methodology would be advantageous.

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INTRODUCTION

The last few years have witnessed an explosive growth in the use of the Internet and the World Wide Web (Web) for commercial purposes. Large and small businesses have applied these tools in a wide range of activities such as advertising, on line delivery of products and services, customer support, and recruiting. In 1997, an estimated 51 million adults were Internet users in the United States alone (Vital Signs, 1997). An estimate of revenues generated by Internet-based commerce in just the first half of 2000 was \$127 billion, which is a growth rate of some 60% over 1999's revenues. Furthermore, one in every five dollars of revenue is being generated by Internet-related activities. (Internet Economy Indicators 2001). While estimates regarding the size and scope of the Internet can vary greatly, the general consensus is that the Internet is potentially a powerful tool for commerce that can influence organizational performance and increase an organization's ability to compete in the marketplace (Choi, Stahl, and Whinston 1997; Haley, Cate, and Watson 1996; Lederer, Mirchandani, and Sims 1997; Zwass 1996). This potential has generated a tremendous interest in electronic commerce (EC) and has prompted many businesses to move very quickly to put forth a Web presence.

Strictly speaking, electronic commerce is not a new phenomenon. It has existed in various forms for some time. Early examples include electronic order processing systems (e.g., ASAP) and airline reservation systems (e.g., SABRE). More recently, EC has taken the form of inter-organizational systems and electronic data interchange. Historically, the typical EC application was based on proprietary technology and a private network, implemented by large organizations, expensive, and narrow in scope. In contrast, EC activities today have a decided customer focus. They are based on very accessible public networks (the Internet), are less expensive, and are utilized by a variety of organizations for a wide range of applications.

Explanations of the term electronic commerce are diverse and constantly evolving. The most common definition focuses on the use of computer networks to buy and sell information, products, and services (Kalakota

and Whinston 1996), but this is a narrow interpretation. EC has the potential to support organizations in activities beyond those directly related to buying and selling, and expanded definitions can be found in recent literature (e.g., Choi et al. 1997; Zwass 1996). Following that broader perspective, in this paper EC is considered to be the use of the Internet and related technologies to support any activity that is necessary for an organization to function effectively.

While the above definition includes all Internet activity, this study is limited to the use of the World Wide Web for electronic commerce. The Web is the fastest growing of the assorted Internet services; and, with its array of available user-friendly interfaces, the Web provides a nearly effortless end-user navigation tool for the Internet.

Despite the rapid growth of EC and the eagerness of organizations to embrace it as a competitive tool, very little is known about how best to take advantage of it. Organizations are struggling to identify ways in which EC can benefit them, and there have been few attempts to develop theories in this area. This lack of understanding might well be the leading obstacle to effective fulfillment by individual businesses of the commercial potential of EC. Some efforts have been made in recent years to better understand the nature of EC applications and their value to organizations. For example Cappel and Myerscough (1996) proposed the classification scheme, Bento and Bento (1996) offer the Media-C framework and Kalakota and Whinston (1996) suggest the Architectural Framework. Typically, various commercial uses of the Internet are identified and then grouped into categories--such as marketing or inventory control--to serve as the basis for the models. An obvious shortcoming with such a modeling approach is that the categories are arbitrarily chosen, sometimes overlap, and may not be complete. The resulting models and frameworks have lacked a firm theoretical basis (Shaw 1997).

The purpose of this paper is to present a framework for classifying EC applications based on available models of organizations and to provide a preliminary test of it. Such a framework should prove useful to managers who

seek to apply new Internet capabilities to their organizational processes. The framework can assist managers to methodically evaluate their involvement in EC to identify what applications are possible and what activities in the organization can benefit from EC. The paper proceeds as follows. In the next section, several models of organizations are examined along with an assessment of their value in understanding EC applications. In the third section - a framework for classifying EC applications is presented. In part four, the proposed framework is used to catalog the applications found on a random sample of Web sites of Fortune 500 companies, and an industry analysis of the classification is reported. Finally, a concluding discussion is presented along with directions for future research.

MODELS OF ORGANIZATIONS

Because our definition of EC encompasses any activity required for an organization to function effectively, a logical step in the development of a framework is to identify appropriate models of organizations that identify typical functions and processes. In this section, three such models are reviewed, and their suitability for adaptation to the EC environment is evaluated.

The Functional Perspective

Beardshaw and Palfreman (1982) examine the functions that an organization must perform in order to achieve its organizational goals. Eight major activities that must occur in an organization are identified. These activities are:

- Buying of Input
- Production of Output
- Sale of Output
- Finance and Accounting
- Transport of Input and Output
- Personnel Management
- Law and Public Relations
- Development (both technical and economic)

Upper-level management controls and coordinates all of these functional activities, and

reporting relationships are delineated clearly. This depiction of the organization is based on the traditional, hierarchical structure.

The Process View

A second model is based on cross-functional organizational processes rather than discrete functions. The Process View considers a process to be a "specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action" (Davenport 1993, p. 5). Emphasis is placed on how tasks are accomplished, rather than on what is produced, in the belief that product quality will reflect the resulting improvements in process. Whereas the Functional Perspective centers on responsibilities and reporting relationships, as they exist at a point in time, the Process View is a more dynamic description of how an organization acts.

Organizational processes typically belong to one of two linked classifications under the Process View. Operational processes comprise the primary activities of the business while management processes are those activities associated with administration, coordination, and control of primary activities.

<i>Business Processes</i>	
Operational Processes	Management Processes
<ul style="list-style-type: none"> • Marketing and Intelligence • Design and Development • Procurement and Logistics • Production • Product/Service Delivery 	<ul style="list-style-type: none"> • Information Handling • Coordination • Control • Communication • Knowledge

Figure 1: The Process View

The Process View has been adapted to develop a value-oriented typology of business activity with respect to the use of information technology (*In Search of the Perfect Market* 1997), as shown in Figure 1. Information technology plays an important role in this



framework, supporting both intra- and inter-organizational processes.

The Value Chain Concept

Guidance also can be derived from the Value Chain Concept where the organization is viewed as a collection of many discrete activities, some of which are valued by customers (Porter 1985). An organization can be profitable only if the value package it provides to customers exceeds the aggregate costs involved in creating the product or service.

Competitive advantage is gained by performing the activities along the value chain either more cheaply or better than competitors do. Thus, the identification of an organization's value-adding activities and sources of competitive advantage is the focus of the model. A typical organization's value chain is composed of nine generic types of activity with many linkages among the different activities. The Value Chain Concept is delineated in Figure 2.

Primary Activities	Support Activities
<ul style="list-style-type: none"> • Inbound logistics • Operations • Outbound logistics • Marketing and Sales • Service 	<ul style="list-style-type: none"> • Firm infrastructure • Human resource management • Technology development • Procurement

Figure 2: The Value Chain Concept

Each activity along the value chain is categorized as either a primary or a support function. The primary category consists of activities related to the creation, sale, and servicing of the firm's products, as described below:

- **Inbound Logistics:** Activities designed to equip the firm with usable materials and supplies, including purchasing, freight, receiving, invoice processing, storing, material handling, vehicle scheduling, and returns to suppliers.
- **Operations:** Activities required for the transformation of inputs into products, such as material operations, manufacturing, testing and rework, packaging, assembly,

equipment maintenance scheduling, and engineering support.

- **Outbound Logistics:** Activities related to the distribution of products to buyers and collection of payments. Examples include invoice generation, scheduling, freight, and inventory handling.
- **Marketing and Sales:** Activities that attract customers and create sales, such as those involved with pricing, advertising, marketing channel selection, and promotion.
- **Service:** Activities associated with providing product support services to the customer, including tasks related to customer help, returns, warranties, and parts supply.

As with the Process View, primary functions are facilitated by support activities. These create an environment for business endeavor and provide needed resources. The support activity categories in the Value Chain Concept are:

- **Procurement:** Activities required to achieve the purchase of inputs used in the business value chain, such as raw materials, machinery, and buildings. Procurement activities would include such tasks as monitoring vendors, shopping for prices, and processing of purchase orders. (Procurement differs from the Inbound Logistics purchasing activity in that procurement is primarily an information process whereas purchasing involves the actual business event of acquisition.)
- **Technology development:** Efforts aimed at product and process improvement. These can take many forms - from basic research and product design to the formation of processing equipment or servicing procedures.
- **Human resource management:** Activities associated with the recruiting, training, and compensation of employees.
- **Firm infrastructure:** Activities that comprise the institution within which all others take place, including those related to general management, planning, finance, accounting, and government affairs.



An organization's value chain is embedded in a system consisting of external as well as internal value-adding activities. At one end of this system is the raw material supplier and, at the other, the final consumer. Gaining and sustaining competitive advantage greatly depends on how well the firm fits into the overall value system. Thus, use of the Value Chain Concept for examination of the tasks for which firms utilize EC technology, tasks that we will call EC applications, has an advantage not provided by the other models. An understanding of value chains may provide a methodology for exploiting both intra- and inter-organizational linkages toward the goal of increased competitive advantage. Use of the Web for electronic commerce removes physical and temporal boundaries from many organizational systems and may enhance, particularly, inter-organizational linkages.

Evaluation of the Organizational Models

The models or organizations described above--the Functional Perspective, the Process View, and the Value Chain--are three potential sources from which to derive a framework for classifying the manner in which firms are applying EC technology to support their business activities. To evaluate each model's respective merits, a list of current applications of EC was gathered and fitted to the model's function or activity categories. The list of applications was compiled from previous studies of EC applications (Bento and Bento 1996; Cappel and Myerscough 1996; Kalakota and Whinston 1996) and supplemented with more recent applications familiar to the authors. Table 1 lists thirty distinct applications of EC technology that were identified along with their sources.

Table 1: Representative Applications of Electronic Commerce.

Application	Potential Function of Application
General Company Information [a,b]	Present corporate goals or strategies, policy memos, ethical statements, organizational charts, historical reports, or current status.
Subsidiary Information [d]	Link firm's Web site with that of its subsidiaries.
Corporate Announcements [d]	Present recent corporate announcements, news items, or press releases.
Financial Information Reporting [d]	Present financial statements, ratios, or stock market prices.
Product Information [a, b, c]	Present details about a company's current products or services.
New Product Announcement [d]	Post new products separately to draw more attention from customers.
Special Offer Announcement [d]	Offer discounts or free gifts.
Mass Mailing [d]	Provide and exchange information by building lists of electronic mailing addresses in the contact database.
Public Service [d]	Provide general interest information about such things as community events, news, TV programs, or weather forecasts.
Product/Service Order Processing [a, b, c]	Allow customers to order products / services online.
Product/Service Delivery [c]	Deliver products / services over the Internet directly to customer.

Table 1: Representative Applications of Electronic Commerce, continued.

Customer Feedback [d]	Provide a means for two-way communication with customers.
External Document Distribution [d]	Allow customers or business partners to download official documents from Web sites.
Technical Support [a, b, c]	Provide links to FAQ or README files on Web sites.
Upgraded Product Distribution [a]	Use Web site to distribute upgraded materials to original buyers.
Sales Channel Information [d]	Provide information about sales branches and offices, or link to the Web sites of the wholesalers / retailers of companies' products.
Access Tracking [d]	Collect usage statistics for provision of data about the Web visitors.
Market Intelligence [a]	Study competitors' Web sites.
Environmental Scanning [a]	Use Web search engines to collect social, economic, technology, industrial, international, and government information.
Market Research [d]	Identify customers' demographics and preferences by conducting surveys via Web sites.
Production Customization [c]	Allow customers to participate directly in the manufacturing process.
Internal Document Transfer [a]	Make available a company's standard files to employees so that these materials can be transferred fast and economically.
Employee Training [a]	Distribute employee handbooks, training documents, and software.
Internal Communication [a, c]	Distribute information to coordinate and control segments of organization.
Recruiting [d]	Post job descriptions and application forms for open positions.
Employee Directory [d]	Provide an employee directory link on a company's Web site.
Inter-organizational Collaborative R&D [c, d]	Enhance speed and cost effectiveness of new product development.
Virtual Organization [b]	Sell products and services exclusively through the Web and without maintaining a physical storefront.
Resource Procurement [c]	Use EDI and e-mail to expedite information related to the acquisition of goods and services from suppliers.
Inbound Logistics / Physical Distribution [c]	Use networks to facilitate the physical processes related to the acquisition of new material.

The letters refer to the sources of these EC application categories, where:

[a] The Midia-C Framework (Bento and Bento 1996)

[b] The Classification Scheme (Cappel and Myerscough 1996)[3]

[c] The Architectural Framework (Kalakota and Whinston 1996)[11]

[d] New

Next, the applications from this list were mapped as well as possible into each of the three models of business organization by the co-authors independently of one another. Their results were compared; and, if appropriate, differences were resolved to one category, by consensus. Some of the applications could not be placed into a model, either due to the absence of an appropriate activity category or due to the presence of multiple relevant categories. Those that could not be mapped definitively into a single category were placed into the "Others" category, also by consensus.

Table 2 presents the results from fitting the applications into the Functional Perspective. Note that six applications were unclassifiable.

Results related to the Process View are shown in Table 3. Three categories hold no applications: Design and Development, Coordination, and Control. Six EC applications were assigned to the "Others" category because of fitting difficulties.

Applications related to the Value Chain Concept are presented in Table 4. All categories have at least one representative EC application, and no applications remain unclassified due to lack of a definitive category.

THE PROPOSED FRAMEWORK

Because the Value Chain model provides the best fit among the above three alternatives, it serves as the foundational structure for the

Table 2: Mapping Applications to the Functional Perspective.

Activity in Business Framework	Application
Buying of Input	Resource Procurement Inbound Logistics/Distribution
Production of Output	Product Customization
Sale of Output	Product Information New Product Announcement Special Offer Announcement Product/Service Order Processing Provide Sales Channel Information
Finance and Accounting	Financial Information Reporting
Transportation	Product/Service Delivery Upgraded Product Distribution
Personnel Management	Employee Training Recruiting Employee Directory
Law and Public Relations	General Company Information Subsidiary Information Corporate Announcements Public Service Customer Feedback Technical Support Access Tracking
Development	Market Intelligence Environmental Scanning Inter-organizational Collaborative R & D
Others	Mass Mailing External Document Distribution Market Research Internal Document Transfer Internal Communication Virtual Organization



Table 3: Mapping Applications to the Process Review.

Activity in Business Framework	Application
Marketing and Intelligence	Product Information New Product Announcement Special Offer Announcement Mass Mailing Sales Channel Information Access Tracking Market Intelligence Market Research
Design and Development	---
Procurement and Logistics	Resource Procurement Inbound Logistics/Distribution
Production	Production Customization
Product / Service Delivery	Product/Service Order Processing Product/Service Delivery Upgraded Product Distribution
Information Handling	General Company Information Subsidiary Information Corporate Announcements Financial Information Reporting Environmental Scanning Employee Directory
Coordination	---
Control	---
Communication	Customer Feedback Technical Support Internal Communication
Knowledge	Inter-organizational Collaborative R & D
Others	Public Service External Document Distribution Internal Document Transfer Employee Training Recruiting Virtual Organization

proposed EC framework, but it is modified slightly by insights from the other models. Activities continue to be sorted into two generic categories: primary and support. Most of the activity labels in the proposed model correspond directly to the Value Chain Concept with one modification. Some of the activities classified under Firm Infrastructure have a common theme, Public Relations, and are therefore segregated. The Functional Perspective suggests the use of this category.

The proposed framework is detailed in Table 5. Each general category contains activities that represent the value-adding

functions of the firm from the start of production through sale and the model also encompasses the related informational processes. Business activities are characterized as related, not isolated, processes. In fact, as with the Process View, many activities in the model straddle functional lines and require the cooperation of several traditional departments in order to be completed successfully. The model associates the applications of EC technology, identified by our earlier analysis, with their corresponding activities. Considerable attention also is given to areas beyond the boundary of the organization, which are important when, e.g., monitoring customer needs or industry developments.



Table 4: Mapping Applications to the Value Chain Concept.

Activity in Business Framework	Application
Inbound Logistics	Inbound Logistics/Distribution
Operations	Product Customization
Outbound Logistics	Product/Service Order Processing Product/Service Delivery
Marketing and Sales	Product Information New Product Announcement Special Offer Announcement Customer Feedback Upgraded Product Distribution Sales Channel Information Market Research
Service	Mass Mailing Public Service Technical Support
Procurement	Resource Procurement
Technology Development	Inter-organizational Collaborative R & D
Human Resource Management	Employee Training Recruiting Employee Directory
Firm Infrastructure	General Company Information Subsidiary Information Corporate Announcements Financial Information Reporting External Document Distribution Access Tracking Environmental Scanning Internal Document Transfer Internal Communication Virtual Organization

Table 5: Proposed Model of Electronic Commerce Application.

Category	Activity	Application
Primary Activities	Inbound Logistics	Inbound Logistics / Distribution
	Operations	Production Customization
	Outbound Logistics	Product/Service Order Processing Product/Service Delivery Upgraded Product Distribution
	Marketing and Sales	Product Information New Product Announcement Special Offer Announcement Sales Channel Information Access Tracking
	Service	Customer Feedback Technical Support Mass Mailing

Table 5: Proposed Model of Electronic Commerce Applications, continued.

Category	Activity	Application
Support Activities	Procurement	Resource Procurement
	Technology Development	Market Intelligence Market Research Inter-organizational Collaborative R&D
	Human Resource Management	Employee Training Recruiting
	Public Relations	General Company Information Corporate Announcements Financial Information Reporting Subsidiary Information Public Service
	Firm Infrastructure	Environmental Scanning Employee Directory Internal Communication Internal Document Transfer External Document Distribution Virtual Organization

Table 6: Applications included in the Test of the Proposed Framework.

ID#	Application	Activity
1	General Company Information	Public Relations
2	Subsidiary Information	Public Relations
3	Corporate Announcements	Public Relations
4	Financial Information Reporting	Public Relations
5	Product Information	Marketing and Sales
6	New Product Announcement	Marketing and Sales
7	Special Offer Announcement	Marketing and Sales
8	Mass Mailing	Service
9	Public Service	Public Relations
10	Product/Service Order Processing	Outbound Logistics
11	Product/Service Delivery	Outbound Logistics
12	Customer Feedback	Service
13	External Document Distribution	Firm Infrastructure
14	Technical Support	Service
15	Upgraded Product Distribution	Outbound Logistics
16	Sales Channel Information	Marketing and Sales
17	Market Research	Technology Development
18	Production Customization	Operations
19	Recruiting	Human Resource Management
20	Employee Directory	Firm Infrastructure

MODEL TESTING

This framework was subjected to an empirical test to see if it would classify EC applications currently in use by functioning organizations. Data was gathered at the firm level, and results for both the firm- and industry-levels are reported in this section.

EC applications consist of those uses of EC technology that are visible to the general public as well as those that are not visible. As a practical matter, the test procedures restricted observations to visible, Web-based applications.

Accordingly, a number of framework applications (Access Tracking, Market Intelligence, Employee Training, Environmental Scanning, Internal Communication, Internal Document Transfer, and Inter-organizational Collaborative R&D, Logistics, and Procurement) could not be tested. Further, the application of Virtual Organization was barred from these tests due to the sample selection process. This process drew firms from the Fortune 500 listing of companies, and no virtual company-that is, a firm operating completely over the Internet and maintaining no physical business facility-has appeared on that list. The remaining twenty applications from the framework, as listed in Table 6 (with reference numbers for use in successive tables), permitted an initial, if incomplete, evaluation.

Data Collection

In order to provide a sample of firms from a variety of industries, fifty companies from the Fortune 500 list were selected by a randomized process, and home page addresses for these firms were obtained. The content of each site was examined by one of the authors during a ten-day period in 1997 to locate and determine the nature of the firm's Web-based, visible business activities. Then, these observations were classified according to the proposed framework. As a reliability check, a second author revisited one-third of the sites to verify the initial classifications. The two analyses were virtually identical, and differences in judgments were resolved by consensus. The firm-level data gathered is summarized in Appendix A.

Firm-Level Analysis

Figure 3 presents the rates at which businesses were observed to have adopted particular applications for their Web sites. Some applications, particularly those relating to the provision of company and product information, were very widely implemented. Other applications were rarely noted. For example, no firms from the sample were noted to be distributing upgraded products, and only one company had made its employee directory available.

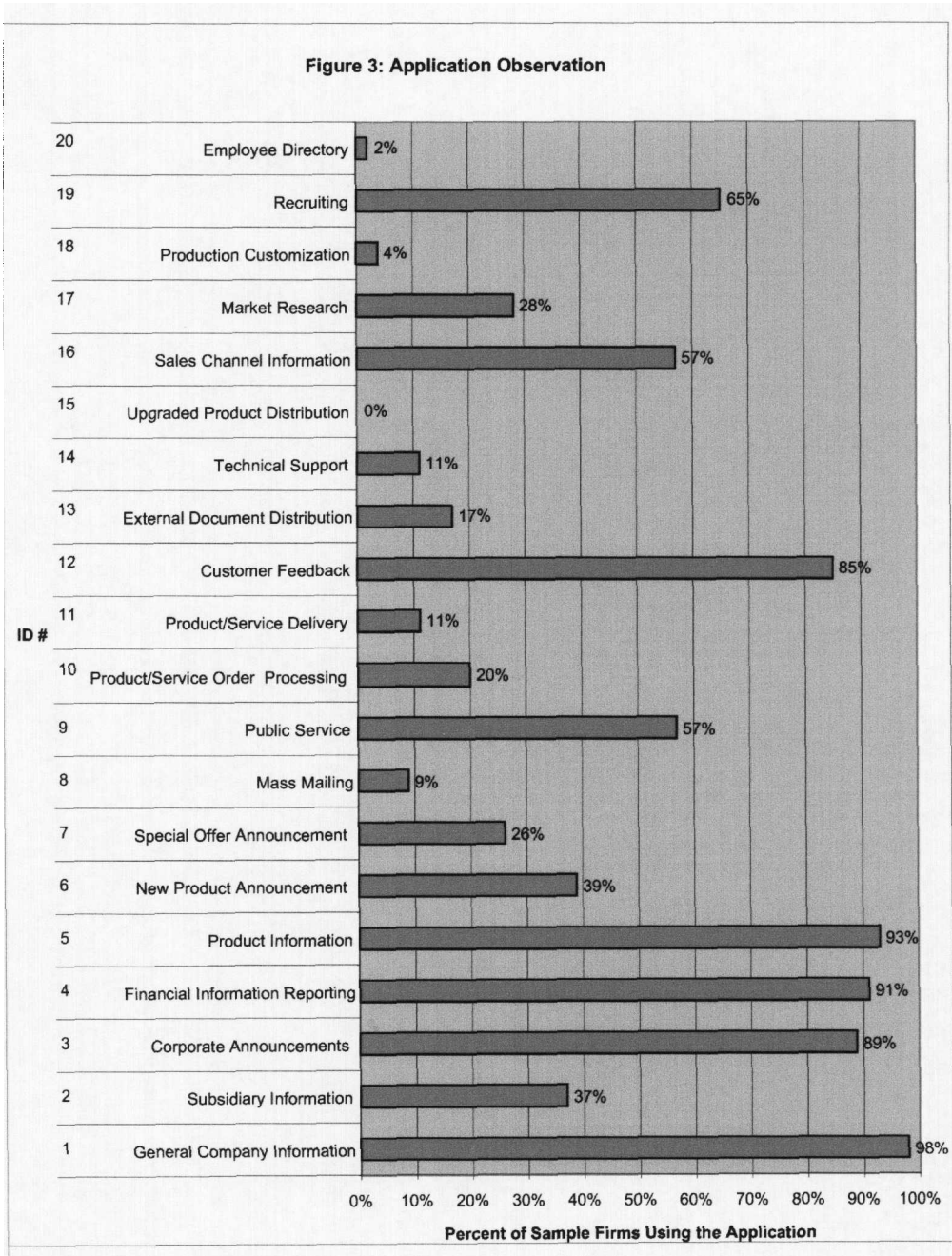
During the data collection period, the Web sites of four firms were not accessible. As a result, the test results involve only 46 firms. Assuming the random sample to be representative, 92 percent of Fortune 500 companies could be inferred to have accessible Web sites in 1997, which was a considerable increase over the 80 percent reported in early 1996 (Dahl and Leslie 1996).

In Figure 4, the twenty applications are shown, by activity and category, as they fit into the proposed EC application framework. For each activity, an intensity rate is shown above the bar. The Intensity Rate represents the proportion of the number of applications observed in a classification compared to the number of observations possible. That is,

$$\text{Intensity Rate} = \frac{\text{Number of Applications Observed as Implemented}}{\text{Number of Possible Observations}}$$

In this formula, the divisor would be 46 if there were only one observation possible per company. However, the divisor depends upon the number of applications assigned to that activity (see Table 6.) For example, Marketing and Sales contains four applications in the proposed model so the divisor is 176 potential observations (4 applications times 46 firms). An equivalent computation is used for the intensity rates of each activity in the primary and support categories in the first column. The sample information as applied to the framework indicates that EC activities are more widely observed in the area of support than for





primary activities. Thirty-two percent of the potential application observations in the Primary Activities category were found in our sample, for an Intensity Rate of 32%. In contrast, an Intensity Rate of 54% was calculated for the

Support Activities category. The Web commonly is recognized as an efficient and effective way to distribute information. A large number of support functions are informational in nature rather than transactional like many

primary activities. In fact, most of the observed primary activities are informational in nature. Support functions are very likely to be of interest to external parties; and, as the design of our study was predicated on external visibility of the application, finding a large number of support applications is not surprising. Further, note that 39 firms recognize the value of receiving information--not just sending or posting it--by facilitating comments from site users.

Industry-Level Analysis

Table 7 summarizes the data by industry, using the North American Industry Classification System. The firms are identified on the table by their ID numbers corresponding to the listing in Appendix A, and the only industries listed are those in which at least one firm was drawn for our sample. Some firms are included more than once because they conduct business in more than one industry. Applications are identified by the numbers used on Table 6, and the values in the Application column are the number of companies in the industry that were observed to have implemented that particular application. The table entries are sorted by the average number of applications observed per company in the industry, as listed in the last column.

Interestingly, two firms from industries related to the direct harvesting of natural resources are observed as the heaviest EC adopters from our sample. Note, however, that the mean observed number of applications is fairly consistent at about 8 or more for any industry, except for construction.

Even within the limited scope of this test, drawing conclusions about industries with only one or two observations seems ill advised. Thus, industries with two or fewer firms in the sample were eliminated, permitting six to remain for more detailed analysis. This reduced set of observations was organized according to the EC applications model, and corresponding intensity rates were calculated using the formula presented earlier. Figure 5 reports a summary of this analysis for the overall categories of Primary and Secondary Activities. Several items of interest are prominent in this analysis. They are listed below with implications discussed in the next section.

Figure 5 shows clearly the preference given to support activities, over primary activities, to firms adopting EC applications, regardless of industry. Across these six industries, 32% of the potential EC primary activities and 54% of the potential EC support activities are observed as implemented. The

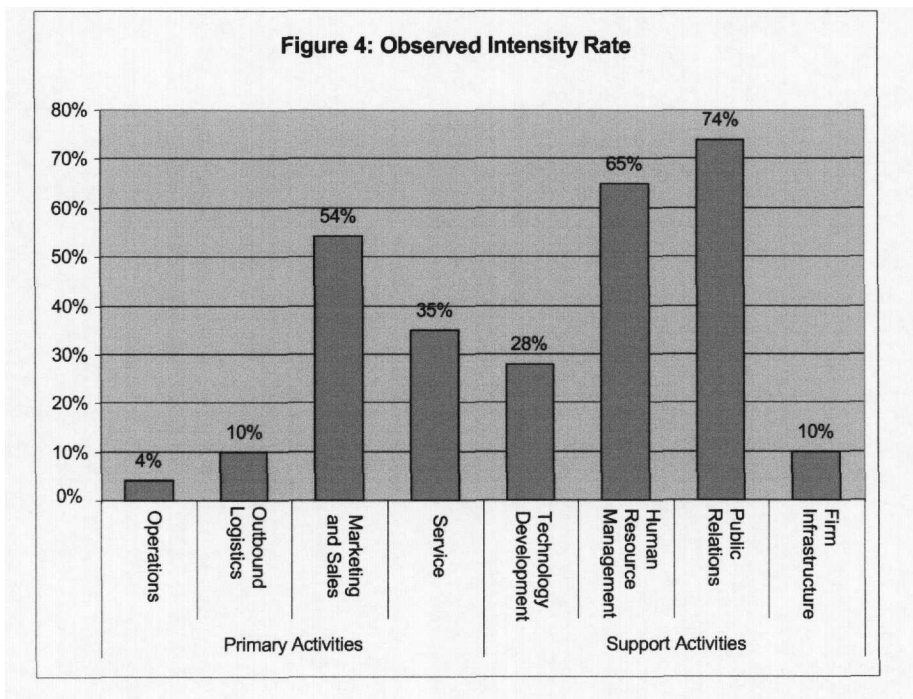


Table 7: Observed Number of Applications by Industry

Sector	Company	Application																			Mean	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		20
Mining	13	1	0	1	1	1	1	0	0	1	0	0	1	0	1	0	1	1	0	1	0	11.0
Agriculture, Forestry, Fishing and Hunting	39	1	1	1	1	1	1	0	0	1	0	0	1	0	0	0	1	0	0	1	0	10.0
Retail Trade	3, 18, 27, 31, 34	5	2	4	5	4	3	3	0	3	1	1	4	0	1	0	3	3	2	4	0	9.6
Information	6, 18	2	2	2	2	2	1	1	0	1	1	0	2	1	0	0	0	0	2	0	0	9.5
Utilities	24, 27, 33, 41, 45, 46	6	3	6	6	6	3	1	0	6	1	1	5	3	0	0	3	0	0	4	0	9.0
Professional, Scientific, and Technical Service	25, 27, 37, 41, 49	5	5	5	4	5	2	2	0	4	0	1	4	1	0	0	0	2	0	4	1	9.0
Transportation and Warehousing	4, 7, 17, 21, 28, 29, 42, 49	8	3	8	6	8	2	2	1	3	4	2	7	3	0	0	4	2	0	5	0	8.5
Arts, Entertainment, and Recreation	9, 18	2	1	2	2	2	1	1	0	0	0	0	2	0	1	0	1	0	0	2	0	8.5
Manufacturing	1, 2, 10, 12, 13, 19, 20, 22, 26, 27, 32, 35, 38, 39, 40, 43, 50	16	6	14	16	16	9	2	3	11	1	1	15	0	2	0	8	4	0	12	0	8.0
Health Care and Social Assistance	5, 11	2	0	2	2	2	0	1	0	2	0	0	2	0	0	0	1	1	0	1	0	8.0
Finance and Insurance	5, 16, 27, 30, 37, 44, 48	7	4	6	6	6	1	2	0	3	0	0	6	0	1	0	5	2	0	4	0	7.6
Accommodation and Food Services	8, 15	2	0	2	2	2	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0	7.5
Construction	43, 48	2	1	0	0	2	0	0	0	1	0	0	2	0	0	0	1	0	0	1	0	5.0

Retail Trade industry leads the others in EC observations for both primary and support activities. EC adoption of support-related

applications appears to be higher for the Utilities and especially for the Professional, Scientific, and Technical Service industries.

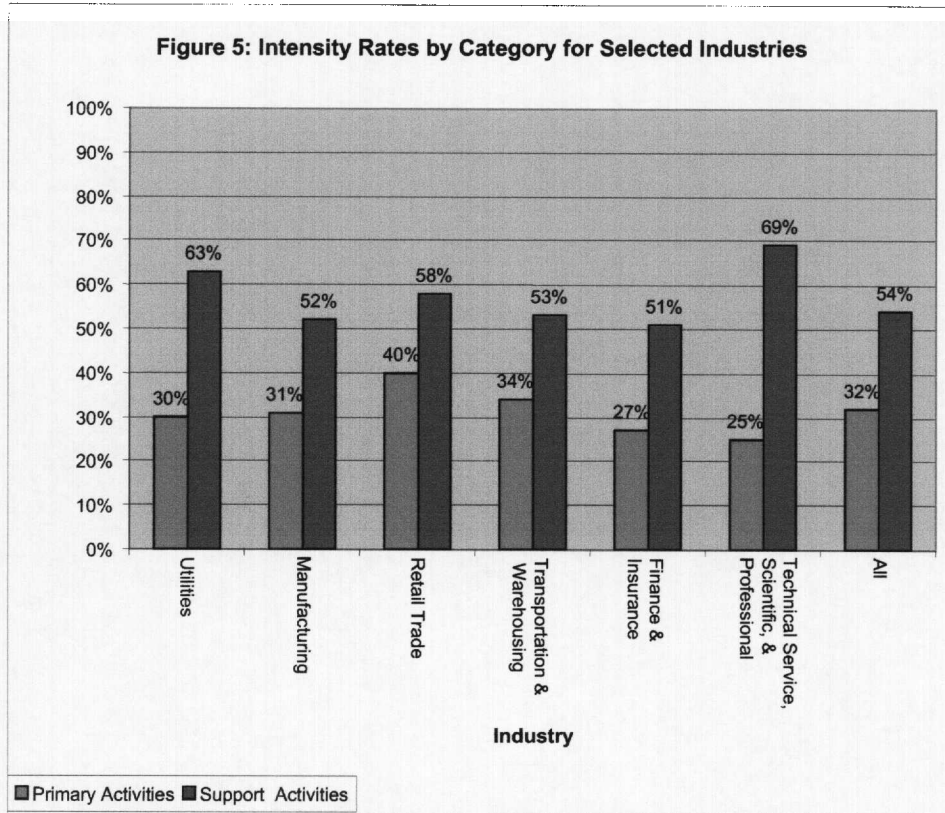
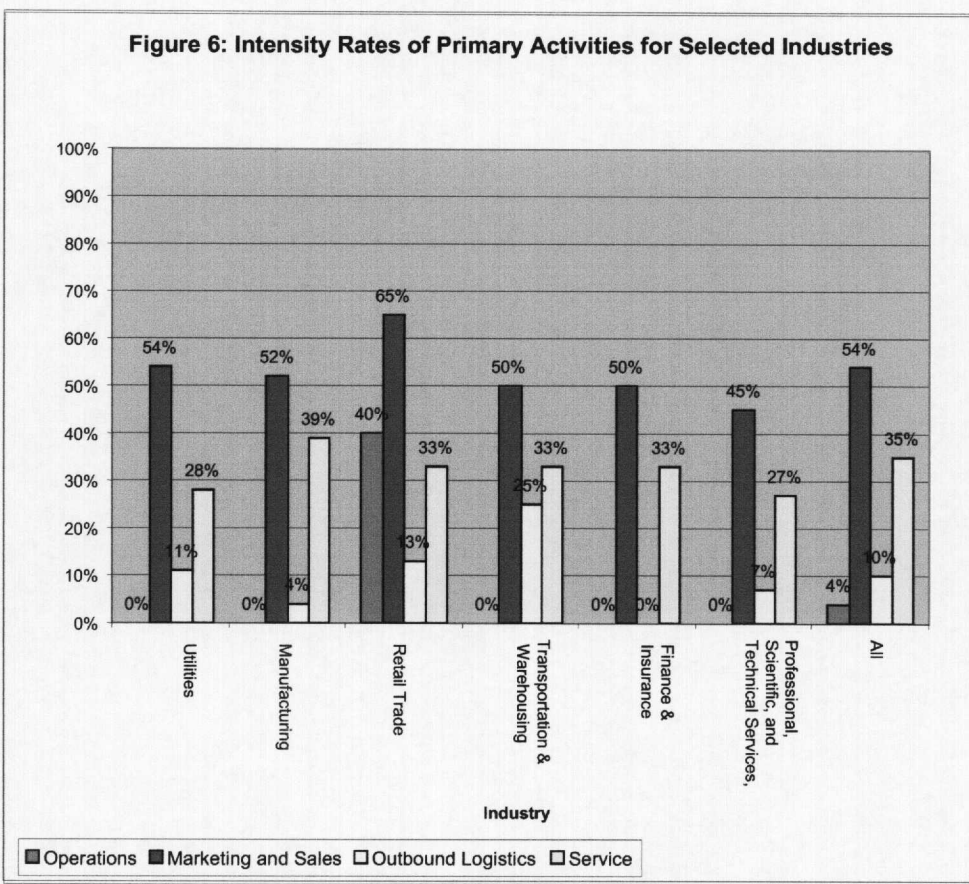


Figure 6 presents industry intensity rates for the primary activities of Operations, Marketing and Sales, Outbound Logistics, and Service. Within the primary activities category, the most commonly observed activity is Marketing and Sales; at least 50% of the possible applications for Marketing and Sales are observed in every industry. Note that service applications are distributed across industries fairly evenly. The Retail Trade industry tends to use EC for Marketing and Sales even more intensively than the other industries, and it is the only one visibly using applications for Operations. The Transportation and Warehousing industry is observed to use Outbound Logistics considerably more heavily than do other industries, as might be expected, with the Finance and Insurance, Manufacturing, and Professional, Scientific, and Technical

Service industries making very little observable use of EC for Outbound Logistics.

As illustrated in Figure 7, within the support activities category, the most commonly observed applications are in the areas of Public Relations and Human Resource Management. The Utilities and the Professional, Scientific, and Technical Service industries are observed applying EC for Public Relations more frequently than the other industries, but even the lowest intensity rating for Public Relations, which belongs to Transportation and Warehousing, is high at 70%. Similarly, while all industries are strong adopters of EC applications for their Human Resource Management activities, the Retail Trade and the Professional, Scientific, and Technical Service industries appear to be the leaders in this area.





The Retail Trade industry is a heavier user than the other industries of observed EC applications also in the area of Technology Development, and the Utilities industry is not observed to be using EC for Technology Development at all. Finally, the Manufacturing, the Retail Trade, and the Finance and Insurance industries make no observable use of EC applications for Firm Infrastructure activities.

DISCUSSION

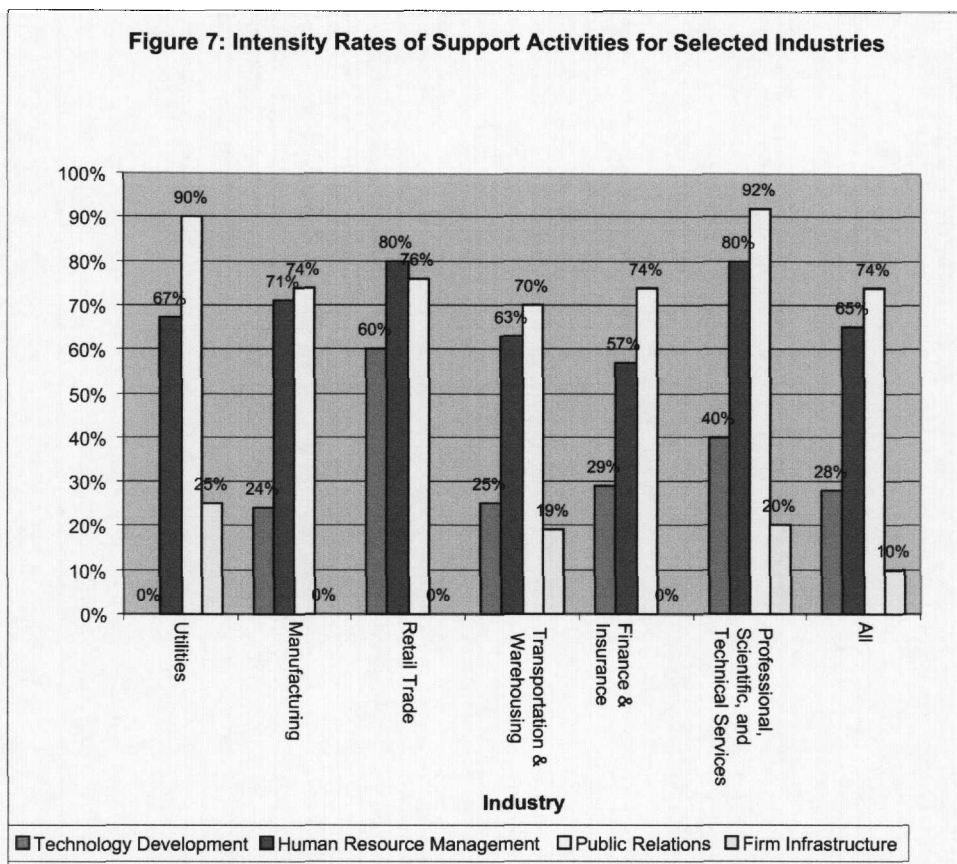
A number of factors suggest explanations as to why a particular EC application is observed as adopted, and these relevant factors are quite likely to be intertwined. Leading explanations for (or against) a specific adoption seem to emanate from the natures of both the industry and the application.

Nature of the industry

Differences in the types of products or services, levels of information sensitivity, relationships with environmental entities, and attitudes towards new technology can be attributed to specific industries. These distinctions make adoption of particular EC applications more or less advisable.

Nature of the product or service. The nature of the products and services provided by, for example, a firm in the Retail Trade industry determines its potential for implementing Marketing and Sales activities over the Internet. One possible product-related application is customization of the product to the customer's specifications. Web sites observed for this project allowed customers to participate directly in the manufacturing processes of clothing and

Figure 7: Intensity Rates of Support Activities for Selected Industries



greeting cards. In more recent months, such varied firms as Dell, Reebok, and Kellogg have also engaged in consumer customization opportunities via the Internet. Similar applications would be very difficult for, say, the Utility industry to adopt; and, in fact, no such applications were observed for sample firms in industries other than Retail Trade. (Note that the lack of observed applications for Operations is in part due to the visibility issue; see the discussion below related to information sensitivity.)

Some products, such as software, periodicals, or sheet music, can be translated into digital form and thus be delivered electronically. Non-digital products, such as trucks and groceries, can be ordered but not physically distributed, thereby designating certain EC applications possible only for particular types of goods within industries.

Information sensitivity. Industries, such as Finance and Insurance, deal largely with consumer information that raises privacy concerns or with time-sensitive product-related information, such as stock market information. Many of these services that would have been classified as Operations or Outbound Logistics require appropriate authorization for access. Thus, that industry's lack of observed Operations applications is more likely due to the visibility issue than to a lack of EC activity in the area. This observation implies, however, that successful implementation of such applications is a non-trivial endeavor and involves more attention to security measures than does, say, the implementation of general public relations material.

Relationships with other entities. majority of the customers of the Retail Trade



industry are final consumers in the community. Managers of retail businesses, therefore, may be more predisposed to making a large investment in Marketing and Sales. Manufacturing businesses are more likely to nurture established, long-term business partners and sales channels. Managers of such firms may be reluctant to invest in Marketing and Sales applications that are observable to external parties.

Since 1997 when the observations presented here were made, more businesses are engaging in vertical and horizontal marketplaces; thus, newer implementations of EC technology are breaking down barriers to trade among established firms. Even so, some industries are reported to lag in their acceptance of EC applications. For example, a recent study by KPMG suggests that a "lack of trust" between parties in the automotive industry is causing it to be less advanced in its EC activity than a number of other industries (Pastore January 2001).

Attitudes towards technology innovations. One cause contributing to the slowness of the automobile industry to adopt certain EC applications is that top executives are not as actively involved in EC activities as those in other industries. Some executives have adopted a "wait and see" attitude towards their competition rather than spending the money required to re-engineer business processes or improve technology skills (Pastore January 2001). Thus, we see low scores for applications by the Manufacturing industry on such applications as Product Customization or Technical Support even as they score highly for Public Relations activities.

Of course, attitudes go beyond those of the EC-adopting business, and the technology attitudes of the business' customers must also be considered. A report by Harris Interactive indicates that for customers, especially affluent customers, of firms related to the Finance and Insurance industry, the Web is a top media source of information (Pastore September 2000). Thus, firms in that industry must be prepared to provide their technologically savvy customers with the desired online information related to Primary activities.

Nature of the application

Generally speaking, the more widely observed applications are simpler from both technical and management perspectives. For example, the EC application, Provide Products/Services Information, can be easy to implement in some environments--such as the provision of search software for service databases--and where not related to issues such as censorship, security, or copyright. Other applications, such as Product/Service Order Processing, can be complicated by issues related to security of credit card payments (a technical issue) or privacy of customer information (a management issue.) Such issue-laden applications are not likely candidates for entry into the EC setting, particularly in the public domain.

The development and maintenance of EC applications can involve major financial, technological, and human capital investments. The design of effective applications, particularly those with interactive and dynamic interfaces, is complicated. Businesses often do not have the expertise in-house and must seek costly help from outside consultants. Even when the application appears to be technically simple, it may not be justified in terms of a cost-benefit analysis. For instance, the cost for Fortune 500 companies to implement and maintain online employee directories may be prohibitive simply due to the size and volatility of the employee force. A recent survey of Fortune 500 firms finds that less than a third of them order strategic goods online. Among other reasons, these companies report maintenance of current price information for their indirect goods is simply too difficult to justify adoption of electronic procurement systems (Pastore December 2000).

Directions for Future Research

The Internet as a business resource is a relatively recent phenomenon, but it is evolving at a rapid pace and in directions that its founders surely never anticipated. The leading barriers to effective Internet fulfillment arise from both management and technical factors. This study focuses on one of the management issues--namely, how to apply EC in the advancement of business activities--and a generic framework was developed for classifying EC applications. This

framework was based on widely accepted models of organizations, and a limited test of the framework provided insights into the EC applications observably implemented at the current time across a number of firms and industries. The framework reinforces the widespread notion that the Internet is amenable to a wide range of business activities and can provide guidance to managers seeking new ways to utilize the Internet.

One major limitation of this study provides a fruitful avenue for future research. Specifically, non-visible and non-Web-based EC applications remain to be examined. The data used for this study were derived from public Web sites, thereby restricting our tests to visible Web-based applications. Some applications in the proposed framework, which is broad enough to include non-Web-based and non-visible Web-based EC applications, could not be observed. Yet, businesses certainly are engaging in EC activities via non-public channels.

Testing the model presented here with broader samples or with more refined measures of EC application adoptions would be advisable. The sample in this study was restricted to Fortune 500 companies, and the sampling process generated firms from only thirteen of twenty industries. Therefore, the results may not be applicable to all industries or to smaller businesses. Further, our methodology for mapping applications to categories is not sophisticated and presents opportunities for further refinement. Finally, the development of industry-specific EC application models based on distinct industry characteristics would be interesting.

Organizations are adopting and applying e-commerce technologies at a very rapid pace. The nature and scope of applications are constantly evolving. The framework provided offers a way to understand how organizations are utilizing such technologies. However the rapid changes in technology and applications have resulted in the data being a bit dated. The data collected in this study primarily serves to demonstrate the utility of the framework. However, analysis with more current data will be necessary before significant conclusions can be drawn and relied upon.

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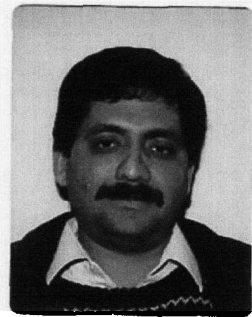
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Appendix A: Observed EC Applications by Firm

ID#	Firm(Web Address)	NAICS Code	Application																		Total %			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		19	20	
1	General Motors Corporation(www.gm.com)	31 - 33	0	0	1	1	1	1	1	0	1	1	0	0	1	0	0	1	1	0	1	0	10	50
2	Ford Motor Company(www.ford.com)	31 - 33	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	1	1	0	1	0	13	65
3	J.C.Penny Company, Inc.(www.jpenny.com)	44 - 45	1	0	1	1	1	1	1	1	0	1	0	0	0	0	1	1	1	0	1	0	12	60
4	United Parcel Service of America, Inc.(www.ups.com)	48 - 49	1	0	1	0	1	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0	9	45
5	CIGNA Corporation(www.cigna.com)	52, 62	1	0	1	1	1	1	0	1	0	0	1	0	0	0	1	0	0	1	0	9	45	
6	MCI Communications Corporation(www.mci.com)	51	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0	12	60	
7	AMR Corporation(www.amrcorp.com)	48 - 49	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	10	50	
8	Safeway Inc.(www.safeway.com)	72	1	0	1	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	6	30	
9	Eastman Kodak Company(www.kodak.com)	71	1	0	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	1	0	10	50	
10	Phillips Petroleum Company(www.phillips66.com)	31 - 33	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	20	
11	Bristol-Myers Squibb Company(www.bms.com)	62	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	7	35	
12	Digital Equipment Corporation(www.digital.com)	31 - 33	1	0	1	1	1	1	1	0	1	0	1	0	1	0	1	0	0	1	0	11	55	
13	Minnesota Mining & Manufacturing Company(www.mmm.com)	21, 31 - 33	1	0	1	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	11	55
14	Bell Atlantic Corporation(www.bel-atl.com)	*																						
15	IBP, Inc.(www.ibpinc.com)	72	1	0	1	1	1	1	0	1	0	1	0	0	0	0	1	0	0	1	0	9	45	

ID#	Firm(Web Address)	NAICS Code	Application																				Total %	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
16	ITT Hartford Group, Inc. (www.thehartford.com)	52	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	6	30
17	Delta Air Lines, Inc. (www.delta-air.com)	48 - 49	1	1	1	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	8	40
18	Viacom Inc. (www.viacom.com)	44 - 45, 51, 71	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	7	35
19	Emerson Electric Company (www.emersonelectric.com)	31 - 33	1	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6	30
20	Occidental Petroleum Corporation (www.oxychem.com)	31 - 33	1	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	7	35	
21	Federal Express Corporation (www.fedex.com)	48 - 49	1	0	1	1	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	8	40	
22	Johnson Controls, Inc. (www.jci.com)	31 - 33	1	0	1	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	6	30	
23	Gillette Company (www.gillette.com)	*																						
24	PG&E Corporation (www.pge.com)	22	1	0	1	1	1	0	0	0	1	0	0	1	0	0	1	0	0	1	0	9	45	
25	Pacific Telesis Group (www.pactel.com)	54	1	1	1	1	1	1	0	1	1	0	1	1	0	0	1	0	1	0	1	13	65	
26	Unocal Corporation (www.unocal.com)	31 - 33	1	1	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	1	0	8	40	
27	Edison International (www.edisonx.com)	22, 31 - 33, 44 - 45, 52, 54	1	1	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	1	10	50	
28	Burlington Northern Santa Fe Corporation (www.bnsf.com)	48 - 49	1	0	1	1	1	0	0	0	0	1	1	0	0	1	0	0	1	0	1	10	50	
29	US Airways Group, Inc. (www.usairways.com)	48 - 49	1	0	1	1	1	0	1	1	0	0	1	0	0	0	1	0	0	1	0	9	45	
30	AFLAC, Inc. (www.aflac.com)	52	1	0	1	1	0	0	0	0	1	0	0	1	0	0	1	0	1	0	1	8	40	
31	Dillard Department Stores, Inc. (www.azstarnet.com/dillards)	44 - 45	1	0	0	1	0	0	0	0	1	0	0	1	0	0	1	1	1	0	0	7	35	
32	Lear Corporation (www.lear.com)	31 - 33	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	7	35	

ID#	Firm(Web Address)	NAICS Code	Application																				Total %
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
33	American Electric Power Company, Inc. (www.aep.com)	22	1	0	1	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	8	40
34	The Gap, Inc.(www.gap.com)	44 - 45	1	0	1	1	1	1	1	1	0	0	1	0	0	1	0	1	1	1	1	12	60
35	Cooper Industries, Inc. (www.cooperindustries.com)	31 - 33	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	8	40
36	WellPoint Health Networks, Inc. (www.wellpoint.com)	*																					
37	Marsh & McLennan Companies, Inc. (www.marshmac.com)	52, 54	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	5	25
38	The Sherwin-Williams Company (november.dtc.net/~dryan29)	31 - 33	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	6	30
39	Union Camp Corporation (www.unioncamp.com)	11, 31 - 33	1	1	1	1	1	1	1	0	0	1	0	0	1	0	0	1	0	0	1	10	50
40	Rohm & Haas Company (www.rohmhaas.com)	31 - 33	1	0	1	1	1	1	1	0	0	1	0	0	1	0	0	0	1	0	1	8	40
41	GPU, Inc.(www.gpu.com)	22, 54	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	1	9	45
42	CNF Transportation Inc.(www.cnf.com)	48 - 49	1	0	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	6	30
43	Temple-Inland Inc.(www.templeinland.com)	23, 31 - 33	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	5	25
44	Allmerica Financial Corporation (www.allmerica.com)	52	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0	1	1	0	1	10	50
45	Baltimore Gas & Electric Company (www.bge.com)	22	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	9	45
46	Long Island Lighting Company (www.lilco.com)	22	1	0	1	1	1	1	1	1	0	0	1	0	0	1	0	0	1	0	1	9	45
47	Whitman Corporation (www.whitmancorp.com)	*																					
48	Centex Corporation (www.centex.com)	23, 52	1	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	5	25

ID#	Firm(Web Address)	NAICS Code	Application																				Total	%
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
49	Caliber System, Inc. (www.calibersys.com)	48 - 49, 54	1	1	1	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	0	8	40	
50	The Stanley Works (www.stanleyworks.com)	31 - 33	1	0	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	6	30	
Totals			45	17	41	42	43	18	12	4	26	9	5	39	8	5	0	26	13	2	30	1	386	
% of Observed Firms Adopting Application			98	37	89	91	93	39	26	9	57	20	11	85	17	11	0	57	28	4	65	2	42	

Key: * : indicates the Web site was not accessible during the data collection period.

1 : indicates the application was found on the Web site during the data collection period.

0 : indicates the application was not found on the Web site during the data collection period.