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DIFFUSION AND IMPACTS OF E-COMMERCE IN THE UNITED STATES OF AMERICA: RESULTS FROM AN INDUSTRY SURVEY

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ABSTRACT

The paper provides baseline conditions of the U.S. e-commerce in the post-dot.com era. The article examines the key factors that act as determinants of e-commerce diffusion. It is based on qualitative analysis of the U.S. industry survey data, matched to a similar data and analyses from other countries. It presents data taken from one of the most comprehensive sample surveys yet done of the U.S. firm activity in e-commerce.

The paper analyses differences among three industry sectors, and between small/medium and large firms using both qualitative interpretations and direct observations from the survey data, as well as use of structural equation modeling of e-commerce diffusion and impacts.

Some differences in e-commerce orientation and experience were found across the three industry sectors studied in the survey of 10 countries. These differences are related largely to the nature of the tasks done in the respective industries, and to prior industry-level investment and learning related to e-commerce. There were also differences found in e-commerce attitudes and experience between small/medium sized enterprises (SMEs) and large establishments. Only modest differences were found between U.S. and non-U.S. establishments.

Quantitative analysis found significant regression relationships with their level of statistical significance. Results show that e-commerce adoption is path dependent (i.e., establishments

follow earlier investment patterns), and that each industry's market and institutional context play a significant role in adoption.

Keywords: e-commerce, EDI, globalization, ICT, information technologies, IT economic impacts, IT, technology diffusion, telecommunication infrastructure, industry survey, qualitative analysis, structural equation modeling

I. INTRODUCTION

This paper examines the evolution, adoption and impacts of e-commerce in the U.S. using data from an e-commerce survey in ten countries completed in 2002 by the Global Electronic Commerce study (hereafter called the survey) at the University of California at Irvine [Kling et al., 2003, Kraemer et al., 2003]. In addition, the paper draws upon other public data sets, including U.S. Census data and ITU data sets.

The paper addresses three broad questions:

1. Do e-commerce experiences in terms of readiness, deployment, adoption and impact of e-commerce technologies of the U.S. establishments differ from those in other countries studied?
2. Do e-commerce experiences in the manufacturing, finance, and distribution differ from one another?
3. Do e-commerce experiences differ significantly between small and medium-sized establishments versus large establishments?

The paper seeks answers to these questions using both qualitative interpretations and direct observations from the survey data, as well as use of structural equation modeling of e-commerce diffusion and impacts. Results show that e-commerce is growing steadily, and that drivers encouraging use of e-commerce technologies outweigh barriers to use. E-commerce use will grow as benefits start to materialize across industry sectors, but it will be a considerable period of time before e-commerce overtakes traditional commerce.

II. METHODS

The methods employed in this paper include documentary study of secondary sources on demographic and economic factors and on experience with e-commerce in the U.S. and internationally. Data sources include government agencies' reports, reports from international non-governmental organizations, scholarly and trade publications, and publications by commercial establishments engaged in research and analysis related to IT and e-commerce. Following documentary analysis, the study shifts to a survey conducted in 2002 by the Center for Research on Information Technology and Organizations at the University of California at Irvine, and the International Data Corporation¹. The survey included 300 establishments in the United States that use the Internet to buy, sell or support products and services. The survey covered three sectors: manufacturing, distribution (wholesale and retail), and finance (banking and insurance). The sample was split evenly by industry sector and by establishment size into large (>250 employees) and small/medium (25 to 250 employees). Additional data from the survey

¹ Given the variables we focused on in the analysis, the findings presented in the paper are still valid today, even though the survey data were obtained in 2002. This paper is best positioned as a documentary utility in a historical analysis of the rise of e-commerce. The paper provides baseline conditions of the U.S. e-commerce in the post-dot.com era. It presents data taken from one of the most comprehensive sample surveys yet done of the U.S. firm activity in e-commerce, and matches similar data and analyses from nine other countries obtained as part of the research project.

cover nine other countries. Throughout this paper analyses compare the responses of establishments within the U.S. to responses of the whole sample of establishments. For convenience, the nomenclature adopted for these analyses refers to the sample of U.S.-only establishments as the U.S. Firms, and the total sample as All Firms.

Descriptive data analyses were done to discover significant differences within the variables covered in survey instrument. Analysis focused on

1. what factors, if any, cause e-commerce adoption across industry sectors and over the whole data set, and
2. whether e-commerce impact businesses significantly across sectors, or sampled sectors as a whole, and
3. what factors produce such impacts.

III EXPECTATIONS ABOUT THE STATUS OF E-COMMERCE

This paper investigates the use, diffusion, and effects of e-commerce activities in the U.S in the context of earlier work [Fomin et al., 2003] that formed a set of six initial expectations in the economy as a whole, and in the sectors of manufacturing, distribution and finance.

First expectation. E-commerce will continue to grow, despite the collapse of the dot.com boom. This expectation appears to be borne out by the data, with the volume of electronic transactions growing steadily with the 2002 level surpassing the 2000 peak (Table 1) [OECD, 2002, p.7]. Manufacturing leads all industry sectors in e-commerce shipments, with merchant wholesale trade and retail trade and sales following (Figure 1).

Table 1. Estimated Quarterly U.S. Retail Sales: Total and E-commerce

	Retail Sales		E-commerce as a % of Total Sales
	Total ^a	E-commerce ^b	
1999 Q4	784,278	5,481	0.7
2000 Q1	711,600	5,814	0.8
Q2	771,691	6,346	0.8
Q3	765,536	7,266	0.9
Q4	810,311	9,459	1.2
2001 Q1	724,224	8,256	1.1
Q2	805,245	8,246	1.0
Q3	782,088	8,236	1.1
Q4	856,285	11,178	1.3
2002 Q1	743,810	9,880	1.3
Q2 ^c	825,243	10,265	1.2
Q3 ^d	827,461	11,061	1.3

Source: [U.S. Census Bureau, 2003]

Data in millions of dollars, not adjusted for seasonal, holiday and trading-day differences

^a - Does not include Food Services.

^b - E-commerce sales are sales of goods and services where an order is placed by the buyer or price and terms of sale are negotiated over an Internet, extranet, Electronic Data Interchange (EDI) network, electronic mail, or other online system. Payment may or may not be made online.

^c - Revised.

^d - Preliminary



Source: [U.S. Census Bureau, 2003]

Figure 1. E-Commerce as Percent of Total Value: 2001

Second Expectation. The U.S. will remain a leader in global e-commerce due to the historical U.S. strengths in information technology, telecommunications, financial services, and transportation, as well as the huge size, dynamism, and diversity of the U.S. economy, the wealth of its consumer base, and the U.S.'s relatively open access to venture capital and its attractive environment for e-commerce innovation and investment. This expectation is supported by the data from the survey, although it is clear that other developed countries are at the same level as the U.S. in many areas of e-commerce.

Third Expectation. No significant change will occur in the U.S. Government's policies regarding e-commerce. The U.S. policy let the private sector take the lead, with government helping to make the right business climate for innovation and investment [Kraemer and King, 1996]. Widespread economic liberalization has been underway since the 1970's in areas such as financial services, transportation, and telecommunications relevant to e-commerce. In addition, the U.S. Government invested heavily in research and infrastructure related to military and other purposes (e.g., digital computing, the Internet, interstate highways, air transport) that were not undertaken in expectation of e-commerce, but enabled it, nonetheless.

Fourth Expectation. Experience with B2B and B2C e-commerce will vary significantly by industrial sector. Commerce is closely tied to specific tasks that vary by industry, so e-commerce will vary as well. This expectation is met by the survey data.

Fifth Expectation. U.S. companies engaging in B2C e-commerce will face challenges in overcoming institutional and behavioral obstacles. This expectation is borne out by the survey. Consumer-related concerns regarding privacy, transaction and data security, and problems in use remain obstacles to universal adoption of B2C e-commerce.

Sixth Expectation. the e-commerce adoption and diffusion experiences of U.S. establishments and those in other countries will be similar. Much of the infrastructure for e-commerce is provided by a relatively small set of global providers, and the professional consulting services that support e-commerce implementation are similar. The survey found that the experiences of U.S. establishments and global establishments are quite similar.

The rapid expansion of e-commerce was enabled as well as constrained by industry structure in the U.S., as reviewed in the next subsection.

INDUSTRY STRUCTURE

Manufacturing, wholesale and retail trade, and finance are the largest industries in the U.S., representing together over two thirds of the economy (Table 2). The U.S. finance industry contributes over 30% to the U.S. GDP with 4% of the total number of the U.S. establishments (among all sectors). Manufacturing, the second largest U.S. industry, generates 19.6% of GDP with 5.4% of establishments [U.S. Census Bureau, 2003].

Table 2. GDP Distributed by Industrial Sector, United States, France, and Germany (%)

Sector	U.S.	Firms as % of Total	France	Germany
Manufacturing	19.6%	5.4%	24.5%	28.6%
Wholesale and retail trade, restaurants and hotels	18.1%	19.2%	19.1%	n.a.
Finance	30.8%	4.0%	29.1%	16.7%
GDP total U.S.\$ (Billions), 2001	10,065.3		1,309.8	1,846.1
GDP per capita (U.S.\$), 2001	35,445.80		22,138.21	22,459.65

Sources. United Nations National Accounts 1999, World Bank World Development Indicators, 2003, U.S. Census Bureau, 2003

U.S. industry is dominated in number by small and medium-sized enterprise (SMEs) in all three sectors defined in Table 2. About 98% of U.S. establishments employ less than 100 people: 93% in manufacturing, 97% in wholesale and 98% in retail distribution, and 98% in finance [U.S. Census Bureau, 2003].²

*E-Stats*³ [U.S. Census Bureau, 2003] provides detail on e-business in these sectors: (Table 3). E-commerce outperformed total economic activity in three of four major economic sectors measured between 2000 and 2001. B2B, which depends critically on EDI, dominated e-commerce activity (93% of total e-commerce activity). All industry groups in each sector participate in e-commerce, though there are differences among the sectors on certain measures. Manufacturing and wholesale trade, where goods are typically sold to other businesses, report substantially higher e-commerce activity percentages than retail trade and selected service industries. The long-standing use of EDI systems for online B2B transactions in these industries might account for this difference. In manufacturing, for example, EDI systems continue to dominate in terms of dollar volume [Mesenbourg, 2001]. Among establishments that provide online ordering capabilities for their customers, half use the Internet most frequently compared to

² Although the U.S. Census Bureau's data on employment size are not grouped according to the same classification as defined in the UCI's survey, there is no significant difference in proportions of SME to large firms using either 100 or 250 employee as an SME's size.

³ The data are collected from over 125,000 manufacturing, wholesale, services, and retail businesses. The report does not cover agriculture, mining, utilities, construction, non-merchant wholesalers, and approximately one-third of service-related industries (Source: U.S. Census Bureau [2003]).

little over one-third that use EDI most frequently [Mesenbourg, 2001]⁴. However, in terms of dollar value, Internet ordering systems account for only one-twentieth of total manufacturing e-commerce shipments, while plants offering EDI online ordering account for more than one-half [Mesenbourg, 2001].

Table 3. U.S. Shipments, Sales, Revenues and E-Commerce: 2001 and 2000

Description	Value of Shipments, Sales, or Revenue				Y/Y % Change		%Distribution of EC	
	2001		2000					
	Total	EC	Total	EC	Total	EC	2001	2000
Total	14,572	1,066	14,657	1,062	-0.6	0.4	100.0	100.0
B2B	6,676	995	6,950	997	-3.9	-0.2	93.3	93.9
Manufacturing	3,971	725	4,209	756	-5.7	-4.1	68.0	71.2
Merchant Wholesale	2,705	270	2,741	241	-1.3	12.0	25.3	22.7
B2C	7,896	71	7,707	65	2.5	9.2	6.7	6.1
Retail	3,141	34	3,059	28	2.7	22.1	3.2	2.6
Selected Services	4,755	37	4,648	37	2.3	-1.4	3.5	3.5

In millions of dollars

Source: [U.S. Census Bureau, 2003]

SECTOR ANALYSIS

Manufacturing

The manufacturing sector encompasses five industry groups (Table 4). Transportation Equipment is the largest industry group, accounting for a quarter of total manufacturing and nearly half of all e-shippments in manufacturing [U.S. Census Bureau, 2003]. Transportation Equipment is followed by Computer and Electronic Products, Chemicals, Food Products, Beverage and Tobacco, Machinery, and Electrical Equipment, Appliances, and Components. In 2001 e-commerce-based shipments within manufacturing declined 4%, compared to a 6% decline in total manufacturing sales, a proportional increase in e-commerce activity within the value chain.

Distribution

Wholesale

U.S. wholesale sales suffered a decline of 1.2% between 2000 and 2001, but e-commerce sales reached \$272 billion, an increase of 12.9% (Table 5) [U.S. Census Bureau, 2003]. Wholesale e-commerce is concentrated, with 63% of total e-sales in just three industry groups led by drugs (35%), motor vehicles and automotive equipment (17%), and professional and commercial equipment and supplies (11%).

Retail

Retail e-commerce sales reached \$34 billion in 2001, an increase of 22% over 2000. This amount, however, accounted for only 1.1% of total retail sales (Figure 1) [U.S. Census Bureau, 2003]. Electronic shopping and mail-order houses account for over 90% of retail e-commerce sales, [U.S. Census Bureau, 2003]. Clothing and computer hardware contribute over one-third of volume in electronic shopping and mail order e-commerce (Table 6).

⁴ In contrast, 64.6% of manufacturing firms exchange operational data over Internet with business customers in GEC survey data (Table).

Table 4. Historical. U.S. Manufacturing Shipments¹ - Total and E-commerce Value: 1999-2001

Description	Value of Shipments, Sales, or Revenue				Y/Y % Change		EC as % of Total Shipments		% Distrib. of EC Shipments
	2001		2000						
	Total	EC	Total	EC	Total	EC	2001	2000	2001
Total Manufacturing	2,421,169	555,154	2,563,572	580,446	-5.6	-4.4	22.9%	22.6%	100.0%
Transportation equipment	602,496	264,368	639,861	281,396	-5.8	-6.1	43.9%	44.0%	47.6%
Computer and electronic products	429,471	73,232	510,639	77,933	-15.9	-6.0	17.1%	15.3%	13.2%
Chemicals	438,410	54,515	449,159	52,974	-2.4	2.9	12.4%	11.8%	9.8%
Food products	451,386	53,556	435,230	54,837	3.7	-2.3	11.9%	12.6%	9.6%
Beverage and tobacco	118,786	45,665	111,692	42,862	6.4	6.5	38.4%	38.4%	8.2%
Machinery	266,553	35,799	291,548	40,441	-8.6	-11.5	13.4%	13.9%	6.4%
Electrical equipment, appliances, and components	114,067	28,019	125,443	30,003	-9.1	-6.6	24.6%	23.9%	5.0%

Note: Estimates are not adjusted for price changes. For information on confidentiality protection, sampling error, nonsampling error, sample design, and definitions, visit www.census.gov/eos/www/mestats.html.

¹Estimates include data only for businesses with paid employees and are subject to revision. Source: U.S. Census Bureau, Annual Survey of Manufactures

Table 5. U.S. Merchant Wholesale Trade Sales – Total and E-commerce Sales: 2001 and 2000

Description	Value of Shipments, Sales, or Revenue				Y/Y % Change		EC as % of Total Shipments		% Distrib. of EC Shipments
	2001		2000						
	Total	EC	Total	EC	Total	EC	2001	2000	2001
Total Merchant Wholesale Trade	2,708,666	272,183	2,742,593	241,109	-1.2%	12.9%	10.0%	8.8%	100.0%
<i>Nondurable goods</i>	1,358,394	146,976	1,320,010	126,920	2.9%	15.8%	10.8%	9.6%	54.0%
Drugs, drug proprietaries and druggists' sundries	201,114	96,363	168,471	77,790	19.4%	23.9%	47.9%	46.2%	35.4%
<i>Durable goods</i>	1,350,272	125,207	1,422,583	114,189	-5.1%	9.6%	9.3%	8.0%	46.0%
Motor vehicles and automotive Equipment	205,577	46,771	199,522	40,106	3.0%	16.6%	22.8%	20.1%	17.2%
Professional and commercial equipment and supplies	249,981	30,904	269,129	30,827	-7.1%	0.2%	12.4%	11.5%	11.4%
<i>Computer equipment and supplies</i>	122,458	15,776	150,402	18,948	18.6%	16.7%	12.9%	12.6%	5.8%

Note: Estimates are not adjusted for price changes. For information on confidentiality protection, sampling error, nonsampling error, sample design, and definitions, visit www.census.gov/eos/www/mestats.html.

¹Estimates include data only for businesses with paid employees and are subject to revision

Sales in millions of dollars. Source: U.S. Census Bureau, 2001 Annual Trade Survey (Revised April 2003)

Table 6. Top 20 U.S. Internet Retailers, 2000

Rank	Company	Primary Web Site(s)	Online Sales to U.S. Consumers	Past-Year Customers	Average 12-month Spending	Repeat Purchase Potential Index
1	eBay	ebay.com	\$3.5-3.7B	10M	\$350	101
2	Amazon.com	amazon.com	1.7-1.9B	12M	150	115
3	Dell	dell.com	1.1-1.3B	600K	2,000	66
4	buy.com	buy.com	700-800M	3M	250	105
5	Egghead.com	egghead.com, onsale.com (formerly)	500-600M	700K	800	79
6	Gateway	gateway.com	500-600M	350K	1,500	73
7	Quixtar	quixtar.com	400-450M	600K	700	140
8	uBid	ubid.com	275-325M	600K	500	82
9	Barnes & Noble	bn.com	275-325M	3M	100	98
10	Cyberian Outpost	outpost.com	200-250M	425K	550	80
11	Value America*	va.com	200-250M	250K	900	83
12	MicroWarehouse	microwarehouse.com	200-250M	175K	1,200	92
13	Office Depot	officedepot.com, vikingop.com	175-200M	250K	750	114
14	eToys.com	etoys.com, babycenter.com	150-175M	1.7M	100	93
15	Lands' End	landsend.com	150-175M	800K	200	105
16	The Spiegel Group	spiegel.com, eddiebauer.com, newport-news.com	150-175M	450K	350	97
17	Fingerhut	fingerhut.com, andysauctions.com, andysgarage.com	150-175M	400K	375	96
18	CDW	cdw.com	150-175M	200K	800	92
19	JCPenney	jcpenney.com	150-175M	500K	300	103
20	Gap	gap.com, oldnavy.com, bananarepublic.com	125-150M	800K	175	114

*Ceased retail operations

Source: National Retail Federation

Finance

Detailed data on e-commerce activities in finance are not available. The U.S. Census Bureau does provide data for selected parts of finance (Table 7) [U.S. Census Bureau, 2003]. For example, securities and commodity contracts intermediation accounted for 10% of total e-commerce revenues among selected service industries.

SUMMARY OF SECTOR ANALYSIS

The secondary data on sector characteristics in e-commerce are spotty, but some conclusions can be drawn. Considerable activity and genuine growth occurred in e-commerce across the sectors, but as yet e-commerce accounts for a relatively small share of overall commerce in any sector, if a narrow definition of e-commerce as Internet-based exchange is used. If use of non-Internet-based EDI is considered to be a form of electronic commerce, the manufacturing sector shows a much greater level of e-commerce activity. Nevertheless, even with EDI the manufacturing sector shows less than one-fifth of its total commerce in electronic form.

Table 7. U.S. Selected Services Revenue¹ – Total and E-commerce: 2001 and 2000

Description	Value of Shipments, Sales, or Revenue				Y/Y % Change		EC as % of Total Shipments		% Distrib. of EC Shipments
	2001		2000						
	Total	EC	Total	EC	Total	EC	'01	'00	'01
Total for Selected Service Industries	4,759,796	37,261	4,647,156	37,312	2.4	-0.1	0.8	0.8	100.0
Information	870,204	10,438	845,665	9,305	2.9	12.2	1.2	1.1	28.0
Publishing industries	233,110	4,941	233,327	4,748	-0.1	4.1	2.1	2.0	13.3
Broadcasting and telecommunications	487,538	2,516	469,707	1,880	3.8	33.8	0.5	0.4	6.8
Online information services	32,390	1,850	31,438	1,997	3.0	-7.4	5.7	6.4	37.4
Administrative and Support and Waste Management and Remediation Services ⁵	411,947	9,599	411,236	9,680	0.2	-0.8	2.3	2.4	25.8
Travel arrangement and reservation services	26,054	6,272	26,306	6,185	-1.0	1.4	24.1	23.5	16.8
Selected Finance ³	293,981	3,754	338,071	5,976	-13.0	-37.2	1.3	1.8	10.1
Securities and commodity contracts intermediation and brokerage	195,667	3,570	232,798	5,664	-15.9	-37.0	1.8	2.4	9.6

Note: Estimates are not adjusted for price changes. For information on confidentiality protection, sampling error, nonsampling error, sample design, and definitions, visit www.census.gov/eos/www/mestats.html.

¹Estimates include data only for businesses with paid employees and are subject to revision.

Source: U.S. Census Bureau, 2001 Service Annual Survey (Revised April 2003)

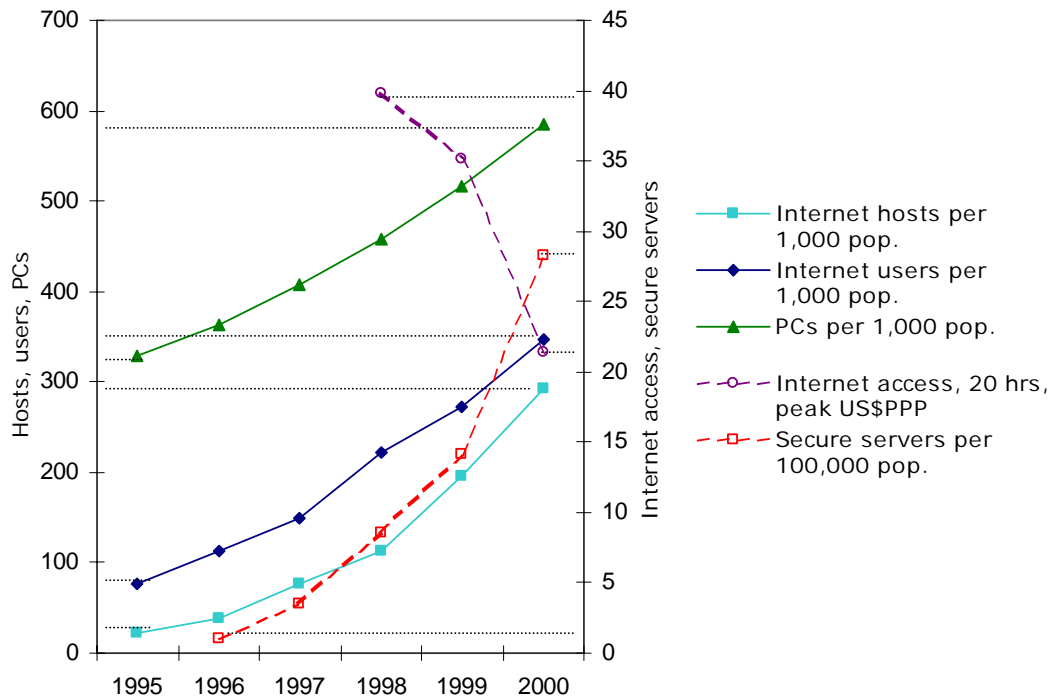
IV E-COMMERCE READINESS IN THE U.S. SURVEY

E-commerce readiness refers to the extent to which a country has physical and institutional infrastructure and organizational and intellectual capabilities in place to support and expand e-commerce activities. This section concentrates on a set of factors that define readiness including information infrastructure, IT investment, industry readiness and globalization of e-commerce. This section provides some indications of the U.S. position with respect to these factors.

INFORMATION INFRASTRUCTURE

Telecommunication infrastructure

Earlier work [Fomin et al., 2003] pointed out that five types of infrastructure – communications, information processing, Internet, transportation, and enterprise – are important to the promotion of e-commerce in the U.S. Wire-line telephone penetration is high, including nearly all households (70% of the population). An increasing proportion of wire-line telephony is digital. Residential satellite communications (mainly downloads for television) is growing slowly, and remains below 5% of the population. The fastest growing sector is cellular telephony, which grew from 10% to about 40% of the population between 1995 and 2000 [Fomin et al., 2003]. Internet access fees increased steadily (Figure 2). Since 1995, growth in personal computer use and in the number of Internet users grew significantly, whilst the price of Internet access has dropped rapidly. On the supply side, the number of Internet hosts grew quickly since 1995, and in the past few years, the number of secure servers increased sharply.



Sources: International Telecommunications Union (ITU), International Data Corporation (IDC, World Bank, Reed Electronics Research, Netcraft, BSA Piracy Study, International Labour Organization (ILO), OECD

Figure 2. Internet Indicators in the U.S.

Mobile communications will potentially play a major role in e-commerce⁵ growth, but as of writing its use for these purposes is limited (Table 7). Less than 15% of establishments in the survey offer or use such services, with the largest fraction (about 18%) in Distribution and less than 10% in Finance. Plans for future use are ambitious: finance establishments reported aggressive plans to add such services within a year, followed by manufacturing and distribution. The differences between U.S. and establishments in other countries in this regard are small: non-U.S. establishments and large establishments are somewhat more ambitious than all establishments together.

INFORMATION SHARING SERVICES

Application services in the U.S. e-commerce infrastructure are highly developed. U.S. companies are leading users of e-mail and file sharing services, and enjoy the world's most extensive support for Electronic Data services through the application of ANSI X12 EDI standards. U.S. e-commerce infrastructure is expected to grow substantially in scale and scope in the coming years. A key are development of Internet-based standards and protocols that enhance system-to-system interoperability and application service integration across organizational boundaries. One direction in this area is the creation of new e-collaboration spaces within supply-chains which do not only automate transactions, but provide a space for much broader and deeper electronic

⁵ E-commerce from mobile devices is often referred to as M-commerce.

Table 7. Content/Services To Mobile Customers, 2002

Percent providing or planning to provide mobile content or services ^e	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Already available	14.7	13.9	10.7	18.0	8.1	14.6	13.7
Plan to add within the next year	15.1	19.7	17.7	11.0	29.4	15.7	18.2

Notes:

^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Today it is possible to access content or services from various mobile devices such as mobile phones and handhelds such as Palms or Pocket PC devices. Does your organization provide or plan to provide content or services that mobile customers can access?

Source: CRITO Global E-Commerce Survey, 2002

integration between supply chain partners (e.g., quality control, design modifications, and demand information sharing). The adoption of such systems has been increasing due to their low cost compared to earlier EDI services, their flexibility, and the broad range of support functionality they provide.

The U.S. is a leading participant in the development of second-generation B2B platforms to follow first-generation EDI services. These platforms include the standardization of business-related web services at W3C⁶ and OASIS consortia where new business inter-operability standards drawing upon XML (Extensible Markup Language) [Solomon and Simon, 2001] are being developed. Such standards cover SOAP (Simple Object Access Protocol), WSDL (Web Service Description Language) and UDDI (Universal Description, Discovery and Integration). Both IBM and Microsoft have developed centralized UDDI registry services they offer to business partners for free. Also higher-level business transaction protocols and frameworks that are expected to replace earlier EDI ANSI X12 standards are forged through EbXML and Biznet consortia. These frameworks have been adopted in many emerging industry-wide e-market places as underlying standards including Rosettanet (electronics), Covisint (Car industry), and Estee! (steel industry), just to name a few. Though the development of standards has been relatively fast, the adoption and impact of such technologies is still in early stages and uncertain. Unresolved issues remain related to cross-industry standardization, security, and performance of such technologies. Another challenge is the political and business problems in developing and maintaining industry wide e-market places.

BusinessWeek [2003d] outlines two important emerging standardization initiatives affecting system interoperability within e-commerce space. The first, seeks to standardize and maintain e-

⁶ A list of abbreviations and their meanings is included following Appendix I.

catalogs of the products retailers sell. This initiative is expected to save retailers and manufacturers \$50 billion a year [Mullaney and Coy, 2003, p.72]. Another similar initiative, dubbed UUCnet⁷, seeks to standardize manufacturers' product catalogs and how to distribute them to retailers. It is estimated, that stores and manufacturers each lose up to \$2 million in profits on every \$1 billion of sales because of bad data [Mullaney and Coy, 2003]. Another important cross-industry project is an attempt to standardize radio-frequency identification (RFID) chips and related product information catalogues. This initiative will allow retailers and suppliers to track goods downstream all the way from the factory to the retail sales and after-sales service including maintenance and service. Wal-Mart, for example, is heavily investing in the project, expecting by 2007 to boost earnings 38% by using RFID widely [Hof, 2003, p.70].

IT INVESTMENT

Two different types of investment are relevant to e-commerce:

1. investment in telecommunication infrastructure, and
2. investment in e-commerce equipment and protocols.

Investments in Telecom

U.S. telecommunications investment ran between .17% and .32% of GDP between 1995 and 2002. Levels of investment in 2002 were down from what they were through the years of slow growth between 1996 and 1998. Overall spending on telecommunications services is expected to exceed \$165.2 billion by 2009, from the \$154.4 billion spent in 2004, a CAGR of 1.4% [Tekrati.com, 2005b]. Despite the fall in telecom investments between 1995 and 1998 the number of main and digital line and cell phone subscribers was growing. The sharp decline in investment in 2002 coincided with the reversal of the trend in fixed line growth, but has not affected the steady growth in cellphone subscribers. The post-1995 decline in investment can be attributed to several factors, including the cut in surplus investments due to recession. With flat revenues, carriers are increasingly buying new equipment only when their networks need fixing [BusinessWeek Online, 2003h]. Hardware costs (including fiber optic cables) decreased drastically. Two other important reasons for the decline are

1. the debt that the biggest telecom providers created during the reintegration of local and long-distance services in the 1990s⁸ into an "all-distance" telecom [BusinessWeek Online, 2003a], and
2. the regulatory tension created by the 1996 Telecommunications Act that obliged incumbent operators to sell capacity on their local networks at wholesale rates to all comers – at rates reported to be below cost [BusinessWeek Online, 2003b].

Although the decline in telecom investments reversed in 1998, the growth was slow just to see a swift decline in 2002. The year 2003 is believed to be the first year of a telecom recovery [BusinessWeek Online, 2003b]. The increase in investments is due mostly to the result of the advent of IP telephony. Some analysts report that 2004 was a break-through year for VoIP adoption in North America, and 2005 is shaping up for more of the same⁹ [Tekrati.com, 2005a]. On the other hand, the growth of investment in IP telephony is being held back by the installed

⁷ UUCnet received its name from the Uniform Code Council trade group, which coordinates the project.

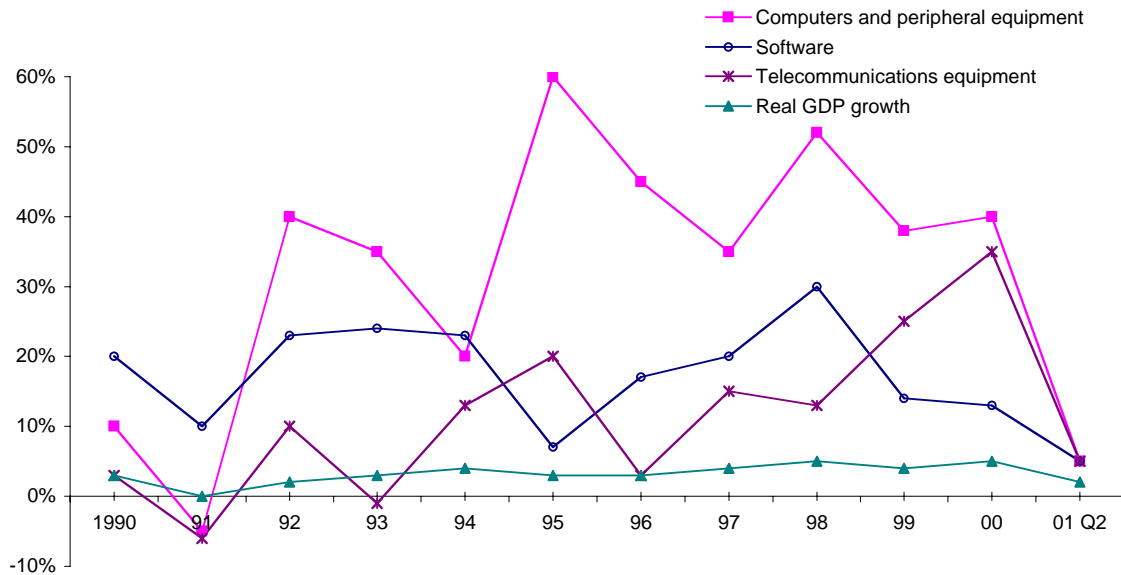
⁸ For example, AT&T spent \$97 billion buying cable TV properties that it has since sold to Comcast at a loss, SBC spent \$56 billion to buy Bell Ameritech, and Verizon spent 52.9 million to purchase GTE [BusinessWeek Online, 2003b].

⁹ A report released in February 2004 from National Cable and Telecommunications Association states the following: "Compared to circuit-switched telephony, VoIP offers lower rollout costs, increased flexibility, and more innovative and advanced services. More specifically, VoIP allows a provider to avoid the huge capital expenditures and investments needed to purchase and install circuit switches" [NCTA, 2004].

base of telecom service providers in the traditional circuit-switched PBXs, which still meet customer demand. IP PBX shipments in 2004 accounted only for 10% of the total PBX line shipments worldwide, with 44 percent of the total revenue coming from North American sales [TechWeb.com, 2004]. Carriers also are experimenting with new services including high-speed wireless Internet access, but with precautions [BusinessWeek Online, 2003h]. Analysts suggest that wireless and IP services can be expected to drive telecom growth in the near future, but the bulk of telecommunications revenue is going to continue to be supported by voice services [Tekrati.com, 2005b]. For the moment there is not enough data traffic for carriers to justify the cost of building municipal or nation-wide Wi-Fi networks [BusinessWeek Online, 2003c, Tekrati.com, 2005c].

Investments in IT

IT investment in the US are traditionally strong, and are likely to remain so in the future [Fomin et al., 2003]. Improving cost/performance in ICT encouraged investment (Figure 3). A major bubble in IT investment in computers between 1995 and 2000 relative to flat GDP growth resulted in a major increase in IT capital stock. Software investment also rose during this time, but with a somewhat flatter slope. Overall, IT investment rose during the 1990s, but decelerated significantly in 2001 as the dot.com bubble burst and a recession in the high-technology sector began. Still, investment in the sector continues and in the long run the decrease in IT investment between 1998 and 2001 (Figure 3) does not necessarily imply negative growth in the IT industry. The decline of the curve was affected, among other factors, by drastic reduction of prices as technological progress in materials, design, and manufacturing accelerated [Bayoumi and Haacker, 2002]. Also, during the downturn of dot.com firms, companies like Amazon and Google were actually expanding, buying office spaces and equipment of less successful IT entrepreneurs at liquidation prices [Vogelstein, 2003].



Notes: ¹ Real gross fixed investment.

Source: [International Monetary Fund, 2001], referring to the U.S. Department of Commerce, Bureau of Economic Analysis.

Figure 3. Information Technology Investment in the United States¹.

The current situation is well reflected in the business trade press.

“Investors are cautious about handing over more dough to venture capitalists after being left with battered remnants of hundreds of dot-com flops. Indeed, the money committed to venture capital is expected to total just \$25 billion this year, down from a high of \$99.8 billion in 2000. But that still would be one of the industry’s best years ever and puts it back above its 1997 level – in other words, back to what was normal before the Internet boom knocked everything off-kilter”
[BusinessWeek Online, 2003f]

Investment in IT is expected to continue and might accelerate again as the economy begins to recover. In their report, Standard & Poor estimated that IT equipment investment will rise more than twice as fast as the overall economy grows between 2004-06 – somewhere between 8.5% and 9.5% [BusinessWeek Online, 2003e]. Forrester predicts that spending on IT goods, services, and staff will grow 7 percent in 2005 and continue at a similar pace through 2008 – only slightly faster than overall economic growth [Tekrati.com, 2004].

The 1990s boom in IT is still fueling productivity growth in many parts of the economy [Mullaney and Coy, 2003]. It is expected that by 2007, IT investments could yield \$140 billion in annual cost savings for the whole economy, and the bulk \$131 billion will come from manufacturing, retailing, and financial services industries (Table 8). Firms in all sectors still face technological overcapacity. To survive, companies must keep wringing productivity gains out of existing technologies. These gains will probably be achieved through investment in software. For example, General Motors used to spend \$4 billion a year on new software and support – a figure it cut by 25% by developing a web-based system that enables inter-operability of GM’s more than 3,000 different software

Table 8. The Information Technology Investment Effect

Industry	Size in 2007 ^a	2007 cost savings	Examples of where the savings will come from
Manufacturing	\$1.6 trillion	\$56 billion	Higher levels of internal and external database- and applications- integration
Financial services	\$1.1 trillion	\$44 billion	Reduced paperwork
Retailing	\$1.0 trillion	\$21 billion	E-cataloguing and product tracking

Note: ^a Forecast of value added by sector

Source: [Mullaney and Coy, 2003, p.73]

applications [BusinessWeek Online, 2003g]. Amazon, due to its conversion to the Linux operating system, expects to cut technology and content expenses by 20% in two years [Vogelstein, 2003]. As much as \$10 billion in savings in retail is expected to come from an industry-wide effort to coordinate data sharing among stores and suppliers of consumer packaged goods [Mullaney and Coy, 2003].

The survey data provide some additional information on IT investment at the sector levels, as well as between the U.S. and the non-U.S. establishments, and between SMEs and large establishments (Table 9). Significant differences appear among sectors in IT investment. Finance enjoys a much higher proportional investment in IT as a function of the number of employees than distribution or manufacturing, and leads in IT spending as a proportion of total revenue. However, the situation changes if absolute numbers are taken into account. Manufacturing spends almost twice as much on IT as finance, and almost three times more than retail distribution. In web-based spending manufacturing also leads both in absolute numbers and as a percent of IS operating budget. SMEs and large establishments are at approximate parity among

large and small in the area of IT investments per employee, but major differences in both IT spending and web-based spending are seen as a proportion of revenue or budget, where larger establishments clearly out-invest smaller establishments in those categories.

Table 9. Investment in IT technologies, 2002

	United States	Large	SME	Mfg.	Distrib.	Finance
Number of PCs per employee	0.65	0.64	0.77	0.14	0.98	1.33
IT employees as % of total employees	5.95	5.96	5.83	0.90	8.17	13.41
Total IS operating budget (in millions of dollars)	90,832.61	89,187.02	1,645.58	43,137.32	18,876.56	28,818.73
Total IS operating budget as % of 2001 Revenue	4.17	4.39	1.10	3.40	3.18	9.09
Web-based spending (in millions of dollars)	12,374.68	12,300.74	73.94	10,482.40	531.36	1,360.92
Web-based spending as % of IS operating budget	13.62	13.79	4.49	24.30	2.81	4.72

Note: Survey data, our own calculations

The findings in Table 9 must be understood in conjunction with Table 3, shown in Section III, and Table 21, shown in Section VI. Manufacturing uses the lowest number of PCs per employee and the lowest number of IT employees as a percent of total employees among the three sectors. Yet, manufacturing reports substantially higher web-based spending than the other two sectors. This high expenditure on web-based applications might be explained by the globalized character of the sector, and its more diverse system-to-system applications (Table 21, Section VI). In manufacturing, more companies report using extranets accessible to supplier and business partners than in the other two sectors (20% vs. 16%, Table 10 in the next subsection). Manufacturing is also the highest Internet-based EDI and extranet services user. As Table 22 shows, almost 60% of manufacturers' web sites support product configuration – a complex information-intensive service. The survey data, unfortunately, do not include data on similar, complex services for either finance¹⁰ or distribution sectors. It is not clear why web-based service provision costs so much in manufacturing. What we assume is that on-line product configuration and use of Internet-based EDI are costly services that manufacturing establishments must undertake as part of their B2B effort if they are to reap operational benefits such as lower manufacturing costs, faster cycle times, and lower inventories.

ORGANIZATIONAL READINESS FOR E-COMMERCE

Organizational readiness is an organization's capability to make sense of, appropriate, deploy and mobilize emerging and available e-commerce technologies in their competitive and organizational environment. We used three measures to profile organizational readiness:

- the extent of on-line buying and selling,
- types of technologies used in e-commerce, and
- the level of business integration (internal and external) with information technologies.

Types of Technologies Used

Seven technologies used for e-commerce in 2002 are shown in Table 10. More than 82% of all American businesses reported being connected to the Internet in some way. Among medium and large businesses, more than 90% were connected. Between one-quarter and one-half of companies in the electronics, IT, and telecommunications sectors were engaging in an electronic supply chain. Among U.S. establishments, nearly all use email and over 80% maintain web sites of some kind. Over 80% of finance establishments use electronic funds transfer; levels for

¹⁰ The closest comes probably bill payment in the finance sector (60% of surveyed companies offered this service).

manufacturing and distribution are somewhat lower. Between one-third and two-thirds of establishments use EDI, Intranets, and call centers, with less than one-third using extranets.

Table 10. Use of E-Commerce Technologies, 2002

Percent using ...	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
E-mail	99.5	99.9	98.3	100.0	100.0	99.6	98.5
Web-site	78.2	90.2	85.1	76.1	85.5	79.8	74.1
Intranet	53.0	77.7	52.1	57.7	56.6	56.2	63.6
Extranet	26.4	43.7	29.9	28.9	26.3	28.7	32.7
• accessible by suppliers/ business partners ^e	14.0	35.8	20.0	15.9	16.4	16.9	20.9
• accessible by customers ^e	14.1	25.5	19.0	13.6	17.6	15.6	17.8
• EDI	39.2	64.7	58.1	37.6	37.2	42.5	44.3
• over private networks only ^e	15.3	29.5	26.4	16.9	4.6	17.1	19.4
• Internet-based only ^e	8.4	8.6	11.7	6.7	9.8	8.4	8.4
• both ^e	25.5	19.0	13.1	22.7	16.1	15.9	14.7
EFT	62.4	65.1	53.7	60.3	82.0	62.7	43.4
Call center	55.6	48.3	35.4	48.1	40.5	32.3	38.2

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Percent based on total sample.

Source: CRITO Global E-Commerce Survey, 2002

The U.S. manufacturing sector is a slightly higher user of extranets by customers and suppliers than are the distribution and finance sectors. Because manufacturing is more globalized than the other two sectors, the observed reliance on extranets is not surprising. Manufacturing establishments also report they use EDI almost twice as often as companies in the other two sectors (58% vs. 37%). This data also reflects the global nature of manufacturing that draws upon a large network of customers and suppliers. Although Internet-based EDI systems are cheaper and easier to install than those using VANs, the lack of security issues might be one reason for manufacturing and distribution companies to use to a larger proportion of VAN-based EDI services.

Except for modestly greater use of EFT by the U.S. establishments, the U.S. and the non-U.S. establishments were quite similar in their use of different e-commerce technologies. As expected, large establishments showed somewhat greater use of different technologies than SMEs. Large past investments render establishments often inflexible and they cannot rapidly reorient their technology platforms [Ciborra et al., 2001].

Business Integration Using IT

The survey data provide a glimpse of the extent to which establishments are using IT to integrate their business processes internally and with external establishments (Table 12). Internal integration is more advanced than external integration. About two-thirds of establishments have Intranets, compared to only about one-quarter with Extranets accessible by suppliers or customers. The strongest indicator of actual internal integration is the degree to which establishments make use of internal databases and information systems for that purpose: about

half of finance service establishments do so, while distribution establishments and manufacturing establishments trail with about one-third and one-quarter respectively. About half

Table 11. Enterprise Integration Strategy, 2002

Extent to which internet applications are electronically integrated with ...	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Internal databases and information systems ^e							
% little to none	55.1	40.2	58.0	55.4	37.3	52.9	52.5
% some	13.4	26.8	20.6	13.7	14.0	15.4	23.6
% a great deal	31.5	32.9	21.4	30.9	48.7	31.7	23.9
Those of suppliers and business customers ^f							
% little to none	65.9	74.9	70.9	66.2	64.8	67.2	72.1
% some	16.5	16.4	14.4	19.7	8.7	16.5	18.3
% a great deal	17.7	8.8	14.6	14.1	26.5	16.4	9.6

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Using a 5-point scale where 5 is "a great deal" and 1 is "not at all", please rate the extent to which your internet applications are electronically integrated with your internal database and information systems. Scores of 1 or 2 are categorized as "little to none", a score of 3 as "some" and scores of 4 or 5 as "a great deal".

^f Exact wording of question: Using a 5-point scale where 5 is "a great deal" and 1 is "not at all", please rate the extent to which your company's databases and information systems are electronically integrated with those of your suppliers and business customers. Scores of 1 or 2 are categorized as "little to none", a score of 3 as "some" and scores of 4 or 5 as "a great deal".

Source: CRITO Global E-Commerce Survey, 2002

of the distribution establishments are making sales on-line, with manufacturing and finance trailing significantly. Around one-third of all sectors support some kind of on-line payments activity.

The differences among the U.S. and the non U.S establishments, and among the SMEs and the larger establishments are small. Compared to the global averages, the U.S. manufacturing sector does not differ significantly in the degree of reported enterprise integration. In contrast, distribution and finance sectors report slightly higher levels of integration.

Manufacturing is heavily involved in EDI, with many establishments reporting use of extranets (Table 10). High extranet use suggests a high degree of integration of Internet applications with internal databases and those of suppliers and business partners. Yet, only 21% of manufacturing establishments report a high degree of integration of internal databases and Internet applications, compared to 31% for distribution, and 49% for finance. This data is somewhat counterintuitive, given manufacturing's high use of Internet applications and Internet-based EDI, and its high level of spending on web-based applications as a percent of total IS budget. This result may be due to the complexity of business processes and, consequently, the complexity of systems in the manufacturing sector, and the resulting difficulty of internal-external IS integration among many

suppliers. When we gathered our data in 2003, only the 1st tier suppliers (those that supply directly to OEMs) could achieve high levels of integration of their Internet applications with their business partners. This observation is partially reflected in the survey data, which showed that 15% of SMEs vs. 7% of large establishments reporting a great deal of integration – the only significant difference in enterprise integration in manufacturing. The security requirements in a large network of suppliers might cause a low level of enterprise integration, especially in manufacturing and finance establishments that want to prevent information from being stolen. For example, an initiative by General Motors to develop web-services that integrate organization-wide software services among its 3,000 different systems will not be extended to parts and inventory directories with GM suppliers because of security concerns [BusinessWeek Online, 2003g].

The Extent of Buying and Selling

The survey data provide useful insights into on-line buying and selling behaviors (Tables 17, 19, and 21) The data show that about three-quarters of U.S. establishments understand the concept of an electronic marketplace, and about half of them participate in buying and/or selling on-line. About one-third of the money spent on supplies and equipment is transacted on-line across establishments. As shown, however, only B2B on-line sales in manufacturing come close to 20% of buying and selling (Table 1). Financial service establishments tend to be more engaged in buy-only behavior than manufacturing or distribution and do little selling on-line. Distribution establishments tend to be engaged in both buying and selling to a greater extent than manufacturing and finance, buying from manufacturers and selling to other businesses or consumers.

U.S. and the non-U.S. establishments are quite similar across the categories, although U.S. establishments show a somewhat higher level of engagement in on-line selling (buying+selling) than the non-U.S. establishments, and U.S. establishments order slightly more supplies and equipment on-line. These differences are small, however. Remember, however, that the establishments represent technology leaders in each country – not the overall country average.

Therefore, great differences would not be expected in this group. Similarly, we observed only slight differences between the SMEs and larger establishments in terms of the extent of on-line buying and selling, with the larger establishments showing slightly greater activity.

GLOBALIZATION

Earlier research shows that the level of an establishment's globalization correlates significantly with the propensity to adopt e-commerce, and an establishment's capability to engage in global operations is one critical capability that can affect e-commerce readiness [Gibbs et al., 2002]. Data from the survey (Table 13) offer a profile of globalization among participating establishments.

A substantial majority of both the U.S. and the non-U.S. establishments surveyed are domestic, but the non-U.S. establishments generate more international activity than the U.S. establishments. Manufacturing is the most globalized sector in the U.S., with 36% of surveyed companies having establishments abroad. Among the surveyed manufacturing companies that use the Internet, about 10% are headquartered abroad. Their total sales and procurement to/from abroad is more than 10%. One-third of companies report a high degree of foreign competition. The U.S. finance sector is the least globalized sector, the least affected by foreign competition, procures the least from abroad, and only operates one-third the number of establishments abroad compared to manufacturing. The U.S. distribution sector lies between manufacturing and finance, and with the exception of establishments abroad, is substantially below the global average.

Table 13. Globalization Indicators, 2002

	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Percent of companies with establishments abroad	20.0	46.4	36.1	21.4	13.2	23.4	23.9
Percent of companies with headquarters abroad	5.0	8.0	9.3	4.6	3.2	5.4	8.5
Mean percent of total sales from abroad	4.7	7.5	11.5	3.1	4.0	5.1	12.1
Mean percent of total procurement spending from abroad	8.3	7.8	12.6	8.9	0.7	8.2	20.3
Degree affected by competitors abroad ^e							
Low	79.8	70.1	45.1	86.2	96.0	78.5	68.3
Moderate	9.3	13.7	20.3	7.7	3.6	9.9	15.7
High	11.0	16.1	34.6	6.2	.4	11.6	15.2

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact question wording: Using a 5-point scale where 5 is significantly affected and 1 is not at all affected, please tell me how much your establishment is affected by competitors from outside your country. Scores of 1 and 2 were classified as low, a score of 3 as moderate, and scores of 4 and 5 as high.

Source: CRITO Global E-Commerce Survey, 2002

SUMMARY: READINESS FOR E-COMMERCE

U.S. establishments are ready for e-commerce, with some caveats. The U.S. is the world's largest economy, and is highly diverse. That many establishments are ready for e-commerce does not mean all the U.S. establishments are ready. The differences in e-commerce experience between large establishments and SMEs are slight, suggesting a considerable population of

small establishments (less than 25 employees) that are less prepared for e-commerce. Routine use of e-commerce lags behind more traditional forms of commerce. Most IT uses in establishments are for communication and information sharing such as email, web sites, and file transfer. The primary challenge of readiness for e-commerce for most establishments is business integration, in knowing what needs to be integrated and how IT can help.

V. KEY DRIVERS AND BARRIERS

Ability to use the Internet is a key factor in e-commerce [Fomin et al., 2003]. Drivers and barriers to Internet use include the nature and content of internal business processes, cost issues, and political and social factors.

DRIVERS OF INTERNET USE

The survey data provide a useful picture of the drivers behind adoption of Internet services (Table 14). The drivers are similar across all three sectors, including

- expansion of markets for existing products and services (49.8%),
- improvement of coordination with customers and suppliers (41.6%),
- penetration of new businesses or markets (39.2%),
- meeting customer demand (35.5%)
- meeting competitor action (33.1%), and
- cost reduction (32.6%).

Table 14. Drivers for Internet use, 2002

% indicating driver is a significant factor ... ^e	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
To expand market for existing product or services	48.0	61.2	52.1	45.4	61.7	49.8	47.9
To improve coordination with customers and suppliers	38.3	63.0	50.5	37.8	42.8	41.6	43.7
To enter new businesses or markets	38.1	46.6	45.2	38.6	33.5	39.2	42.0
Customers demanded it	34.5	42.1	35.2	33.8	41.9	35.5	36.9
Major competitors were online	31.1	46.1	30.3	28.1	55.5	33.1	31.3
To reduce costs	31.5	39.5	36.4	30.0	36.5	32.6	35.7
Suppliers required it	18.0	23.2	21.9	18.8	14.2	18.7	22.3
Required for government procurement	9.5	6.0	13.3	8.5	4.7	9.0	15.2
Government provided incentives	3.8	1.3	4.5	3.9	0.4	3.4	8.3

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

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^e Exact wording of question: Using a 5-point scale where 5 is "a very significant factor" and 1 is "not a factor at all," please rate how significant each of the following was to your organization's decision to begin using the Internet for business. A score of 4 or 5 was classified as "a significant factor".

Source: CRITO Global E-Commerce Survey, 2002

Across all establishments, these drivers were reported by between one-third and two-thirds of establishments. Less commonly noted drivers were demands by suppliers (18.7%), and government requirements or incentives (less than 10%). Manufacturing and distribution report similar key drivers, with the distribution sector ahead on most. Finance reports greater need to expand markets for existing products and services, and greater pressure from customers and competitors to provide services. Financial service establishments might be under competitive pressure related to use of IT due to dependence on IT for all aspects of their operations, including customer service delivery. In contrast, manufacturing establishments seek to build efficient information sharing channels between a large number of their suppliers and customers.

Cost reductions were among the less significant drivers in all three sectors (30.0% in distribution, 36.5% in both manufacturing and finance). Firms appear to be well aware of the relative high costs associated with the adoption of Internet technologies to conduct e-commerce, and do not expect significant cost reductions from using new channels for their commerce. There are small differences between U.S. non-U.S. establishments with respect to drivers. U.S. establishments cite market expansion slightly more frequently, and new market penetration less so. U.S. establishments compete in domestic markets and are less aggressive in diversifying to international markets. The U.S. government offers few incentives for Internet use compared to

governments in other countries, reflecting the view that the private sector must lead in e-commerce development. Larger establishments report substantially greater need to expand markets (61%) and improve coordination with customers and suppliers (63%) than SMEs (48% and 38% respectively). Government incentives related to procurement were more important for large establishments than for SMEs except in manufacturing, where small establishments assign greater importance to every driver except for two: demand of suppliers (18.4% vs. 36.0% for large establishments), and improvement of coordination with suppliers and customers (46.9% vs. 64.0%). This difference may be the result of many SMEs in manufacturing being suppliers to large manufacturing establishments.

BARRIERS TO INTERNET USE

Perceived barriers to Internet use are shown in Table 15. Three barriers to Internet use

- privacy,
- need for face-to-face interaction, and
- cost of implementing of e-commerce

Table 15. Barriers for Internet Use, 2002

% indicating statement is a significant obstacle ^e	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Concern about privacy of data or security issues	47.9	42.4	48.8	40.9	66.7	47.1	44.2
Need for face-to-face customer interaction	43.2	32.1	43.3	37.8	53.5	41.7	33.8
Costs of implementing an e-commerce site	32.5	25.1	27.0	31.2	39.3	31.5	33.6
Customers do not use the technology	26.6	28.5	17.5	32.4	20.8	26.9	31.4
Finding staff with e-commerce expertise	24.5	22.0	22.8	25.5	21.1	24.1	26.5
Level of ability to use the Internet as part of business strategy	20.7	19.3	18.6	21.5	19.7	20.5	24.8
Prevalence of credit card use in the country	17.7	7.2	12.8	19.1	10.9	16.3	20.3
Taxation of internet sales	16.0	6.1	6.2	21.3	0.4	14.8	16.5
Making needed organizational changes	13.5	21.2	20.0	12.7	12.9	14.5	23.9
Inadequate legal protection for Internet purchases	12.5	7.5	11.5	11.2	14.8	11.9	34.1
Cost of internet access	12.2	1.7	4.5	12.3	14.4	10.8	15.1
Business laws do not support e-commerce	9.0	2.2	4.4	9.0	10.1	8.1	24.2

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Using a 5-point scale where 5 is "a very significant obstacle" and 1 is "not an obstacle," please rate how significant the following obstacles are to your establishment's ability to do business on-line. A score of 4 or 5 was classified as "a significant obstacle".

Source: CRITO Global E-Commerce Survey, 2002

constitute the major concerns for both large and small establishments. SMEs raised concerns related to B2C e-commerce: prevalence of credit card use (17.7% vs. 7.2%), taxation of Internet sales (16.0% vs. 6.1%), inadequate legal protection for Internet purchases (12.5% vs. 7.5%), and cost to access the Internet (12.2% vs. 1.7%). Taxation and credit card use barriers are intuitively associated with B2C e-commerce, whereas concerns about the business laws and legal protection for Internet purchases, and cost of Internet access are generic small business barriers. Larger establishments, in contrast, were more concerned with the ease of access to communications, transportation, financial, or legal capability. U.S. establishments report fewer obstacles to Internet use than do non-U.S. establishments, with the exception of concerns about privacy of data and security (47.1% vs. 44.2%), and a need for face-to-face customer interaction (41.7% vs. 33.8%). These findings might be an artifact of the higher level of e-commerce activity in the U.S. and higher levels of transactions in open networks. Also, U.S. establishments adopt of EDI systems more, and EDI standards must be negotiated face-to-face. Finally, finance is a sensitive business demanding high levels of face-to-face interactions.

Similarities exist in barriers across the three sectors. For all sectors, privacy and security and the need for face-to-face communication form the major barriers, while costs for implementing e-commerce follow for finance and manufacturing, and a lack of customer ability to use technology in distribution. Financial service establishments show greater concern than manufacturing or distribution, possibly because financial services are inherently more sensitive than production and sale of physical products. The financial service industry also invests substantially more in IT than other sectors, which might make cost a serious concern. Distribution registers a substantially higher concern than the other sectors regarding use of credit cards in transactions and the taxation of Internet sales. These are concerns for B2C business; credit cards are the dominant form of payment in B2C e-commerce, and increased Internet taxation would affect B2C e-commerce directly. Manufacturing reports the challenge of making necessary organizational changes, possibly reflecting manufacturing's special needs for organizational integration of e-business initiatives.

SUMMARY: DRIVERS AND BARRIERS

The sectors show some variance with respect to both drivers and barriers, consonant with the nature and structure of their industries. For example, financial service establishments deal routinely with information that customers find sensitive, privileged, or private and are particularly concerned about issues of privacy and security. Distribution establishments that interact with end consumers are understandably concerned about customer readiness for the use of e-commerce technologies and sales taxation. Nevertheless, there is significant agreement on the key drivers and barriers. The biggest driver for Internet use is market expansion, followed by a need to improve coordination with suppliers and customers in manufacturing, expansion to new markets in distribution, and competitive pressure in financial services. The biggest barrier for Internet use is the concern for privacy and data security, followed by the need for face-to-face communications and the cost of implementing an e-commerce site.

Few significant differences were found between large establishments and SMEs. Large establishments find competitive pressure to be a significant driver, and limits on customer use of technology to be a barrier. SMEs find customer demands for Internet use a driver, and the costs of implementing an e-commerce site a barrier. Large establishments tend to be somewhat more motivated by drivers and somewhat less concerned about barriers than SMEs. U.S. and the non-U.S. establishments show about the same attention to drivers, but U.S. establishments seem to be less concerned than non-U.S. establishments about barriers. This difference might be a result of the richer experience by the U.S. in e-commerce, or it could be an outcome of greater complexity facing the non-U.S. establishments due to their international scope of operations. Still, there are forces that encourage similarity in global perception of drivers and barriers to e-commerce. The business trade press is increasingly global and communicates shared views of drivers and barriers. Management consultancy on e-commerce is increasingly a global affair, and

commerce itself is increasingly governed by global standards and practices that encourage uniformity.

VI. DIFFUSION OF E-COMMERCE

The survey provides insights about four aspects of e-commerce diffusion:

1. the use of the Internet as a distribution channel;
2. the level of on-line sales;
3. the level of on-line procurement; and
4. the use of Internet marketplaces. The data can also be used for a deeper structural analysis of e-commerce diffusion as a function of the previously discussed drivers and barriers.

THE INTERNET AS A DISTRIBUTION CHANNEL

A comparison of the use of the Internet as a distribution channel across sectors and between the U.S. and the non-U.S. establishments is shown in Table 16. Manufacturing and distribution show similar profiles in use of the Internet as a distribution channel, with the majority of use in traditional distribution channels, followed by use that competes with or replaces traditional channels. Internet use is modest in creating entirely new channels.

Table 16. How Establishments Use the Internet to Sell Products and Services, 2002

Percent indicating Internet used to ... ^e	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Address new markets only	9.6	2.2	11.6	8.2	5.2	8.5	15.3
Address traditional distribution channels only	45.5	39.2	49.9	47.3	20.3	44.6	44.1
Compete directly with traditional distribution channels	25.2	49.9	23.5	25.0	59.6	28.8	27.4
Replace traditional distribution channels	19.7	8.7	15.1	19.4	15.0	18.1	13.2

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Which of the following statements best characterizes how you are using the Internet to sell products and services.

Source: CRITO Global E-Commerce Survey, 2002

Manufacturing and wholesale distribution use EDI extensively for e-commerce, and use the Internet to address traditional channels far more often than finance establishments. In addition, that distributors lead in using the Internet to replace traditional distribution channels could be related to the expansion of e-catalogues that are hoped to save the industry \$21 billion by 2007 (Table 8, Section IV). Finance shows a much stronger use of the Internet to compete with existing channels. The surge among U.S. banks to introduce online banking might be one example of such a trend, and is consistent with data in Table 8, that show the U.S. finance service industry hoping to achieve \$44 billion in savings as a result of reduced paperwork. Little difference was found between U.S. and the non-U.S. establishments, although, relative to U.S. establishments, the non-U.S. establishments tend to be a bit more aggressive in pursuit of new channels.

The greatest activity in use of on-line transactions is in on-line purchasing, with three-quarters of U.S. establishments and half of non-U.S. establishments reporting such activity. Still, the overall level is low: such purchases still account for less than 5% (B2C) to 5.5% (B2B) of total sales in the U.S. The global averages are 3.8% (B2C) and 4.0% (B2B) (See Table below). The U.S. dominance in electronic purchasing might be attributable to greater readiness for e-commerce in the U.S. (i.e., infrastructural, political, legal, financial environment) and the large size of the market.

On-line Sales

Significant differences between sectors in on-line sales can be seen in Table 17. Distribution leads in both B2B and B2C on-line sales. Manufacturing dominates B2B, followed by distribution and finance. In contrast, finance dominates B2C, followed by distribution and manufacturing. Taking B2B and B2C together, a clear lead accrues to distribution, followed at some distance by finance and manufacturing.

Table 17. On-line Sales, 2002

	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Type of On-Line Sales ^e							
% B2B only	15.4	18.3	22.0	16.3	5.5	15.8	12.9
% B2C only	14.5	12.9	8.6	15.5	17.5	14.2	7.1
% both B2B and B2C	16.6	23.8	7.1	23.6	10.7	17.6	15.0
Mean percent of total consumer sales conducted on-line (all establishments) ^f	5.1	4.0	4.7	4.8	6.1	5.0	3.8
Mean percent of total business sales conducted on-line (all establishments) ^g	5.4	6.5	2.5	7.3	3.4	5.5	4.0
Mean percent of total consumer sales conducted on-line (only those doing B2C sales on-line) ^f	17.3	12.5	32.9	12.8	23.8	16.6	18.6
Mean percent of total business sales conducted on-line (only those doing B2B sales on-line) ^g	18.0	16.8	9.2	19.7	22.8	17.8	15.1
Percent of web-sites that support on-line payment (only those doing on-line sales)	30.4	50.1	29.1	34.1	39.4	33.5	33.6

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Percents are based on the full sample (all establishments). Exact wording of question: Are these online sales to other businesses or to consumers or to both?

^f Exact wording of question: What percent of your establishment's total consumer sales are conducted online?

^g Exact wording of question: What percent of your establishment's total business to business sales are conducted online?

Source: CRITO Global E-Commerce Survey, 2002

Among all establishments, B2C and B2B sales as a percentage of total sales are low (below 10%). Yet, among those establishments that are doing B2B and B2C sales on-line, the percentages range between about one-tenth and one third. Between one-third and one-half of establishments across sectors report the ability to do on-line payments. These same trends hold

in comparing U.S. and non-U.S. establishments, except for a larger difference between U.S. and non-U.S. establishments among establishments doing only B2C. Size does not appear to be a major factor in on-line sales, although some differences between large establishments and SMEs may be seen. Large establishments are more active in B2B and both B2B and B2C, and significantly more large establishments that are doing on-line sales show ability to accept payment on-line.

Table 18 shows e-commerce sales in the Americas and OECD countries in 2000. The U.S. clearly dominates in all aspects, except that Canada shows a somewhat higher percentage of e-commerce sales as a percentage of GDP than does the U.S..

Table 18. E-commerce sales in Americas, 2000

E-Commerce	B2B trade in U.S.\$M 2000 ^b	B2C trade in U.S.\$M 2000 ^b	% E-Commerce Sales of GDP 2000 ^b
Argentina	\$634.99	\$52.58	.24
Brazil	\$1,720.78	\$202.86	.32
Canada	\$12,923.30	\$2,649.52	2.20
Chile	\$228.61	\$15.86	.35
Mexico	\$1,753.86	\$82.35	.32
United States	\$118,457.20	\$44,084.29	1.63
Venezuela	\$285.44	\$9.10	.24
Latin America ^c	\$4,623.66	\$362.74	.30
OECD ^d	\$268,500.30	\$69,146.65	1.33

^aSource: Netcraft. <http://www.netcraft.com>. Strong encryption is defined as having a key length greater than 40 bits (systems limited to a 40-bit key are classified as 'weak' since it has been shown that messages encoded using a 40-bit key with RC4 can be broken in about a week by a good computer science student using facilities available in a good computer science lab).

^bSource: IDC, Internet Commerce Market Model, Version 8.1 (2002).

^cOnly countries included in the 44-country sample are used in the classification. Latin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^dOnly countries included in the 44-country sample are used in the classification. OECD consists of the following countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

ON-LINE PROCUREMENT

Table 19 shows that two-thirds of U.S. establishments and over half of non-U.S. establishments procure on-line, accounting for between 10% and 20% of the overall volume of procurement. U.S. establishments engage in on-line procurement at a noticeably higher level than the non-U.S. establishments: about three-quarters to one-half of the U.S. establishments buy more supplies and equipment from on-line sources than do non-U.S. establishments, although U.S. establishments do less on-line procurement abroad. There is little difference between SMEs and larger establishments in engaging in on-line procurement. The differences between sectors are slight. Finance leads, possibly due to the nature of procurement in finance establishments that includes such items as office supplies and computing equipment available in on-line offers.

ON-LINE SERVICES

Engagement in on-line services is shown in Table 20 as well as in Figures 4 and 5. Data are organized by sectors to address the kind of work done in each sector. Manufacturing is heavily engaged in on-line product specification, service and order tracking (half to two-thirds of establishments), but less engaged in sharing on-line account information (less than one-third of establishments). Distribution is heavily engaged in on-line product catalogs (more than two-thirds)

Table 19. On-Line Procurement, 2002

	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Percent of establishments doing on-line purchasing	73.5	79.8	76.6	72.8	76.5	74.3	50.8
Mean percent of money spent for direct goods for production is ordered online (all establishments) ^e	9.3	13.9	10.5			10.5	8.3
Mean percent money spent on goods for resale is ordered online (all establishments) ^f	11.2	3.7		10.7		10.7	6.8
Mean percent of the money spent on supplies and equipment for doing business is ordered online (all establishments) ^g	19.2	20.1	17.0	19.1	23.0	19.3	8.3

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

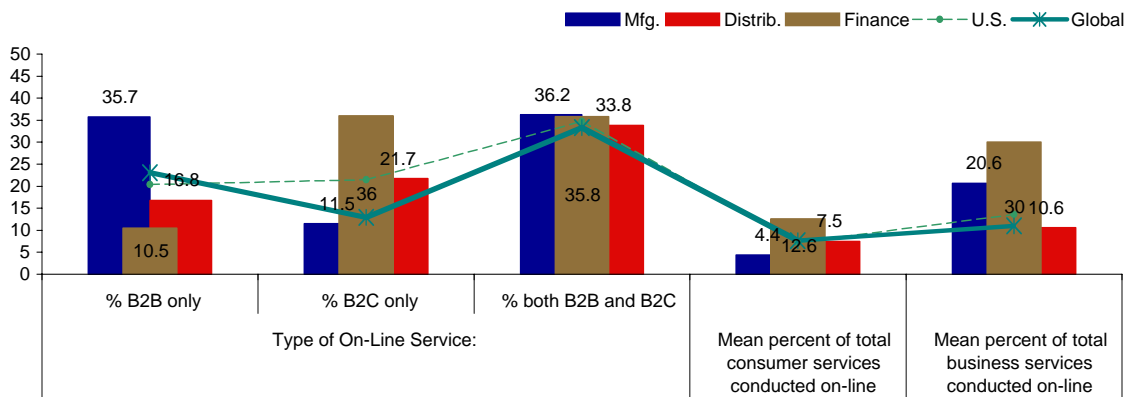
^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Question asked only to those in the manufacturing sector; percent based on all manufacturing establishments. Exact wording of question: What percent of the money your establishment spends on direct goods for production, such as parts and components, is ordered online?

^f Question asked only to those in the wholesale/retail distribution sector; percent based on all wholesale/retail establishments. Exact wording of question: What percent of the money your establishment spends on goods for resale is ordered online?

^g Percent based on all establishments. Exact wording of question: What percent of the money your establishment spends on supplies and equipment for doing business is ordered online?

Source: CRITO Global E-Commerce Survey, 2002



Source: CRITO Global E-Commerce Survey, 2002

Figure 4. On Line Service 2002

Table 20. On-Line Services

	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Type of On-Line Service ^e							
% B2B only	18.8	29.7	35.7	16.8	10.5	20.4	23.1
% B2C only	22.6	15.3	11.5	21.7	36.0	21.5	12.9
% both B2B and B2C	33.0	44.6	36.2	33.8	35.8	34.7	33.3
Mean percent of total consumer services conducted on-line ^f	7.7	4.7	4.4	7.5	12.6	7.2	7.6
Mean percent of total business services conducted on-line ^g	13.8	12.5	20.6	10.6	30.0	13.6	11.0
% of manufacturing web sites which support ... ^h							
Product configuration	54.1	69.2	57.8			57.8	54.7
Order tracking	38.2	73.8	48.0			48.0	21.5
Service and technical support	56.5	80.6	63.1			63.1	54.4
Product specification	72.9	91.3	77.7			77.7	79.9
Account information	24.0	36.9	27.5			27.5	17.0
% of wholesale/retail distribution web sites which support... ^h							
Gift certificates and/or registry	20.3	50.9		25.2		25.2	20.6
Product catalogue	81.2	93.4		83.4		83.4	69.8
Product reviews	50.6	67.5		53.4		53.4	48.6
Ind. customization	49.4	66.9		52.4		52.4	21.3
Account information	55.3	50.9		54.5		54.5	21.7
% of banking and insurance web sites supporting ... ^h							
On-line services such as filing applications, filing claims, paying bills, transferring funds	52.3	83.3			58.6	58.6	53.9
Access to account information	66.2	100.0			72.8	72.8	57.3
On-line tools such as research tools, planning tools, etc.	68.2	86.4			71.8	71.8	52.0

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

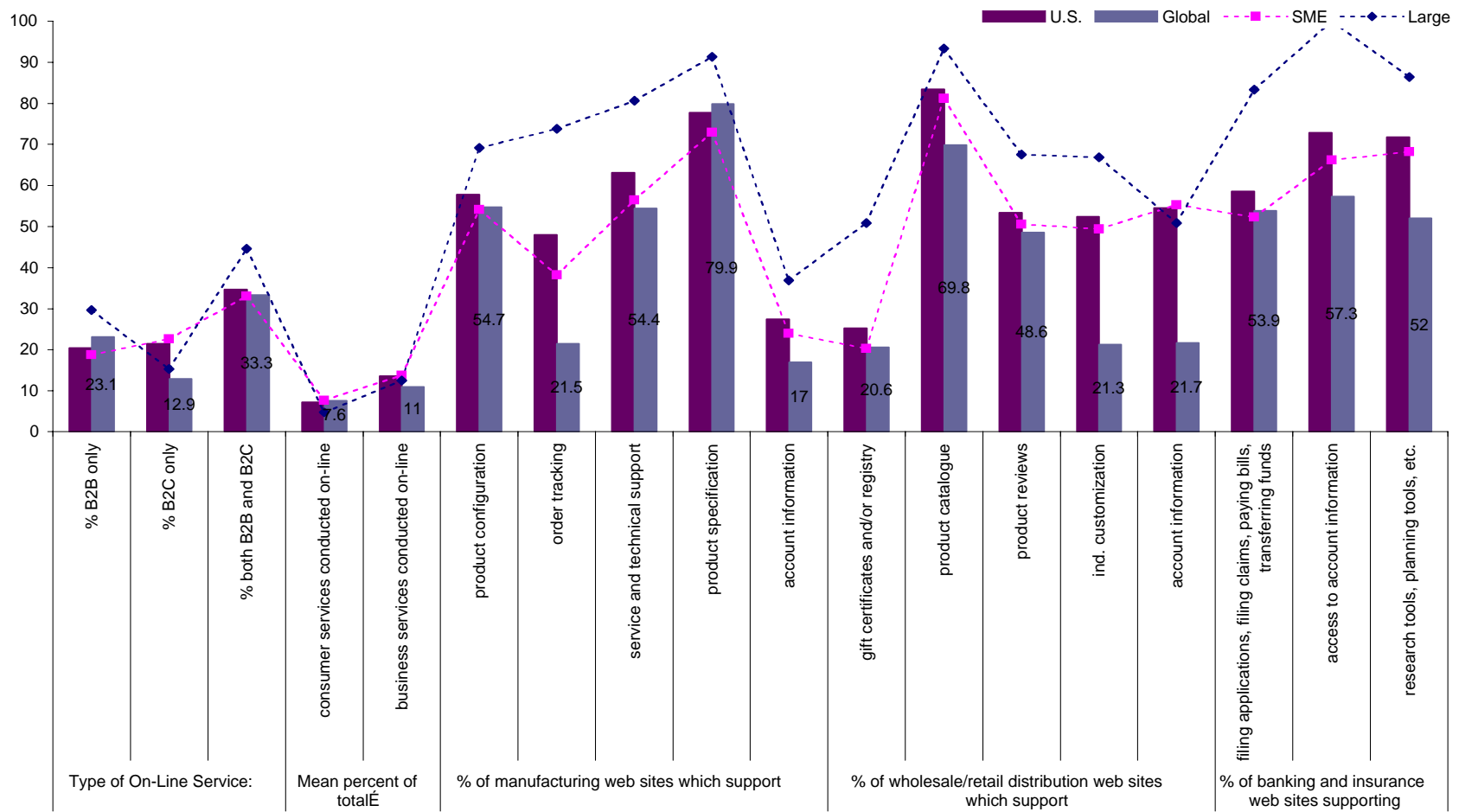
^e Percents are based on the full sample (all establishments). Exact wording of question: Are these online services to other businesses or to consumers or to both?

^f Percents are based on the full sample (all establishments). Exact wording of question: What percent of your establishment's total services to consumers are conducted online?

^g Percents are based on the full sample (all establishments). Exact wording of question: What percent of your establishment's total services to businesses are conducted online?

^h Percents are based on only those establishments which have a web-site and conduct business within the specified sector.

Source: CRITO Global E-Commerce Survey, 2002



Source: CRITO Global E-Commerce Survey, 2002

Figure 5. On-Line Services, 2000

in on-line product reviews, customization, and customer account information (about half), and less so with on-line gift certificates and registration. Finance is significantly engaged in on-line customer access to account information, research and planning services, and filing of claims or making payments (more than half).

U.S. establishments tend to be ahead of the non-U.S. establishments in nearly all areas, but especially in on-line product catalog, customization, and provision of customer account information within distribution establishments; in provision of on-line order tracking in manufacturing; and provision of access to customer

U.S. establishments tend to be ahead of the non-U.S. establishments in nearly all areas, but especially in on-line product catalog, customization, and provision of customer account information within distribution establishments; in provision of on-line order tracking in manufacturing; and provision of access to customer account information and research and planning services in finance. Large establishments show significantly greater deployment of all these services than SMEs.

INTERNET MARKETPLACES

The survey data in Table 21 suggest that a majority of establishments are aware of the concept of an electronic marketplace, though few engage in such markets through on-line buying or selling

Table 21. Participation in an Internet-Based Trading Community, 2002

	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Percent who have heard of the concept of an Internet marketplace ^e	71.0	81.4	77.6	69.0	76.7	72.3	80.0
Percent participating as a buyer only ^f	12.7	18.8	18.6	7.5	53.2	13.6	6.7
Percent participating as a seller only ^f	30.5	40.0	39.4	31.6	5.5	31.9	12.2
Percent participating as both a buyer and a seller ^f	47.4	29.3	35.4	49.9	30.9	44.7	16.9

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Have you ever heard of the concept of an Internet marketplace, exchange or trading community, through which multiple businesses buy and sell goods and services?

^f Percents based only on those establishments which have heard of the concept of an Internet marketplace.

Source: CRITO Global E-Commerce Survey, 2002

(Tables 17 and 22). No single e-commerce activity dominates among the three industry sectors. Between half and two-thirds of U.S. establishments use on-line facilities to purchase, advertise and market products and services, exchange operational data with their customers and suppliers, and provide after-sales service and support. A smaller portion uses the e-commerce technologies to integrate business processes (or outsource such processes) with other business partners.

Table 22. Uses of Internet, 2002

Percent using the Internet for:	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Advertising and marketing purposes	62.3	77.7	71.3	56.6	81.4	64.3	57.6
Making sales online	41.5	54.7	27.9	52.4	31.5	43.2	29.9
After sales customer service and support	54.0	66.1	57.9	54.6	55.9	55.6	43.7
Making purchases online	72.2	79.6	76.6	70.9	76.5	73.2	46.8
Exchanging operational data with suppliers	41.1	54.8	46.0	42.2	40.9	42.8	48.1
Exchanging operational data with business customers	52.2	64.6	64.6	46.7	64.4	53.8	50.7
Formally integrating the same business processes with suppliers or other business partners	34.7	41.2	38.5	34.2	36.3	35.5	33.9

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Does your establishment use the Internet for ...

Source: CRITO Global E-Commerce Survey, 2002

About two-thirds of distribution establishments make sales on-line, but fewer than half of manufacturing and finance establishments do so. The differences between U.S. and the non-U.S. establishments are small. U.S. establishments make more on-line purchases and have somewhat higher levels of on-line customer support and sales. The larger establishment's use of the e-commerce technologies more aggressively for these purposes than do smaller establishments, though the differences are not great.

A STRUCTURAL ANALYSIS OF E-COMMERCE ADOPTION IN THE U.S.

A structural equation model of adoption (Figure 6) was performed on U.S. establishment data from the survey to detect and validate statistically significant relationships between the drivers and barriers for Internet use and the adoption of e-commerce technologies. Details of the statistical analysis and model construction are outlined in Appendix I. The analysis consisted of trials in the AMOS analytical package for separate data sets taken from the U.S. survey.

Table 23 illustrates significant regression relationships that were detected with their level of statistical significance. Results show that e-commerce adoption is path dependent (i.e., establishments follow earlier investment patterns), and that each industry's market and institutional context play a significant role in adoption. The main findings can be summarized as follows:

1. Prior use of EC technologies (extranet, EFT, call centers) has a positive impact on B2B adoption (Internet-based data exchange w/business customers and suppliers) and B2C adoption (consumer sales and service online). Prior use of EC technologies is also positively correlated with the adoption of B2C and B2B adoption in distribution, and of B2B in large businesses

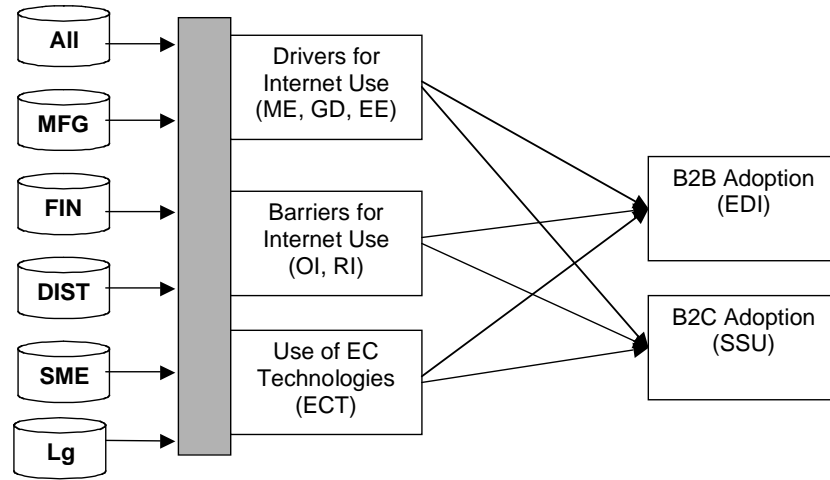


Figure 6. E-Commerce Adoption Model

Table 23. Adoption Model and its Significant Regression Relationships

Data Set	Relationship	Significance
ALL	Use of EC Technologies/B2C Adoption*	.556
	Market Expansion/B2C Adoption*	-.072
	Use of EC Technologies/B2B Adoption*	.428
	External Environment/B2B Adoption**	-.099
MFG	External Environment/B2B Adoption**	.138
DIST	Use of EC Technologies /B2C Adoption**	.755
FIN	No significant relationships	
SME	Market Expansion/B2C Adoption**	-.06
Large	Use of EC Technologies /B2C Adoption*	.894
	Use of EC Technologies /B2B Adoption*	.869
	Market Expansion /B2B Adoption**	.204
	External Environment /B2B Adoption**	-.20

Source: Calculated
 * = significant at 5% level ** = significant at 1% level

2. Market Expansion (use of the Internet to expand and enter new markets) has a negative impact on B2C adoption for SMEs, and a positive impact on B2B adoption in large businesses.
3. External Environment (suppliers and customers demand for Internet use) has a negative impact on B2B adoption in manufacturing and in large businesses.

Two broader findings are suggested by the analysis.

1. Prior use of e-commerce technologies is associated with both data exchange between business customers and suppliers (B2B Adoption) and the level of consumer sales and service online (B2C Adoption). This finding is particularly true in distribution, which has achieved a high level of e-commerce readiness and is focused on direct interactions with customers. The result is in alignment with the Chwelos et al. [2001] hypothesis that increased IT sophistication (readiness) translates into a higher level of adoption. SMEs show a stronger tendency toward this in the case of B2C adoption, and larger businesses in the case of B2B adoption. SMEs are focused on

implementing simple B2C e-commerce solutions to establish Web presence, while larger businesses expand e-commerce activity toward complex B2B processes in pursuit of large players like Wal-Mart.

2. SMEs attempting to use the Internet to expand B2C business show a negative level of adoption, while large businesses attempting to expand B2B business show a positive level of adoption. SMEs might not be as quick to adopt new technology, while large businesses often can access superior financial and technical resources. On the other hand, the analyses also show lower adoption rates for large businesses because they face high external pressure. This is in contrast to Iacovou et al.'s [1995] finding that high external pressure leads to greater adoption. Perhaps pressures in large business environments such as the automotive industry are not in the direction of innovation, but, to the contrary, are toward staying with more traditional technologies such as EDI for conducting B2B transactions. A study by Daniel and Grimshaw [2002] found that larger establishments are less likely to adopt e-commerce technologies when existing customers and suppliers fail to see the payoffs and wish to maintain their current technologies.

SUMMARY: DIFFUSION OF E-COMMERCE

E-commerce is growing steadily when it is narrowly defined as on-line sales. It needs to go far before it overtakes traditional forms of commerce. However, if it is defined to include all the complementary components of commerce such as customer access to on-line catalogs instead of printed catalogs prior to use of the telephone or the Internet to place an order, much faster diffusion of e-commerce is apparent. The survey data show that establishments in all sectors, of all sizes and origins are using e-mail, web sites, EDI and other IT-enabled communications and information processing to advance their business. Although such uses are changing the way establishments do business, the processes take time. The development of production engineering that led to modern manufacturing principles took nearly 100 years, from the development of interchangeable parts and bench measurement standards at the Springfield Armory in the early 19th century, to Henry Ford's creation of the integrated automobile assembly process in the early 20th century.

Many similarities in e-commerce adoption were found across sectors, between U.S. and non-U.S. establishments, and between large establishments and SMEs. Differences across sectors appear to be related mainly to the different nature of the tasks that are typical in those sectors. The only notable difference found between the U.S. and the non-U.S. establishments, is that U.S. firms make more purchases and sales on-line. This difference could be due to the ease of such transactions in the U.S. economy with its single currency¹¹, good logistics systems, and uniform commercial practices. Large establishments tend to be ahead in the diffusion of e-commerce, but this lead is less pronounced than might be expected. Early and extensive adoption of e-commerce technologies is the best predictor for future adoption across all sectors.

VII. IMPACTS OF THE INTERNET AND E-COMMERCE

The relatively low level of penetration of e-commerce into overall commerce suggests that the impacts so far are negligible. However, as just noted above, a broader notion of e-commerce

¹¹ In Europe the single currency Euro was introduced in January 1, 2002 by Belgium, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland in hope that a common currency would produce in the "Euro Zone" many of the benefits seen in the "Dollar Zone." At the time of data collection, the Euro had not been in place long enough to register any effect on survey results, and the effects of the Euro overall (e.g., on trade) are materializing slowly [Helge et al., 2005]. In part, result it is due to European payment systems that would work across the Europe just do not exist. The Euro takes away only the currency risk and exchange fees.

would probably reveal a broader set of impacts. The impacts of e-commerce on establishment and industry performance in the 1990's were significant [Brynjolfsson et al., 2003]. Van Ark [2001] suggests that industries producing or using IT equipment intensively contributed between 1/2-1 percentage points to the economic growth (Table). It is difficult to narrow such impacts to just one subset of IT-related activities such as the Internet and e-commerce but the survey data suggest that after a time lag of perhaps five to seven years, e-commerce will show major impacts on commerce as a whole, similar to the effect the 1990s boom in IT has had on the productivity growth in the 2000s [Mullaney and Coy, 2003].

The survey data suggest that establishments can benefit from e-commerce (Table 24). A significant number of establishments report positive impacts from doing business on-line, especially in areas such as internal efficiency and productivity, customer service, process efficiency, and sales performance. Many also report improved customer service, widening of sales area, improved competitive position, improved internal processes, greater coordination with suppliers, staff productivity improvements, increased sales, decreased procurement costs, international sales increases, and reduced inventory costs. These reports come from both U.S. and non-U.S. establishments, and in both large companies and SMEs.

Table 24. Contribution of Capital Deepening in IT-Related Industries to GDP Growth, 1990-98.

	Real GDP Growth	Contribution of IT-Related Industries		
		Total	IT-Using	IT-Producing
		(percent per year)		
Canada	2.1	0.8	0.6	0.2
Denmark	1.8	0.5	0.3	0.2
Finland	1.6	0.7	0.0	0.7
France	1.3	0.5	0.2	0.3
Germany	1.1	0.5	0.4	0.1
Japan	1.4	0.8	0.5	0.3
United States	3.2	1.4	0.9	0.5

Notes: For Germany, the numbers refer to 1991-97.

Source: [Haacker and Morsink, 2002], referring to [van Ark, 2001].

Some differences in experience were found across the sectors, all of which seem related to sector-specific characteristics. Distribution shows less internal process improvement than manufacturing and finance, possibly due to the consistency of activities within distribution irrespective of whether sales are made on-line. Finance shows greater improvement in staff productivity and inventory cost reduction than manufacturing and distribution, and lower effects on sales. Financial services are not engaged in sales in the same way manufacturing and distribution are, and new financial sales channels compete directly with their traditional channels.

Beyond these basic observations, e-commerce may have broader sectoral and regional impact as time goes on. The gains from technological progress, either measured by increases in domestic demand or in the consumer surplus, are mainly linked to spending on IT-related goods [International Monetary Fund, 2001, p.121]. This analysis does not take into account key differences between IT-producing and IT-consuming sectors and regions. Given the steep improvement in the price/performance ratio of IT products, and the intense competition in IT production, benefits are more likely to accrue differentially to the consumers than the producers. If so, IT using sectors and regions are likely to benefit relative to IT-producing sectors and regions due to deteriorating terms of trade for producers [International Monetary Fund, 2001, p.116]. For most G-7 economies, the contribution to GDP growth of IT-using sectors is much stronger than the contribution of the IT-producing sector [Haacker and Morsink, 2002, p.6]. Countries that are heavy consumers are likely to benefit more than those that are only producers, although countries that do both are probably in a good position. Within the U.S. as a whole, the effects might be difficult to determine (Figure 7). Only a few U.S. states are substantial producers and consumers.

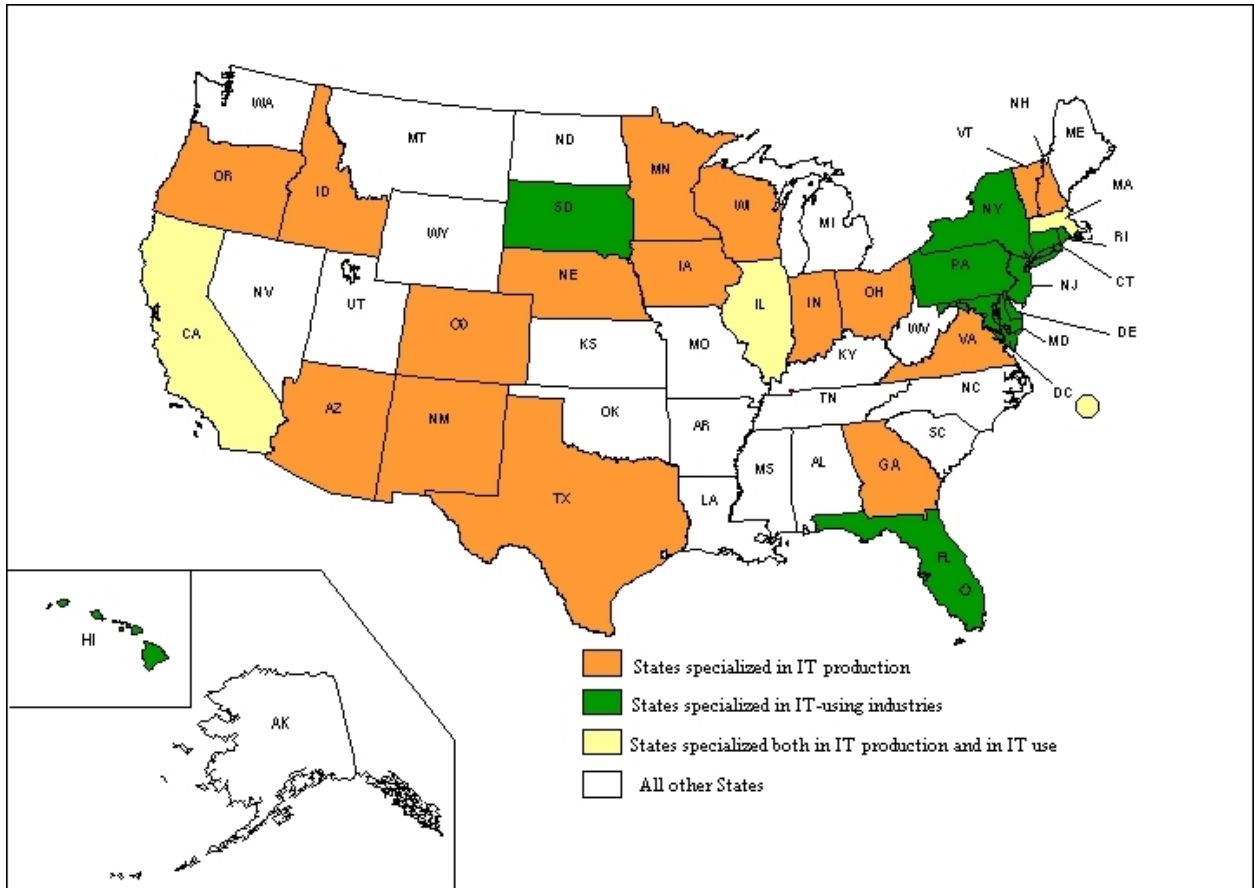


Figure 7. IT Production and Use in the United State 1881-1995

A few are major consumers, but the majority are either primarily producers or are neither producers nor consumers. Therefore, differential impacts may result from engaging in e-commerce across the U.S. states as a function of the relative production/consumption characteristics.

E-commerce impact (Table 25) could be substantial on competition and industrial organization. E-commerce is still only a small proportion of all commerce, and the most interesting effects of e-commerce are probably embedded in conventional commerce. It is therefore hard to determine whether major competitive or industry structure impacts are possible, *ceteris paribus*, due to e-commerce. Distribution establishments are active in on-line procurement and sales, and used EDI and other electronic or electronics-assisted (e.g., phone/fax) technologies for decades. It is not clear whether moving from one type of computerized order-entry system based on the telephone to a computerized order-entry system based on the Internet will really change things. Aggressive and disruptive experiments in new types of e-commerce that seek to create entirely new models for manufacturing, distribution, or finance are underway in all three sectors [Zhu et al., 2004].

In manufacturing, Dell Computer integrated its entire business from sourcing to end customer distribution through use of e-commerce technologies [Kraemer and Dedrick, 2001, Kraemer and Dedrick, 2002a]. Dell's use of e-commerce technologies might signal an altogether new era in manufacturing. Dell was one of only two personal computer makers that turned a profit in 2002 and continued growth to become the world's largest maker of personal computers, overcoming HP and IBM [Jones, 2005]. Its success is clearly due to its e-commerce strategy that offers tremendous efficiencies and economies of scale and scope. Dell remains an isolated example

Table 25. Impacts of Doing Business On-Line, 2002

Percent indicating high impact ^e	Establishment Size ^a		Sector ^b			Total	
	SME	Large	Mfg.	Distrib.	Finance	U.S. ^c	Global ^d
Internal processes more efficient	26.5	37.9	34.8	22.9	36.5	28.0	33.9
Staff productivity increased	30.7	32.1	29.0	29.4	38.6	30.8	27.2
Sales increased	22.5	34.3	25.6	25.8	15.6	24.1	20.5
Sales area widened	35.4	39.2	39.1	34.9	34.8	35.9	31.4
Customer service improved	39.0	48.2	40.4	39.9	41.1	40.2	34.8
International sales increased	8.8	9.9	14.4	7.0	7.8	9.0	19.5
Procurement costs decreased	12.2	14.3	18.3	8.7	17.8	12.5	17.7
Inventory costs decreased	10.3	14.2	6.4	10.6	18.4	10.8	14.0
Coordination with suppliers improved	28.4	34.7	32.9	26.6	33.4	29.2	29.8
Competitive position improved	31.7	43.5	36.9	32.3	31.7	33.3	29.8
% indicating ^f							
Number of distribution channels increased	45.9	41.6	48.7	44.4	44.1	45.4	40.2
Number of suppliers increased	34.1	35.3	48.3	28.7	34.2	34.2	29.9
Number of competitors increased	27.8	33.9	30.1	28.2	28.2	28.6	27.9
Intensity of competition increased	36.6	44.8	51.5	32.2	37.7	37.7	41.5

Notes: ^a SME (small and medium sized establishments) are those with 25-250 employees; large are those with more than 250 employees.

^b Manufacturing includes all establishments classified as SIC 20-39; distribution includes wholesale and retail (SIC 50-54, 56-57, 59); finance includes banking and insurance (SIC 60-65).

^c Responses were weighted based on the total number of establishments by employee size within the sector for each country. Survey sample sizes for U.S. by sector are 100 establishments in manufacturing, 100 in wholesale & retail distribution, and 100 in banking & insurance; by size are 155 establishments classified as SME and 145 as large.

^d Consists of weighted survey responses in 10 countries combined: United States, Mexico, Brazil, Germany, France, Denmark, Singapore, Taiwan, China and Japan. "Global" sample sizes by sector are 743 in manufacturing, 701 in wholesale/retail distribution, and 695 in banking & insurance; by size are 1,088 establishments classified as SME and 1,053 as large.

^e Exact wording of question: Using a 5-point scale where 5 is "a great deal" and 1 is "not at all", please rate the degree to which your establishment has experienced the following impacts since it began using the Internet for business. A score of 4 or 5 was classified as "high impact".

^f Exact wording of question: Using a 5-point scale where 5 is "a great deal" and 1 is "not at all", please rate the degree to which your establishment has experienced the following impacts since it began using the Internet for business. A score of 4 or 5 was classified as "high impact".

Source: CRITO Global E-Commerce Survey, 2002

among manufacturing establishments in the electronics industry, and should not be seen as an exemplar. Alternative strategies can also produce success. The other profitable personal computer company in 2002 was Apple, which embarked on an ambitious strategy of innovative product design and opened a number of flashy, physical retail outlets. Although Apple runs an on-line store, it sells the vast majority of its products through its traditional distribution channels. The survey data suggest that few companies seek or dare to overhaul their current business model using e-commerce technologies. If manufacturing is being transformed by e-commerce technologies, the transformation is seen in subtle and complicated changes in strategy, and not primarily in simple stories of cost reduction and disintermediation. Profound changes in production regimes normally accrue through accretionary processes of capacity building that take place over decades [Kraemer and Dedrick, 2002a, 2002b].

Distribution is actively engaged in both on-line buying and selling, as well as in both B2B and B2C e-commerce. Predictions of e-commerce in the mid-1990s forecast major disintermediation between manufacturers and consumers. However, distributors such as Amazon proved a number of important roles played can be played by intermediaries. Similarly, sites such as eBay and the "consolidator and comparator" web sites that provide comparison pricing and information on

distributor reliability (e.g., buy.com) were successful. E-commerce in distribution seems to be evolving along five directions:

1. traditional commercial distribution;
2. manufacturing-based distribution such as Dell Computer;
3. the e-only distribution model of Amazon;
4. the consolidator and comparator such as buy.com that offers customers meta-data on shopping options; and
5. the end-consumer auction house such as eBay.

Finance is the progenitor of modern e-commerce. The Federal Reserve's FedWire system, which carries value in excess of \$500 trillion per year, began over telegraph lines in 1925. Consumer electronic funds transfer began in certain European inter-bank networks and in the deployment of Automatic Teller Machines (ATMs) before 1980. Data from the survey show finance establishments feel pressures from customers and competitors to provide e-commerce services. This pressure is to be expected from a sector that did e-commerce for decades. Finance learned that customer convenience is a paramount competitive virtue. The survey shows finance to be focused on transforming existing channels, but important changes appear to be taking place in the nature of financial services. The problem is, and will probably remain for some time, that the nature and extent of the changes are going to be extremely difficult to measure.

E-COMMERCE IMPACT ANALYSIS

A structural equation model of e-commerce (shown in Figure 6 in Section VI) tested the effect of B2B and B2C adoption levels, use of EC technologies and Ecommerce-related IS spending on sales improvement and overall efficiency. This analysis was done using the AMOS package on the same data sets described above in the section adoption on e-commerce adoption.

Table 23 shows significant regression relationships. Despite relatively large sample sizes, the significant relationships are few and modest. This might be due to the early stage of adoption of e-commerce solutions and the brief time e-commerce has been in use. The analysis suggests that information systems spending on web projects is correlated with sales improvements (increased sales, customer service, competitive position) when doing business online. The results also show that B2B e-commerce adoption is negatively correlated with overall efficiency (efficient processes, productivity increase, decrease in procurement costs, improved coordination with suppliers since doing business online). This finding appears at the aggregate data level, but not at the industry, or business size level. It is consistent with findings in e-commerce studies that e-commerce has a positive impact on the establishments earning potential [Clark and Lee, 2000, Iacovou et al., 1995, Mirchandani and Motwani, 2001, Ratnasingam, 2000]. It could be that, as businesses attempt to migrate to B2B technologies, coordination with suppliers and procurement processes suffer at first due to less stable e-commerce technologies, implementation problems, and resistance within the organization and interorganizationally.

VIII. CONCLUSION

The paper set out to address three broad questions:

1. Do e-commerce experiences in terms of readiness, deployment, adoption and impact of e-commerce technologies of the U.S. establishments differ from those in other studied countries?
2. Do e-commerce experiences in the manufacturing, finance, and distribution differ from one another?
3. Do e-commerce experiences differ significantly between small and medium sized establishments versus large establishments?

This section reviews the findings in relation to those questions, and discusses open issues awaiting further study.

Earlier work demonstrates that the U.S. is a leader in e-commerce, particularly in the Americas [Fomin et al., 2003]. Other developed countries in Europe and Asia are also aggressively developing e-commerce capability. The size and strength of the U.S. economy, the U.S. lead in technologies related to e-commerce, and the liberal economic policies of the U.S. government are all presumed to be important factors in making the U.S. an e-commerce leader.

The paper uses a survey of e-commerce by CRITO [Kraemer et al., 2003] to compare U.S. and non-U.S. establishments. Only modest differences were between U.S. and non-U.S. establishments, the most notable being that U.S. establishments appear to be more in touch with the drivers for e-commerce, and less concerned about barriers to e-commerce. That is, U.S. establishments are somewhat more positive about e-commerce.

In most cases, however, little distinguishes U.S. and non-U.S. establishments from one another in the survey data. This finding could be related to sampling bias: the only establishments participating are those already engaged in e-commerce. Thus, the data provide little information about the population characteristics of establishments in countries taken as a whole. Similarity in experience with e-commerce across national borders could be due to the global nature of discourse about e-commerce in the business trade press and among consultancies that help establishments develop e-commerce strategies. In addition, the technologies and techniques for doing e-commerce are themselves increasingly global, provided by multinational establishments that can spread their expertise quickly across their global reach. In general, we conclude that the survey finds few significant differences between U.S. and non-U.S. establishments with respect to readiness, deployment, adoption, and impact of e-commerce technologies. A survey employing a representative sample of establishments in each country, irrespective of whether the establishment is using e-commerce currently, might produce different results.

Some differences in e-commerce orientation and experience were found across the three industry sectors studied in the survey. Initial analysis suggests that these differences are related largely to the nature of the tasks done in the respective industries, and to prior industry-level investment and learning related to e-commerce. One good example of this is the manufacturing sector's experience with EDI, which seems to presage e-commerce capability more broadly. Another example is the distribution sector, which lags somewhat behind manufacturing only on B2B e-commerce, and somewhat behind finance only on B2C e-commerce, but leads manufacturing and finance with respect to establishments doing both B2B and B2C. This finding makes sense for a sector that buys from manufacturers and sells to end consumers.

Taking all sectors together, the primary drivers for e-commerce are expansion of markets for existing products and services, improved coordination with customers and suppliers, penetration into new businesses or markets, cost reductions, and meeting customer demand and increased competition. These drivers were reported by between one-third and two thirds of the studied establishments. Less common drivers are demands by suppliers, and government requirements or incentives. These drivers do not significantly differ from those reported by establishments in other countries, and they are quite uniform across all sectors. The primary barriers to e-commerce are privacy and security, the need for face-to-face business communication, and the high costs of implementing e-commerce. In general, we conclude there are some differences between establishments in different sectors surveyed, but there are no striking differences that warrant extensive discussion. It is likely that deep, sector-specific studies will be required to determine the mechanisms of change due to e-commerce over the coming years. These sectoral studies can then be compared with one another to discover whether and in what ways systematic differences across sectors occur.

There are differences in e-commerce attitudes and experience between small/medium sized enterprises (SMEs) and large establishments. None of the findings are surprising. Large establishments have greater resources than SMEs, and devote those resources to e-commerce.

They also have needs that SMEs do not have as a function of the scale and scope of their activities, and these help drive investments in e-commerce that show up in the findings. Again, the survey responses are only from establishments that are using e-commerce, so the establishments with little or no experience with e-commerce cannot be examined in this study. Given that the overwhelming majority of establishments in the U.S. are SMEs, and that SMEs as a whole have a much lower rate of investment in e-commerce than do large establishments [Fomin et al., 2003], it is likely that a significantly different picture of attitudes toward e-commerce would emerge if non-using SMEs were surveyed.

The survey results show that e-commerce is well established among a significant number of U.S. establishments, that U.S. establishments tend to be motivated by the drivers for e-commerce and are not particularly worried about the barriers, and that there are no obvious impediments to e-commerce adoption across sectors or between SMEs and large establishments. Given that the U.S. is a leader in e-commerce and that U.S. key indicators of readiness for e-commerce are all strong, it is reasonable to predict that growth of e-commerce in the U.S. will be robust over the coming years. It is less clear whether the U.S. will retain its e-commerce lead over some advanced, smaller countries that innovate actively and are supported by assertive governmental policies promoting use of e-commerce.

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APPENDIX I. RESEARCH METHODOLOGY AND GOALS FOR THE STATISTICAL ANALYSIS OF E-COMMERCE ADOPTION AND IMPACTS IN THE U.S.

The purpose of this appendix is to explain how the U.S. e-commerce data set was used in carrying out both exploratory and confirmatory analyses of adoption and impacts. Our goal in this process was to establish a consistent and rigorous model to explain the adoption and impact of e-commerce, which could be used for e-commerce diffusion analyses across countries. To do so, required stringent validation of the validity and reliability of the survey instrument. To this end we conducted exploratory factor analyses for survey data to establish factors for structural equation modeling (SEM). Thereafter we constructed structural models in AMOS to causally explain observed e-commerce adoption and impact.

The proposed measurement model specifies eleven first order independent factors, which fall into five categories associated with e-commerce diffusion (Table A1). These factors were identified through exploratory factor analysis of 31 survey items (Table A2).

The entire data set was first tested for multivariate normality and model goodness of fit using standard tests. Test for normality was conducted separately on the five factor groupings listed above using the macro 'Normtest.sps' [DeCarlo, 1997], an SPSS program which tests for univariate and multivariate skew and kurtosis, as well as outliers. Skew and kurtosis levels were sufficient (greater than 3), and therefore the distribution of data set was assumed to be normal.

Table A1. Factor Model for SEM modeling

Survey Category	Factors	Model Key	Survey Item Numbers
Prior Use of EC Technologies	EC Technologies	ECT	17,18,22,23
Use of Internet for Ecommerce (Adoption)	Internet Data Exchange Use (B2B)	IDE	24e, 24f
	Sales and Service Use (B2C)	SSU	24b, 24c
Drivers for Internet Use	Market Expansion	ME	28e, 28f
	Governmental Drivers	GD	28h, 28i
	External Environment	EE	28a, 28c, 28g
Barriers for Internet Use	Organizational Issues	OI	29d, 29g
	Institutional/Regulatory Issues	RI	29e, 30a, 30c, 30d
Impacts of doing Business Online	Sales Improvements	SIM	31c, 31d, 31e, 31j
	Overall Efficiency/Productivity	EFF	31a, 31b, 31g, 31i
IS Spending	2001 IS Budget/Total Revenue, 2001 Web-based Spending/Is Budget	SP	isrange, webrange

Table A2. The Item List Selected for Factor Analysis For Each Factor

Use of EC Technologies	
q17	Establishment's Use of an Intranet
q18	Establishment's Use of an Extranet
q22	Establishment's Use of EFT
q23	Establishment's Use of a Call Center

Use of Internet	
q24b	Use - Making Sales Online
q24c	Use - After Sales Customer Service and Support
q24e	Use - Exchanging Operational Data with Suppliers
q24f	Use - Exchanging Operational Data with Business Customers

Drivers for Internet Use	
q28a	Driver - Customers Demanded It
q28c	Driver - Suppliers Required It
q28g	Driver - To Improve Coordination with Suppliers
q28e	Driver - To Expand Market for Existing Products/Services
q28f	Driver - To Enter New Businesses or Markets
q28h	Driver - Required for Government Procurement
q28i	Driver - Government Provided Incentives

Barriers for Internet Use	
q29d	Barrier - Finding Staff with eCommerce Expertise
q29g	Barrier - Making Needed Organizational Changes
q29e	Barrier - Prevalence of Credit Card Use in this Country
q30a	Barrier - Cost of Internet Access
q30c	Barrier - Taxation of Internet Sales
q30d	Barrier - Inadequate Legal Protection for Internet Purchases

Impacts of doing Business Online	
q31a	Impact - Internal Processes More Efficient
q31b	Impact - Staff Productivity Increased
q31g	Impact - Procurement Costs Decreased
q31i	Impact - Coordination with Suppliers Improved
q31c	Impact - Sales Increased
q31d	Impact - Sales Area Widened
q31e	Impact - Customer Service Improved
q31j	Impact - Our Competitive Position Improved

IS Spending	
isrange	2001 IS Operating Budget as a % of Revenue
webrange	2001 Web-based Spending as a % of IS Operating Budget

After testing for normality, the data set was examined for outliers, which may disproportionately influence the results, using Mahalanobis distances. Observations with extreme distances (20% greater than the next closest point) from the mean were removed from the data set. The scatter plots of ordered distances resulted in the decision to eliminate five observations (154, 63, 243, 139, 148) from the data set. After establishing normality, items in each area of the questionnaire were grouped and subjected to EFA. The parameters for this analysis were as follows:

- Specified minimum Eigenvalues of 1.
- Ran each analysis twice with PAF and ML extraction methods applied to confirm results.
- Promax Rotation applied to all factors.
- Need at least 2 items to load in order to be considered a factor.

After the data set was tested, the diffusion factors were examined through exploratory and confirmatory factor analysis to discover relations between factors and measures in an effort to eliminate inappropriate items while creating new factors. The models constructed and tested were primarily derived from prior EDI adoption and impact models first proposed by Iacovou et al., [1995], and later refined by Chwelos et al., [2001]. In this model, adoption is explained by three factors: perceived benefits, external pressure and readiness. The generalization of this model to the e-commerce context has been described as follows: "this model has general applicability to other forms of inter-organizational systems, particularly B2B ecommerce. While this extension may require re-operationalization, we hypothesize that the relationships predicted in our model will continue to hold" [Chwelos et al., 2001]. The two factors in the adoption and impact models developed in our analysis of the survey data that were similar to the EDI model adoption model are: 1) the factors "Drivers for Internet Use" compares to their "External Pressures" factor, and 2) the factors "Use of EC Technologies" is similar to their "Readiness" factor. We expanded this model by adding an additional a factor called "Barriers for Internet Use". Moreover, we did not examine the impact of these factors only in general but instead conducted the analysis both at the overall economy level, industry level, and based on the size of the business. Our concept of adoption follows the notion adopted in Kraemer et al. [2002], which looked at level of adoption and impacts in the B2B and B2C contexts for specific industries. The factors were grouped into categories consistent with the survey model as shown in Table A1.

All these factors were then placed in a single structural equation model to test the quality of the overall measurement model. Individual models were then constructed by using AMOS to test relationships between factors, which relate both to adoption and impacts of e-commerce. Each of the factors was then placed in a single SEM in order to test the overall data fit to measurement model. All factors were allowed to co-vary in order to test multi-collinearity and factor and discriminant validity. The fit analyses and correlation matrix were then examined. The results, which confirmed the fit of the measurement model, were as follows:

- Data was determined to fit factor model using AMOS fit analysis (NFI>.9, CFI>.9, RMSEA<.5).
- Multi-collinearity occurred only between factors that were expected to correlate.

Thereafter the data set was grouped by industry sector (manufacturing, distribution and finance), and business size (SME and large) in order to provide more detailed analysis to control for the impact of industry or business size. Each model was tested using the aggregate data set, and then by industry sector and business size. Significant regression relationships in these models provided the basis for analysis and conclusions.

LIST OF ABBREVIATIONS

AMOS	Structural equation modeling (SEM) software
ANSI	American National Standards Institute
ANSI X12	Also known as "ASC X12." A protocol from the American National Standards Institute (ANSI) for electronic data interchange (EDI)
ATM	Automatic Teller Machine
B2B	Business-to-Business (B2B) electronic commerce
B2C	Business-to-Consumer (B2B) electronic commerce
CFI	Comparative Fit Index
CRITO	Center for Research on Information Technology and Organizations at the University of California, Irvine
EbXML	Electronic Business using eXtensible Markup Language
EC	Electronic Commerce
EDI	Electronic Data Interchange
EFA	Exploratory Factor Analysis
EFT	Electronic Funds Transfer
GDP	Gross Domestic Product
GEC	Global Electronic Commerce
GNP	Gross National Product
ICT	Information and Communication Technology
IP	Intellectual Property
IP	Internet Protocol
IT	Information Technology
ML	Maximum Likelihood
NAICS	North American Industry Classification System
NFI	Normed Fit Index
NSF	National Science Foundation
OASIS	Organization for the Advancement of Structured Information Standards
OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
PAF	Principal Axis Factoring
PBX	Private branch exchange (private telephone exchange)
PC	Personal Computer
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modeling
SME	Small and Medium Sized (Company)
SOAP	Simple Object Access Protocol
SPSS	Statistical (Software) Package for the Social Sciences
UDDI	Universal Description, Discovery and Integration
VAN	Value-Added Network
VC	Venture Capital
W3C	World Wide Web Consortium
WSDL	Web Service Description Language
XML	eXtensible Markup Language

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