THE DIGITAL DIVIDE: CURRENT AND FUTURE RESEARCH DIRECTIONS

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ABSTRACT

The digital divide refers to the separation between those who have access to digital information and communications technology (ICT) and those who do not. Many believe that universal access to ICT would bring about a global community of interaction, commerce, and learning resulting in higher standards of living and improved social welfare. However, the digital divide threatens this outcome leading many public policy makers to debate the best way to bridge the divide. Much of the research on the digital divide focuses on *first order* effects regarding who has access to the technology, but some work addresses the *second order* effects of inequality in the ability to use the technology among those who do have access. In this paper, we examine both first and second order effects of the digital divide at three levels of analysis — the individual level, the organizational level, and the global level. At each level, we survey the existing research noting the theoretical perspective taken in the work, the research methodology employed, and the key results that were obtained. We then suggest a series of research questions at each level of analysis to guide researchers seeking to further examine the digital divide and how it impacts citizens, managers, and economies.

Keywords: digital divide, e-commerce divide, information and communications technology, ICT, diffusion of technology, public policy, electronic commerce.

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1. INTRODUCTION

It is widely presumed that universal access to information and communications technology (ICT) would bring about a global community of interaction, commerce, and learning resulting in higher standards of living and improved social welfare. However, during the 1990s researchers and policy experts began debating the existence of a "digital divide" between those who have access to ICT — such as personal computers (PCs) and the Internet — and those who do not. For example, a recent study by the Pew Internet & American Life Project found that, independent of all other factors, annual income was the strongest predictor of individual Internet usage [Pew Internet, 2003]. At the organizational level, large organizations are more likely to adopt innovations and advanced ICT solutions than smaller organizations [Iacovou et al., 1995; Rogers, 1995]. In terms of differences across nations, Dewan and Kraemer [2000] found that spending on ICT is highly correlated with level of development, and ICT investments are associated with higher output in developed countries, but such investments are not (yet) productive in developing countries. After a decade of debate by experts in public policy, communications, philosophy, social sciences, and economics, there is still no consensus on the definition, extent or impact of the digital divide.

The potential existence of the digital divide and how managers react to the divide should be of interest to those conducting research in business management — especially in the areas of information systems (IS) and marketing — as well as those working in economics and public policy. Specific phenomena of interest within the context of the digital divide are adoption and dissemination of ICT, the impact of simultaneous globalization and digitization trends, the pricing and diffusion of online products and services, the creation of a workforce that is literate in information technology (IT), the way organizations make strategic use of ICT, and the formulation of policies regarding the regulation and promotion of access to IT and the Internet.

The digital divide has both policy and managerial implications, and understanding these implications is a worthwhile area of research. On the policy side, the key question is what should be done to close the gap between the haves and have-nots — in local communities and in the global arena. Taxes (or subsidies), tariffs, trade and legislation, and funding for public access points are examples of levers that can be used to influence

access to ICT and the Internet, and thereby shape the evolution of the divide. As we will discuss in this survey, policy implications of the digital divide have received considerable research attention. By comparison, there has been little attention given to the impact of the digital divide on management strategies and business in general, an issue this survey will attempt to shine some light on.

For business and social science researchers, understanding the divide is important because it has a profound impact on how firms compete globally, how they relate to their customers and business partners, and how they formulate their strategies for online commerce. One might presume that the narrower the digital divide the better it is for business; e.g., businesses operating in the online world would benefit from having more potential customers online. One can imagine scenarios, however, where profitable business strategies are predicated on the existence of the divide. For example, Riggins [2004] notes that for sellers operating in both online and offline channels simultaneously, the digital divide can act as a natural segmentation mechanism to help differentiate the marketplace. At the organizational level, while managers would like to see their trading partners investing in the latest ICTs, they would also prefer that their competitors did not exploit new technologies. Clearly, there are many scenarios where government initiatives to promote new ICT adoption by businesses will be at odds with the incentives of competing businesses. Thus, the managerial and business implications of the divide are sometimes subtle and counter-intuitive and deserve research attention.

In this survey, we critically examine both policy and managerial implications of the digital divide, at three levels of analysis:

- Individual Level — those who are technologically, sociologically, or economically disadvantaged may lack or forgo access to IT, creating a gap between themselves and those who choose to make ICT an integral part of their daily life. Indeed, there is considerable variation in access to technology across geographical areas; e.g., broadband Internet access is still sparse in many rural areas.

- Organizational Level — some organizations use ICT to gain advantage over their rivals and redefine the rules of engagement within their industry, while others lag behind as technological followers potentially putting themselves at a strategic disadvantage; and

- Global Level — while some countries are heavily invested in ICT and have adopted policies to promote corporate and individual adoption, other countries are being left behind technologically.

Our analysis of the digital divide at these three levels of analysis considers two types of effects — *first order* effects regarding inequality in access to ICT, and *second order* effects in terms of the inequality in the ability to use ICT among those who already have access. Literature on these effects encompasses a variety of theoretical perspectives and methodological approaches. In the next section, we present a conceptual framework of research on the digital divide based on the ICT adoption cycle that incorporates the three levels of analysis, the first and second order effects, the theoretical perspective taken in the research, and the methodology employed. Such a framework is useful to help frame the disparate research studies on the digital divide that has occurred to date. We then apply our framework to examine existing research in this area and to suggest research questions to guide researchers seeking to examine the divide from the perspectives of policy or managerial implications. We conclude with a brief overview of recent cutting-edge research presented at the 2004 Symposium on the Digital Divide held at the University of Minnesota.[1]

2. CONCEPTUAL FRAMEWORK

In this section we describe a conceptual framework that we will use to organize past and suggest future research on the digital divide. The framework is illustrated in Figure 1, and it contains five essential elements, corresponding to the italicized descriptors in the figure. The *ICT Adoption Cycle* of ICT Innovations → ICT Access → ICT Use represents the essential underlying process of diffusion of ICT innovations, which is at the heart of the digital divide. It is worth noting that the digital divide at any point in time is a composite picture of the variations in access and use corresponding to

[1] In August 2004, a symposium was held at the Carlson School of Management on the campus of the University of Minnesota to examine the impact of the digital divide on management and policy issues. *The Symposium on the Digital Divide* was jointly sponsored by the MIS Research Center (MISRC) at the University of Minnesota, the Center for Research on Information Technology in Organizations (CRITO) at the University of California, Irvine, and the Digital Technology Center (DTC) at the University of Minnesota. The research articles in this issue and a future special issue are representative of the breadth of topics discussed at the symposium.

previously introduced ICT innovations. The notion of a series of ICT innovations driving the digital divide is an important one, since there is no single focal ICT, but a series of focal ICTs, such as mainframes, PCs, the Internet, wireless technologies, etc., all of which have served as major drivers of ICT adoption and investment at different points in time. Indeed, there is the potential for diffusive interactions among clusters of ICT innovations available at the same point in time, such as complementarity between access to PCs and the Internet [see e.g., Ganley et al., 2005]. The ICT adoption cycle is recurring in the sense that the processes of access and use start anew, with the introduction of each new ICT innovation.

As new ICT innovations become commercially available, individuals, organizations and countries adopt them at varying rates, leading to variations in the level of access. Among the adopters, there is variation in the ability to use the technology to obtain the comparative advantages the new technology provides. Accordingly, there are two *Inequality Types*, one in *access* to the technology and the other in the ability to *use* the technology, corresponding to the first order and second order digital divides, respectively, as shown in Figure 1. Indeed, as the majority of the participants in any social system have obtained access to a technology, the second order divide starts to become more important than the first order divide.

The analysis of the first and second order effects of the digital divide can be conducted at three distinct *Levels of Analysis*, which are the individual, organizational and global levels. While there is an obvious aggregation effect going from one level of analysis to a higher level, there are unique questions of interest at each level of analysis. For example, at the individual level, one might ask how access and/or the ability to use technology varies among different segments of a social system, and what policies one could adopt to bridge the corresponding divides. At the organizational level, a natural question is how do factors such as size, geographical location, industry, and ownership status affect adoption and the ability to exploit technology in organizations. Finally, at the global level, pertinent questions include how countries differ in access and use of technology as a function of their wealth, education levels, infrastructure, and other socio-economic factors.

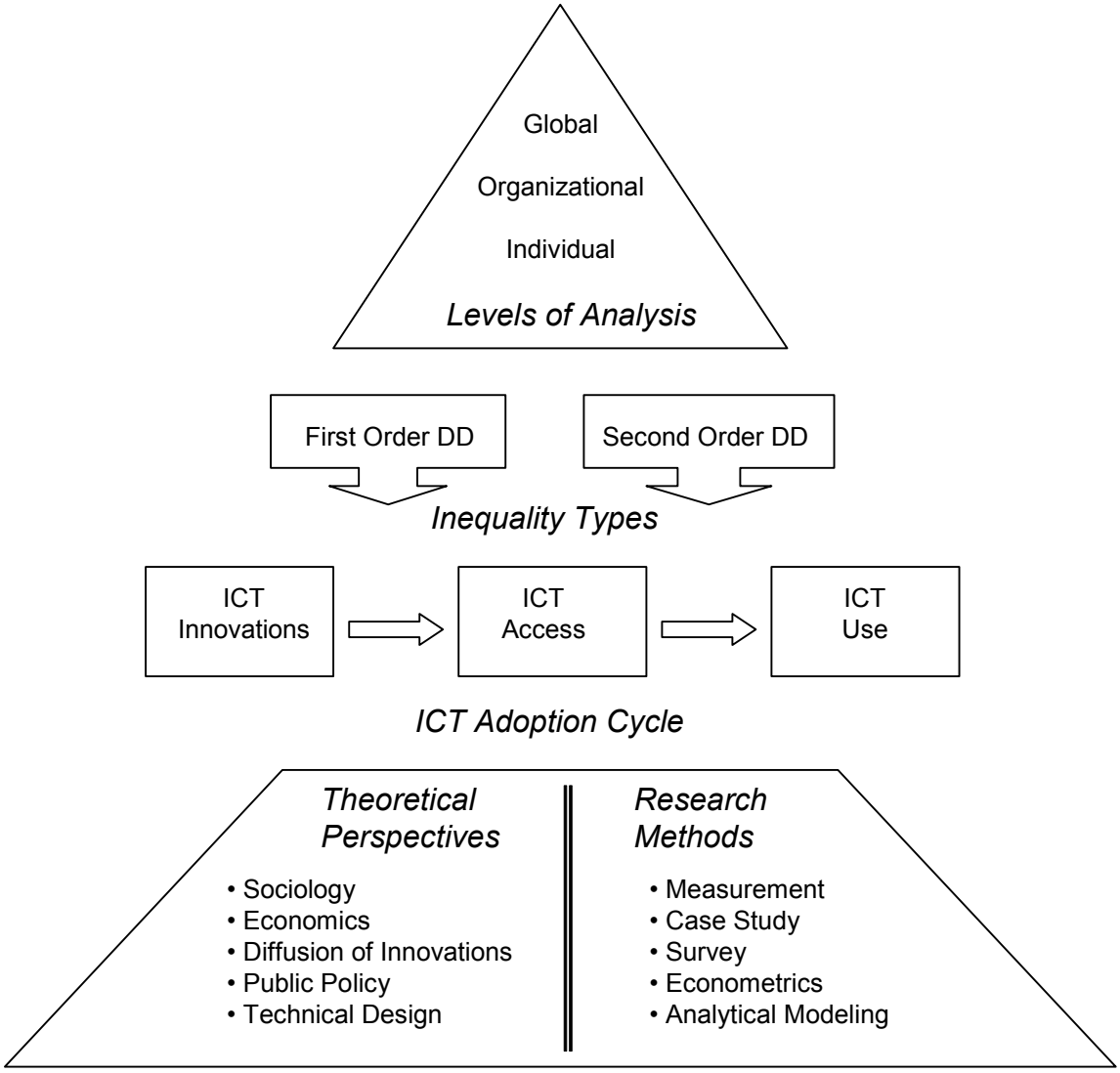

Figure 1. Conceptual framework for organizing research on the digital divide

As shown in Figure 1, a variety of *Theoretical Perspectives* and *Research Methods* can be brought to bear on the analysis of the two types of divide and the three levels of analysis described above. With respect to the former, sociology is perhaps the single most active area engaged in research on the digital divide. This is natural since the digital divide is to a great extent a social phenomenon, involving the spread of technological innovations inside various social systems. The digital divide is also an economic phenomenon, so that economics is another relevant theoretical perspective. Indeed, at each of the three levels of analysis, most of the studies tend to include socio-economic explanatory variables. We also singled out the diffusion of innovations as

another theoretical perspective, due to the enormous research interest in understanding the diffusion processes of ICT innovations, from either a behavioral or a modeling perspective. The interest in understanding the nature of the digital divide is driven by the desire in policy circles to take proactive measures to bridge the divide — hence, public policy informs much of the analysis of the divide. Technical design is also listed as a theoretical perspective, since the design of human-computer interfaces, and systems as a whole, has a direct bearing on the rate of adoption and intensity of use. Finally, the *Research Methods* used in research pertaining to the digital divide covers a range of techniques from simple measurement exercises and case studies to surveys, econometric analyses, and analytical modeling.

In the following sections, we analyze the recent and current research on the digital divide noting the theoretical perspectives taken and the research methodologies employed. This provides a useful lens to suggest further research on each level of analysis of the digital divide.

3. THE DIGITAL DIVIDE AT THE INDIVIDUAL LEVEL

The term *digital divide* has most commonly been used to highlight the view that certain individuals are not able to obtain access to personal computers or the Internet due to a variety of factors including race, socio-economic status, age, gender, place of residence, level of education, adeptness with technology, and/or social associations. While some factors may be beyond the control of the individual, the phrase has also been applied to those who have an aversion to technology and so choose, for one reason or another, not to make use of such technologies.

3.1 Antecedents of Research at the Individual Level

As the Internet grew in popularity during the mid-1990s, the digital divide took on political and public policy overtones as certain groups and policy makers claimed that some individuals were being left behind in the digital revolution and would have trouble catching up. This led to calls for public subsidization for access to the Internet through schools, public libraries, and even financial incentives directly to households [Hoffman and Novak, 1998]. Just as the government adopted a universal telephone policy in the

early twentieth century that led to broader rural economic development [Hudson, 1984], there were calls at the close of the twentieth century for a policy encouraging universal access to the Internet [Norris, 2001].

In 1995, the U.S. Department of Commerce began issuing a series of reports to document the digital divide. These reports were based on the U.S. Census Bureau's Current Population Survey (CPS) supplements which periodically examine computer ownership. The first of these studies found that computer ownership rose dramatically with income, however, within an income category those located in rural areas were much less likely to own computers than their urban counterparts [NTIA, 1995]. Similarly, the study found that computer ownership lagged for minorities, seniors, and those with less education. Subsequent studies released over the next few years showed increased adoption of personal computers and the Internet, but with the same gaps occurring in certain demographic categories [NTIA, 1998; 1999; 2000; 2002; and 2004]. The dynamic nature of the divide is evident by the fact that the gender divide, which was quite prevalent in the early report, has since closed.

The politically charged nature of the debate increased the need for further measurement and analysis of the existence and impact of the digital divide. In the following subsection, we highlight much of the research at the individual level of analysis that has been conducted over the past decade, with a particular focus on the results relevant to managers and businesses. We discuss the first order effects of the digital divide regarding who has access and then examine the second order effects of inequality of usage for those that do have access to the technology.

3.2 Overview of Research on the Individual Digital Divide

3.2.1 First Order Digital Divide

Many of the studies on the digital divide have taken the sociological, public policy and diffusion of innovations theoretical perspectives in asking research questions such as: Who has adopted ICT tools? What might be the sociological implications of the digital divide? And how might government bodies take action to bridge the divide? Research addressing these questions began with basic measurement studies to chronicle

the divide and survey studies examining various demographic factors driving adoption.[2] Some work has attempted to utilize the theory of the diffusion of innovations to build models of ICT adoption using survey data. Such models are useful in understanding the patterns of adoption, hindrances for non-adopters, and providing guidance for public policy initiatives. Other work grounded in the sociological perspective has examined the day-to-day impact of using the Internet, which can inform policy makers about the relative importance of bridging the divide, as well as allowing us to begin to examine the second order effects of inequality of usage. Again, the sociological perspective, using both the case study approach and survey questionnaires, can examine the differential impact on individuals as they make use of ICT in different ways. More recently, some research using an economic analytical modeling approach provides insight into both first and second order effects in the area of e-commerce. Other research using the technical design perspective and the diffusion of innovations literature provide useful lens for understanding why people who are online make use of the technology in different ways. These studies are summarized in Table 1 where we highlight the scope of the analysis (years and the subjects examined), along with the methodology, and key findings.

The NTIA (National Telecommunications and Information Administration) reports began in 1995 with the provocative title, "Falling through the Net: A Survey of the 'Have Nots' in Rural and Urban America" [NTIA, 1995]. These periodic reports focused on measurement of the phenomena with the theoretical perspective of diffusion of this innovation, sociology implications, and the need for public policy. Based on the CPS data, these reports provide the broadest, most reliable periodic snapshot of the digital divide. The most recent report released in 2004 indicates that about 62% of U.S. households had PCs in their homes in 2003, 55% had Internet access, and 20% had broadband Internet access [NTIA, 2004]. One of the first theory-based studies making use of the CPS data was conducted by Hoffman and Novak [1998]. Using data collected in 1997, they characterized the divide using income, racial, and education level factors. They conclude with public policy recommendations about the need to provide more access to computer technology in schools.

[2] For an extensive and up-to-date perspective on the measurement and quantitative aspects of the digital divide, the reader is referred to the IT & Society (www.itandsociety.org), a Web journal examining how technology affects society.

Table 1. Summary of Research on the Digital Divide at the Individual Level

Topics/ Papers	Scope		Methodology	Key Findings
	Years	Subjects		
ICT Adoption				
NTIA [1995 to 2004] Hoffman and Novak [1998]	1994 - 2003	Random individuals	CPS supplemental survey	Identified and tracked divide for a decade. Significant factors include income, location, race, age, and education. Latest survey tracks broadband adoption.
Pew Internet [2003]	1997 - present	Random individuals	Mass adoption and usage questionnaire	Income most significant factor for Internet adoption; other factors: race, education, age, location, and gender.
Eamon [2004]	2000	Youths, aged 10 to 14	Adoption and usage survey	Family income is major factor in PC home ownership, but not in predicting usage.
Rice and Katz [2003]	2000	Individuals	Random telephone survey	Income and age predict Internet use; income, work and marital status predict mobile phone use.
Kraut et al. [1996;1999]	1995 - 1997	Households	Observation and surveys	Tracked in-home usage. E-mail more important than Web surfing.
Selwyn et al. [2005]	2002	Random individuals	Survey and interviews	Internet usage based on interest, mediation of others, relevance, household dynamics.
Katz and Rice [2002]	1995 - 2000	Households	Telephone survey	Large usage study of positive and negative effects. Usage based on prior interests.
Mehra et al. [2004]	2000 - 2001	Individuals in demographic segments	Focus groups, community, e-mail analysis	Individuals within segments use Internet to overcome marginalization via info search, relationships, and online communities.
Mossberger et al. [2003]	2001	Individuals	Telephone survey	Disconnected at employment disadvantage.
Venkatesh and Brown [2001]; B&V [2003;2005]	1997 and 1999	Households	Theory building, surveys	MATH model. Adopters and non-adopters motivated differently. Must take household life cycle into account.
Efforts to Bridge the Divide				
O'Neil and Baker [2003]	1997 - 2002	Urban populations	Case study	Efficacy of community centers to promote ICT adoption and usage to urban poor.
Jaeger [2004]	1999 - 2003	Elderly	Case study and interviews	How government sponsored programs impact Internet adoption.
Barbatsis et al. [2004]	2001 - 2003	Disconnected minorities	Observation and interview	Sites viewed as irrelevant due to content and design; sites not developed by peers.
Cotten and Gupta [2004]	2000	Individuals	Survey	Factors influencing search for online health-related info include context specific factors.
Payton [2003]	2002 - 2003	African-Ameri-can students	Interviews and surveys	Internet use related to physical access and social networks; e-commerce: payment.
Zhang and Wolff [2004]	2003	Rural households	Cost analysis	Analysis shows feasibility of broadband access using various new technologies.
Wareham et al. [2004]	1994 - 1998	Disconnected households	Survey	Socio-economic factors that contribute to mobile communications adoption.
Riggins [2004]	N/A	Individual unit of analysis	Analytical model	Sellers view divide as segmentation tool; must incent for-profit businesses.
Littlejohn et al. [2005]	2002	Online pharmacies	Study of 275 Web sites	Drugs could be procured online without appropriate user authorization.
Patterns of ICT Usage				
Hargittai [2002;2003]	2001	Individual users	Experiments, probit models	Social surroundings impact search skills. Also: age, education, time spent online.
Davidson and Cotten [2003]	2001	2,000 U.S. households	UCLA project; survey	Broadband access impacts usage patterns, time spent online, value gained.
Howard et al. [2001]	2001	Random individuals	Pew data	Gender, Internet experience, and race impact types of e-commerce activities used.
Akhter [2003]	2000 - 2001	Individuals	Survey	Gender, age, education, and income predict usage of online commerce.

In an effort to further determine the extent and nature of the divide, the Pew Internet & American Life Project was initiated in the late 1990s with the objective of creating and funding research that would examine the sociological impact of the Internet on individuals and American society. In addition to studies that examine how people in different demographic profiles use the Internet, these studies also address issues that include habits regarding downloading music, individual's views of online trust and privacy, why people choose to not go online, and the impact of the Internet on political activities, the practice of religious faith, and personal relationships.[3] These data sets provide a second source of important data and represent a more detailed questionnaire than the CPS supplements.

Other sociological-based measurement and survey studies have elaborated further on the various demographic factors that contribute to the digital divide. Eamon [2004] studied the differences between academic and non-academic use of the Internet for 1,029 children between the ages of 10 and 14 according to family income levels. This study shows that family income is the primary factor in determining which side youths fall along the digital divide, while other demographic factors are not as significant. Rice and Katz [2003] show that the primary factors predicting Internet usage are income level and age, while mobile phone usage is associated with income, work status, and marital status. While these and other papers [see Hargittai, 2004; Jackson et al., 2004] examine the extent of the digital divide and its impact on the disconnected in terms of their inability to participate in online education, e-government, and access to information, there is little discussion of the impact of the divide on participation in online commerce.

As the Internet began to be adopted more broadly in the mid-1990s, social scientists began examining how people make use of the Internet in their home. In particular, it was reasoned that if public policy action was to be taken to encourage adoption and usage, it would be necessary to have an in-depth understanding of how people actually used ICT tools in their homes. The Internet@Home Project provided 110 households with PCs and Internet access from 1995 to 1997 to track the Internet usage of 299 individuals to see how they made use of online services [Kraut et al., 1996; 1999]. The findings indicated that subjects were more likely to make long-term use of e-mail as

[3] These reports can be downloaded from www.pewinternet.org.

opposed to Web use and that the major factors contributing to Internet use were social demographic factors such as age, race, and gender, rather than socio-economic factors such as income and education, or other psychological factors. The outcomes led the authors to conclude that the most likely home usage of the Internet would be for interpersonal communications rather than commercial activities.

In a study similarly grounded in the sociology perspective, Selwyn et al. [2005] conducted household interviews with 1,001 adults in the United Kingdom to understand who use the Internet and how and why, as well as who don't use it and why not. Overall, they find that people's usage of the Internet is based on interest, relevance, mediation of significant others, and the role of household dynamics. In particular, they point out that frequent users integrate the Internet as a resource into activities they are already engaging in within their normal daily lives. These conclusions are similar to those drawn by Katz and Rice [2002] who conducted extensive telephone surveys of Internet use from 1995 to 2000. These results echo what has been said by Anderson and Tracey [2001, p. 458] that "applications and services delivered via the Internet are not changing the way people live their lives in a simple, straightforward manner, but are supporting and enhancing their existing lifestyles, whatever those lifestyles may be."

Another example of a study using the sociology perspective is Mehra et al. [2004], who report findings focusing on three marginalized segments of the population: low-income families, sexual minorities and African-American women. The results suggest that the major use of the Internet by participants in these studies related to distributing information that can be used to empower people within these marginalized segments of society. As such, relationships, information access, and community building were important for users. However, it is worth noting that individuals in the low-income segment study who were online sought to use the Internet for various forms of e-commerce including selling a car online, gathering product information prior to purchase, and procedural information about first-time home buying. Although not addressed by the authors, empowerment for people in this low-income group may involve using the Internet to engage in economic activities that previously were beyond their reach.

The sociology and public policy perspectives also apply to work aimed at employment opportunities for individuals. At a time when employers seek to widen the

diversity of its workforce, Norris and Conceicao [2004] point out that those without online access are shut out of Internet-based training and education. They note that the digital divide creates a gap in who is able to take advantage of online education opportunities, which then translates into fewer employment opportunities for the disconnected. Lindsay [2005] uses a case study of the efforts of the city of Glasgow to provide information about job opportunities to unemployed individuals through the Internet. The author argues that providing such information to this group of people via the Internet is problematic since many of these individuals will likely be those without access. Their public policy recommendations are that public access to the Internet and ICT training are needed to make the Internet an effective channel to deliver this information to the unemployed. In a related sociological study, Mossberger et al. [2003] conducted a telephone survey of 1,837 Americans in 2001 to examine whether people felt their job prospects were limited due to a lack of online access or computer skills.

Economics provides another useful theoretical perspective when considering the impact of the digital divide on the workforce. Research using this perspective has examined the impact of computer usage in the workplace on changes in wages for white-collar workers. As more workplaces require IT skills, the digital divide may be perpetuated between those who are required to use technology on the job and those that don't face such requirements. Using CPS data from 1984 to 1989, Krueger [1993] finds that workers who use computers at work earned 10% to 15% more than other workers, all else being held equal. DiNardo and Pischke [1997] replicate the findings of Krueger by studying the wage differentials of workers in Germany for a variety of white collar tools such as pencils, calculators and chairs. In that study, they take into account a variety of individual fixed effects that were not available to Krueger. They conclude that white-collar workers who use computers possess unobserved skills, which might have little to do with computers, but which are rewarded in the labor market. Autor et al. [1998] also used CPS data and find that for both manufacturing and non-manufacturing sectors, increases in utilization of more-skilled workers are greater in the most computer-intensive industries. However, they stop short of claiming causality. Overall, these studies show that while IT skills are being required in more jobs, the direct impact on wages is unclear.

Some of the most useful theory building in the context of the adoption of ICT has come from efforts to extend the *theory of planned behavior* (TPB) to develop a *model of the adoption of technology in households* (MATH) [see Venkatesh and Brown, 2001; Brown and Venkatesh, 2003 and 2005]. To do this, the authors draw upon the diffusion of innovations literature, which has been successfully applied to organizational IS adoption [Davis, 1989; Venkatesh et al., 2003]. TPB is particularly useful in this area as it is geared toward examining voluntary behaviors [Ajzen, 1991; Mathieson, 1991]. In the development of MATH, the authors seek to understand factors that influence home PC adopters and non-adopters. The model was developed using data collected at two different time frames in 1997 from over 700 households. For non-adopters, social influences and certain barriers to adoption were critical. In particular, information from secondary sources (such as TV or newspapers) was important social influences, while three barriers emerged: rapid change in technology, high cost, and lack of knowledge. A key conclusion is that adopters and non-adopters are driven by *different* factors. In a follow-up study conducted in 1999, the authors refine the model to include the sociology-based life cycle stage model of family situations to show that income is not the sole predictor of adoption; rather the household life cycle stage must be taken into account.

3.2.2 Bridging the Divide

As the measurement studies more accurately chronicled the extent of the digital divide, other studies began examining specific public policy solutions for bridging the digital divide. In addition to subsidizing access within people's homes, several public policy initiatives seek to bridge the divide by providing public access to the Internet. Slack and Rowley [2004] discuss the role of public kiosks in delivering e-government services to those who otherwise might not have access to these services online. The authors point out a number of issues that make the use of kiosks problematic for such purposes. Umbach [2004] points out that many Canadian libraries provide public Internet access and that 8% of Canadians report that the library is their main access point to the Internet. O'Neil and Baker [2003] assess the Family Technology Resource Centers (FTRC) Program in Atlanta where 14 community centers have been used to increase ICT adoption and usage among underserved populations. Although the main focus of the

program has been on providing access and training for basic computer skills, there has been no discussion of providing skills for utilizing basic or advanced features of online shopping.

In a report that examines the status of the digital divide in the state of Georgia [GCATT, 2001], the authors note that there are three issues that need to be addressed to overcome the digital divide: awareness, application, and access. Among other things, the report suggests that online applications must be relevant, interesting, and usable for the potential user to gain value, and that a new level of collaboration needs to emerge between education, business, and government. This is one of the earliest suggestions that for-profit businesses should be involved in solving the digital divide problem. However, at about the same time, Baker [2001] expressed concern that if the public policy initiatives rely too much on market forces, they may be at odds with the goal of improving the overall public good.

In a European study similar to the GCATT report, Jaeger [2004] uses the case study approach to discuss the effectiveness of several public policy projects sponsored by the Danish government to increase Internet usage among the elderly population. While this project showed some value in increasing Internet usage by the elderly, when a new and more conservative government came to power, efforts to bridge the divide were moderated with a shift to the role of the private sector in furthering Internet access. Specifically, market forces that emphasized profit motives both for infrastructure providers and technology users largely replaced more socialistic motives from the previous government.

The GCATT [2001] report suggested that for-profit enterprises can help alleviate the problem of the digital divide by providing more relevant information on their Web sites. This is an example of how the technical design perspective provides a useful theoretical lens to view issues related to the digital divide. In an interesting study utilizing methods from visual studies, Barbatsis et al. [2004] note that many minorities find the content, information and services offered on most Web sites irrelevant to their everyday lives. This case study uses interviews and observation to understand how potential users might make use of the Internet as well as why they would choose not to use it. The authors assert that the digital divide may be more of a design issue than a

socio-economic one and discuss how the interface could be designed in ways that make it more appealing to minorities. They note that the computer interface consists of icons, menus, and command words that for the most part originated within a white, middle-class cultural experience. However, what designers take for granted may seem rather foreign, illogical and unintuitive to non-users.[4] Further, if visitors to a specific Web site do not feel that someone like them designed the site, this lack of a near-peer experience may discourage adoption and further use of the site [Rogers, 1995].

Cotten and Gupta [2004] offer another technical design study that examines the relevance of Web content on the tendency of users to make use of online resources in the provisioning of online health services. They conducted a survey of 385 respondents to examine the characteristics of individuals who get their health-related information from online sources versus offline sources. In addition to the usual digital divide characteristics such as age, income and education, factors that contributed to the use of online sources for health-related information included degrees of health and happiness. Providers of online health-related information need to understand these characteristics in order to tailor their online resources for the designated target audience. This study makes use of a variety of theoretical perspectives — it is a diffusion of innovations study in that it examines what it would take to get people to adopt online health information Web sites, and it is a technical design study since it discusses how the designers need to take certain views of the users into consideration.

The socio-economic conditions that characterize certain minorities may contribute to the impact of the divide on their community. Indeed, new technical design mechanisms for conducting online commerce that take these conditions into account may be required to adequately bridge the divide. For example, Payton [2003] conducted detailed interviews of 10 African-American students, and surveyed 31 other African-American students, to understand their views of the digital divide and the use of ICT by minorities. The information gleaned from these subjects suggests that while not having easy access to the Internet contributes to the digital divide, this deficiency is compounded by the lack of access to a social network that would encourage use of ICT. Further, the

[4] The whole area of human-computer interaction is predicated on the notion of the existence of the digital divide due to different people's reactions to different interface designs.

survey showed these students seldom engaged in online shopping. The interviews illuminate the fact that many of those within traditionally disconnected groups may not have the capability to make credit card payments at e-commerce storefronts. This illustrates the need for new technical design mechanisms to facilitate the online shopping experience of different groups of people.

In addition to more appropriate interface design and functionality, another way to bridge the divide may be to provide other technologies that would help users bypass the traditional means of access. Zhang and Wolff [2004] develop an economic cost model to examine the feasibility of providing broadband Wi-Fi Internet access to rural and remote areas using a variety of emerging technologies such as high-gain antennas, dynamically steerable beam-forming antennas and multihop routing. The results show that using these technologies to develop innovative mechanisms to reach new users can result in a cost-effective way to deliver these services to remote geographic areas. Wareham et al. [2004] used cross-sectional survey data to study the diffusion of mobile communications. They propose that disconnected groups in the U.S. may benefit from the migration from voice-based wireless devices to data-centric mobile computing devices.

Even though the involvement of for-profit businesses in efforts to bridge the divide is attractive [see e.g., Prahalad, 2005], there is evidence that some businesses may have an incentive to not see the divide bridged. Riggins [2004] develops an economic analytical model of pricing and quality choices by a firm that sells in two channels simultaneously — an online channel and an offline channel. He shows that the digital divide artificially segments the marketplace allowing the seller to more efficiently market its goods to different consumer segments. In this case, retailers simultaneously selling in both channels may prefer to not see the divide bridged. Interestingly, he also shows conditions under which bridging the divide may result in *less* consumer choice for those being helped into the online community. Another study that examines potential negative effects of bridging the divide using the sociology theoretic perspective is Littlejohn et al. [2005]. By conducting a case study of online pharmacies, the authors note that experienced Internet users could easily find potentially unscrupulous drug providers over the Internet. They point out that this may result in an increase in illegitimate drug usage and abuse. While the authors note that the typical stereotypes of the socio-economic

status of drug abusers may be inaccurate, they conclude that increasing access to the Internet for individuals that belong to high risk categories may increase the likelihood that more individuals will use the Internet to engage in illegitimate procurement of drugs from online pharmacies and thus increase drug abuse.

3.2.3 Second Order Digital Divide

We turn now to the second order effects regarding the different ways people use ICT technology [e.g., see Warschauer, 2003]. In an extensive review of the digital divide landscape, DiMaggio et al. [2004] note that the digital divide can be defined in several ways depending upon how access and differences in usage are defined and measured. In addition to providing some important direction for future research, the authors categorize a variety of inequalities of usage including the inequality in technical apparatus, the inequality in autonomy of use, the inequality in skill levels, the inequality in the availability of social support, and a wide variation in usage.

One of the most important aspects of inequality of use has to do with differences in computer skill levels. Hargittai [2002; 2003] examined the impact of sociological surroundings on people's ability to develop critical Web searching skills. The data come from in-person observations and interviews with a random sample of 66 Internet users conducted during 2001. The author used probit models to predict the ability to accurately and quickly complete a variety of assigned online search tasks. Her findings suggest that age, education level, and time spent online are relevant predictors of the user's Web searching skills. In addition, she finds that the ability to get time online is hindered by the presence of children in the home who may be usurping time on the computer away from adults, particularly women. She concludes that public policies aimed at getting people online or aimed at providing connections to certain geographic locations may not be sufficient to bridge the digital divide. In addition, it will be necessary to invest in training and support for those who have gone online.

A major cause of the second-order effect is the way in which people connect to the Internet. Using 2001 longitudinal survey data of 2,000 U.S. households from the UCLA Center for Communication Policy Internet Project, Davidson and Cotten [2003] find that significant usage differences exist between broadband and dial-up users. Those

with broadband connections are more likely to spend more time on the Internet than those with dial-up connections. Further, the ability to connect via a broadband connection impacts what people do online. The authors hypothesize that broadband users are better able to make use of the Internet and therefore gain more value from use. As the Internet becomes more critical in performing day-to-day activities, those with dial-up access will be left behind in terms of efficiency and capability. As can be seen, this study takes a technical design perspective to inform public policy makers.

Howard et al. [2001] make use of the Pew Internet data from 2001 to provide several key insights into how people use the Internet. In particular, more experienced users are much more likely to do online transactions and manage their money online compared to more recent adopters of the Internet. Further, more experienced users are more likely to have a higher socio-economic status; therefore, education level and income are predictors of those who engage in e-commerce related activities. They suggest that people with superior technical access and usage skills are emerging as a class of online elite users which they call "Netizens." These individuals represent approximately the 16% most experienced Internet users. Overall, these people are more likely to engage in online commerce activities and use powerful e-commerce functionalities such as recommender services and online auctions. As a group, they account for a quarter of all online traffic, but 45% of those trading stocks online, 40% of those participating in online auctions, 34% of those downloading financial information, and 29% of those engaging in online purchasing — all from a group representing only 8% of Americans.

It is reasonable to believe that there is considerable economic surplus being derived by users of sophisticated e-commerce functionalities such as online investing, auctions, recommender services and personalization technology. Bapna et al. [2005] estimate that the annual consumer surplus accruing to eBay users is roughly $6.5 billion. Based on the research to date, we propose that those most in need of finding ways to get ahead financially will be less likely to make use of the more powerful and beneficial online commerce features, thus leading to further socio-economic stratification. If online investing, auction participation, and highly-personalized online shopping activities generate economic value for the user, then the existence of these powerful online commerce functionalities, which for one reason or another are not widely adopted, is

creating a narrow further economically advantaged online elite. Mossberger et al. [2003] suggest four different types of divides related to ICT: an *information divide* due to certain people's inability to gain access to online information due to demographic characteristics; a *skills divide* related to computer-specific capabilities; an *economic opportunity divide* related to the inability to receive training, education or employment opportunities; and a *democratic divide* related to certain people's inability to participate in e-government.

In addition to these four, we propose that there is an emerging *e-commerce divide* due to certain people's inability to make use of more advanced e-commerce online functionalities and services. This differs from the other four in the sense that the e-commerce divide is based on the online consumer's ability to take advantage of powerful e-commerce functionalities.

In the same way that diffusion of innovations theory has been applied to ICT adoption, recent theory building work has been underway to understand the adoption of e-commerce as an innovation [Gefen and Straub, 2000; Gefen et al., 2003; Koufaris, 2002]. While much of the work has focused on the event of purchasing products online, it is recognized that engaging in online commerce at the individual level is a complex behavioral task. For example, Choudhury et al. [2001] argue that online consumers proceed through two different stages in online shopping: gathering product information and subsequently making the purchase. Individual inequality of usage can occur with both tasks in terms of skills employed, barriers to overcome, type of technology employed, feelings of ease with specific online vendors, and motivation to engage in the activity. (See Pavlou and Fygenson [2006] for recent work in this area.)

From a different theoretical perspective, Akhter [2003] develops and tests a series of sociological hypotheses regarding the correlation of various demographic characteristics, such as gender, age, education, and income, with intention to purchase goods over the Internet. Using a survey questionnaire of 1,794 individuals, the results show that these variables are significant in influencing a person's likelihood of using the Internet for online commerce. This is one of the first studies that look specifically at demographics and individual e-commerce activities.

3.3 Future Research Directions

Bridging the digital divide requires a partnership from public policy makers, for-profit businesses, educational institutions, and the disconnected themselves. Providing access to PCs, the Internet, and other ICT raises many issues related to all five of our theoretical perspectives. What public policies are economically feasible and hold promise for long-term success? What are the sociological implications of bridging or not bridging the divide? How can the proper economic incentives be provided to non-users to encourage adoption? What public policy initiatives can be used to incent for-profit businesses to encourage cooperation in this effort? What technical design solutions can be used to bridge the divide and how effective are they?

Providing public access to PCs and the Internet through schools, public libraries, and community centers is considered one of the most relevant approaches to bridging the digital divide. However, it is not clear how effective this approach is for actually overcoming many of the barriers for the disconnected. There are several research questions that are raised when this solution is proposed. For example, to what extent does public access to the Internet and computer technology actually alleviate the digital divide problem? What other problems might public access raise? How do different demographic segments make use of public access locations? In particular, it is not clear how effective this approach is to solve the various types of divides identified in the previous subsection. For example, how willing are people to engage in online commerce activities from public places? Are people willing to enter their personal information, such as credit card numbers or tax information, into public computer terminals? The use of such public access terminals and kiosks extends beyond issues related to the digital divide since more public kiosks are appearing in a variety of for-profit establishments who seek to provide their customers with a richer customer service experience.

> **RECOMMENDATION 1:** Researchers should examine the efficacy and impact of conducting information gathering and online transactions at publicly-available Internet access points.

In the previous discussion we raised several important questions related to the inequality of e-commerce usage. For managers and businesses seeking to extend their online presence to additional people, questions related to the adoption and usage of e-

commerce by different segments of the population become critical. For example, what are the individual characteristics, environmental factors, and social contexts that facilitate the adoption of online commerce at the individual level and integration of this activity into a person's lifestyle? Theory development and testing of empirical models that predict not only adoption but also usage patterns and types of online commerce activities would be useful in understanding the second order effects of the divide. Specific questions might include: If given access and training, how would traditionally marginalized segments of the population make use of online e-commerce functionality? Given the opportunity, how do low-income individuals make use of more sophisticated online commerce tools and what is the impact on their economic condition compared to online users in other economic situations? What different payment mechanisms are needed? How does the existence of the digital divide at the individual level impact online and offline pricing for business-to-consumer (B2C) online commerce?

Much more research is needed regarding sophisticated online users and their impact on society and online markets. It was suggested earlier that people integrate the Internet into their existing lifestyles. Therefore, integrating e-commerce into people's normal set of activities will depend upon the extent to which they seek to achieve financial gain as a priority in their lives. For individuals who desire to find the best bargain or the product that is just right for them, online shopping will be attractive and more easily integrated into their normal day-to-day activities. This indicates that the already-discriminating shoppers will be more likely to gravitate towards the online channel, thereby fueling a rich-get-richer phenomenon. The interviews conducted by Selwyn et al. [2005] indicate that the people making use of online commerce are more experienced and frequent users, further fueling this phenomenon. Research that examines the economic and social implications of having a small group of users account for a large portion of online commerce activity is needed. Research might address the extent to which this small segment of the population might control or influence online markets, seek to better understand the demographics of these users, and analyze the economic benefits accruing to these individuals.

> **RECOMMENDATION 2:** Researchers should examine the extent and implications of the e-commerce divide.

Apart from the surplus e-commerce functionality delivered to users, it was suggested that an economic opportunity divide exists in terms of employment options. What impact does the digital divide have on employment opportunities for certain disenfranchised groups? Is there a linkage between IT access/ adoption at the individual level to worker productivity, corporate advantage, or economic development? To what extent does simply providing access encourage home users to take advantage of online educational opportunities? Without supplementing access with adequate training, to what extent will home users be able to take advantage of streaming media, pdf attachments, online discussions, etc.? Also, if provided access within the workplace, to what extent does the support, training, and socialized context of the workplace promote home use and skill development as opposed to potential users who don't have such support from a workplace? While much of this work will focus on the impact on the individual, research should also examine the impact on the workplace itself as well as on employers.

> **RECOMMENDATION 3:** Researchers should examine the extent and impact of the digital divide on the individual worker, the workplace and employers.

It was mentioned that for-profit commerce sites and non-profit information sites need to make their functionality, content, and interface more relevant, useful and user friendly for those currently not making use of them. How do different people make use of different types of functionalities and what makes a Web site meaningful and relevant? What makes Web site content and structure more relevant and usable for marginalized demographic segments? In addition to the diffusion of innovation theory building work mentioned earlier, the development of adoption models for recreational home equipment would be interesting. Further, the model of the adoption of technology in the home (MATH) could be supplemented with models of the adoption of specific types of applications.

Although the Payton [2003] study only examined the views of a limited number of students, the insights may be useful in understanding the factors that contribute to the existence of the digital divide within certain minority populations. The limited online payment options may be another factor that contributes to the digital divide that warrants further study. Development of non-credit-card payment mechanisms such as PayPal may be an important tool in increasing online shopping activity to bridge the e-commerce

divide. What mechanisms or new technologies can be used to bridge the divide? What are the limitations of these solutions? In terms of the technical design itself, much more research needs to be done on the role of technical design in getting non-users to feel comfortable with the technology.

> **RECOMMENDATION 4:** Researchers should examine the motivations, required incentives, and implications of businesses helping bridge the divide.

One of the biggest questions that needs to be addressed is the implications on usage of having broadband versus a dial-up connection. What other technical solutions could be used to bypass traditional modes of access? What other technical solutions could be employed to make use of various functionalities? How socially and economically realistic are these solutions?

How does broadband plus other applications and/or technical tools make up a "system" that results in superior usage? How do users adopt entire systems of related components? For example, to what extent does the digital music experience depend on having broadband, plus possession of a digital music player, surfing skills to navigate the online music store, and online payment mechanisms to easily make frequent purchases? Can these innovations be adopted one at a time, or must they be adopted all at once? Similarly, does the online video gaming experience require broadband, plus an expensive game box, purchased software, and subscription to a gaming service? In a commerce context, does frequent use of online commerce sites require broadband (for frequent image downloads), plus surfing skills to navigate the online store, and payment mechanisms?

> **RECOMMENDATION 5:** Researchers should examine the use of new technical design solutions to help bridge the digital divide and facilitate e-commerce.

The analysis by Littlejohn et al. [2005] regarding the procurement of drugs via the Internet is interesting in that it proposes a negative impact of bridging the digital divide. Little formal research has been conducted on the potential negative effects of bridging the digital divide which could provide policy makers with a better view of the incentives needed to encourage online businesses and other commercial enterprises to develop relevant Web sites or new payment mechanisms. As found by Riggins [2004], in some

cases for-profit businesses may have an incentive to not have the divide be bridged. Prior empirical research has not examined this issue that may pose contradicting objectives for commercial enterprises and government policy makers. What potential negative consequences are there for bridging the divide at the individual level? Are there some stakeholders that may have an incentive to not have the divide bridged? What are the policy reasons to subsidize or not subsidize access? Who would subsidize?

In terms of participation in e-government, what would be the impact of having online voting? Would that promote more participation by those currently not involved in the process (making it easier to cast your vote) or would it be harder to participate (may not have access)? What would be the nature of the change in participation? How would the political process be altered?

> **RECOMMENDATION 6:** Researchers should examine any potential negative side-effects of bridging the divide.

As can be seen, the digital divide at the individual level of analysis offers IS researchers and related social scientists many opportunities for investigation. However, there are two other levels of the digital divide that should be of interest to businesses and management researchers. We now turn our attention to the second level of the digital divide which occurs when organizations differ in their adoption and/or use of ICT.

4. THE DIGITAL DIVIDE AT THE ORGANIZATIONAL LEVEL

4.1 Antecedents of Research at the Organizational Level

The digital divide is most commonly discussed in the context of the types of individuals or households that lack access to ICT. In particular, the public policy debate has largely focused on increasing the welfare of individuals in certain demographic categories. However, some work has been done that shows considerable variation in the way *organizations* adopt and use ICT. While not as visible from a public policy perspective, this dimension of the divide is of concern in developing a robust, competitive and stable economy, and is particularly important for firms seeking to develop an IT-competent set of trading partners. Further, significant variations in ICT investment among firms can be a social problem if they cause small businesses, or those led by technically-unaware managers, to be at a considerable competitive disadvantage

relative to their trading partners or competitors. For example, a decrease in the competitiveness of minority-owned businesses might lead to less diversity in the business community. Also, systematic variation in organizational access to ICT by geographic location might cause certain regions of the country to lag behind economically. Given our discussion in the previous section, if we are to create information-based resources that provide content and goods relevant to a wide user base, then diversity in the online business community ought to be an important objective.

4.2 Overview of Research on the Organizational Digital Divide

In this portion of the paper, we will investigate the variation in organizational ICT adoption and usage along three dimensions: the role of firm size, importance of promotion by the owner or manager, and the importance of geographic location. Referring to our conceptual framework, this research is relatively less informed by sociology, public policy and technical design perspectives, and instead uses diffusion of innovations and economics as the primary theoretical lens. Further, while there is some research using measurement and case study methods, the primary research methodology at the organizational level is the use of surveys to understand organization adoption, along with econometrics and analytical models to develop economic theory of ICT adoption and usage. This research is summarized in Table 2. Similar to Table 1, for each study we identify the scope of the analysis (years and the subjects examined), along with the methodology, and key findings.

Small firms have typically lagged behind larger firms in the adoption of ICT. During the mainframe era of computing, small firms had virtually no opportunity to make use of computing technology, except through the use of service bureaus, which was expensive. In a study aimed specifically at small businesses, Cheney [1983] conducted structured interviews via a questionnaire to 30 firms to measure and understand the difficulties they had in implementing their first computer system. The results indicate that implementation problems were based on poor software design, hardware problems, and difficulties in the implementation process — problems that would be accentuated for smaller businesses with limited resources.

Table 2. Summary of Research on the Digital Divide at the Organizational Level

Topics/ Papers	Scope		Methodology	Key Findings
	Years	Subjects		
Role of Firm Size				
Cheney [1983]	Early 1980s	30 small firms that recently implement-ed their first system	Structured interviews	First systems implementation suffered from hardware and software problems.
Farhoomand and Hrycyk [1985]	1984	Small firms	Questionnaire	Difficulties in adopting PCs included technical expertise, conversion problems, and training users.
Cragg and King [1993]	1988	Six small manufacturing firms	Case study	Difficulties in adopting ICT included limited financial resources, technical expertise, and training users.
Iacovou et al. [1995]	1993	Seven small companies implementing EDI	Case study	Factors that influence adoption of IOSs by small firms: external pressure, organizational readiness, perceived benefits.
Riggins et al. [1994]	N/A	Buyers initiating IOSs with trading partners	Analytical modeling	Buyers may subsidize supplier adoption, but asymmetric information results in the initiator not getting its first-best value from the IOS.
Riggins and Mukhopadhyay [1994]	1993	Buyers initiating IOSs with trading partners	Case study and survey of suppliers	Suppliers' IOS implementations impact value buyers' gain. Buyers may need to subsidize both adoption and use.
Promotion by Top Management				
Leonard-Barton and Deschamps [1988]	1986	93 salespeople of a computer manufacturer	Telephone survey	Certain types of employees require higher managerial involvement if they are to adopt and use ICT.
Jarvenpaa and Ives [1991]	1988	Top managers from 57 companies	Mailed survey	CEO involvement more important than CEO participation in organizational IT adoption.
Purvis et al. [2001]	2000	176 managers implementing and promoting CASE tools	Mailed questionnaire survey	Top management must champion technology within existing knowledge structures and work processes.
Sharma and Yetton [2003]	1975 - 1995	Organizations implementing various systems	Meta-analysis of 22 prior studies	Managerial support is especially critical for new systems that involve many users and many interactions.
Geographic Location				
Azari and Pick [2005]	1997, 2001	164 U.S. counties	Cross-sectional study	Technical sophistication influenced by size of professional and services workforce, household income, federal grants, education, and demographic ethnicity.
Forman, et al. [2003a; 2003b; 2004; 2005a; 2005b]	1998 - 2000	Firm-level data of Internet adoption and use	Cross-sectional study	When controlling for industry affiliation, rural companies make better use of the Internet for basic functions, but urban-based companies make better use of more advanced features.

Toward the end of the decade, small businesses found PCs more affordable and user-friendly, leading to increased adoption. With respect to PC adoption, Farhoomand and Hrycyk [1985] note that during the 1980s the price of computing power declined dramatically with the introduction of the PC. However, many small firms still found investment in PC technology problematic due to the cost and lack of internal technical expertise. They conducted a questionnaire study of 69 computer users to measure the growing investment in PCs during the mid-1980s. The study found that the three most common problems with implementing the technology were lack of technical assistance, conversion problems, and difficulty in training internal personnel. The large failure rate of IT projects is problematic for all organizations, however it is more so for small firms that do not have the resources to absorb the costs associated with technology project failures.

Using the case study method, Cragg and King [1993] investigated the diffusion and use of ICT in six small manufacturing firms. They found that inadequate resources and limited expertise and education by internal personnel were the main factors inhibiting adoption of ICT. However, they found that improved enthusiasm for the technology by the company owner was a positive factor for these companies.

Another related research direction is work that examines the adoption of ICT by firms vis-à-vis actions taken by their trading partners. Taking the special case of electronic data interchange (EDI), Iacovou et al. [1995] use the case study method to investigate the adoption pattern of EDI by small companies. They highlight three factors that impact the ability of small firms to invest in this inter-organizational ICT. First, small firms often adopt these technologies because of *external pressure* by larger trading partners. The other two factors limit the ability of small firms to invest in and use new IT: *organizational readiness*, which can be hampered by lower levels of prior IT experience and lack of resources; and lower *perceived benefits* from new IT since smaller firms are less likely to fully integrate EDI-type networking technologies into their internal systems. This research highlights the importance of competitive market pressure in bridging the digital divide at the organizational level.

In a related work, Riggins et al. [1994] develop an analytical model where buyers implement inter-organizational systems with their suppliers. They show that due to

negative externalities on the part of suppliers and the potential for future subsidies from the buyer, the buyer may need to subsidize network growth which may prohibit the buyer-initiator from achieving its first-best value from the technology. In a follow-up study, Riggins and Mukhopadhyay [1994] use the case study method and surveys to show that the way trading partners internally implement these systems impacts the other firm's benefits – an indication of the second order effect at the organizational level.

There has been considerable work done on the role of top management in championing implementation and usage of ICT [Kwon and Zmud, 1987]. Leonard-Barton and Deschamps [1988] examined the role of top management in encouraging organizational adoption of a new innovation and found that employees who had low personal innovativeness, who viewed computerized tasks as less important, had low task-related skills, or who were low performers in their jobs viewed the role of management as high in terms of encouraging adoption. Therefore, organizations characterized by this scenario will require particularly high management support and involvement if the firm is to become IT-intensive. In another early study, Jarvenpaa and Ives [1991] found CEO involvement to be highly associated with the firm becoming IT-intensive. Here, CEO involvement is influenced by their participation in the process, the organizational setting, and the CEO's functional background.

Purvis et al. [2001] investigate the role of *management championship*, which is the degree to which the organization's top management advocates the use of the technology. Specifically, management championship includes mandates, subsidies, and incentives to encourage adoption and use, and symbols that are used to signal commitment to the new innovation. They find that managers should focus on evolving existing and embedded work processes associated with the technology, rather than simply promoting the technology itself, if they are to encourage widespread use within the organization. In another recent study, Sharma and Yetton [2003] develop a contingency model where managerial influence is moderated by the degree of task interdependency to which the system is applied. Specifically, in situations where tasks involve many different users and interactions, management influence is more important than in low dependency situations.

Just as the location of individuals can influence their access to ICT, so too will the location of organizations affect their technology adoption and use. Some locations have better ICT infrastructure or a critical mass of other high-tech companies, thereby attracting other technologically sophisticated companies. Azari and Pick [2005] develop a conceptual framework of social and economic factors that influence the technological level of a given county in the United States. In this study, technological sophistication is measured for three sectors: information systems and data processing, telecommunications and broadcasting, and motion picture/sound recording. Using data from 164 counties across the U.S., they develop an econometric model to show that several factors correlate closely with the level of technological sophistication of a given county, including: size of the workforce involved with professional, scientific, or technical services, size of the workforce for other services, household income, total value of federal grant funds received, average level of college education, and ethnicity. However, only the size of the workforce involved in professional, scientific, or technical services and household income are significantly associated with information systems and data processing sophistication. These findings lead the authors to conclude that technological development within a given county region within the U.S. requires an underlying base of personnel capable of building, using, and maintaining the technology environment. Based on these correlations, the authors suggest several policy steps that local, state and national governments can take to overcome the divide.

Forman et al. [2003a; 2003b; 2004; 2005a] conducted several studies that evaluate organizational IT adoption patterns as they relate to geographical location. In Forman et al. [2004], the authors propose two different perspectives on the relationship between the location of businesses and their reasons for adopting the Internet for business activities. The first perspective, *global village theory*, suggests that the Internet is making location less important. Therefore, we should expect to see significant adoption of the Internet by rural and remote businesses that seek to use the technology to level the playing field against competing firms located in more urban areas which have traditionally benefited from more useful infrastructure services. On the other hand, *urban leadership theory* suggests that firms can make better use of the Internet when they are located in more urban locations, where they have closer access to peripheral ICT services needed to make

full use of the technology. In that case, we would expect to see businesses located in urban and metropolitan areas leading the way in Internet adoption for business purposes.

4.3 Future Research Directions

We have highlighted the importance of top management support in implementing new systems in organizations. One important area of study regarding the organizational digital divide would be to examine the use of IT in organizations with minorities in ownership or prominent management. In light of the discussion in the previous section, researchers should investigate whether firms managed or owned by minority populations are at a disadvantage in terms of IT adoption and usage. In such a context, public policy makers should consider providing additional incentives and aid to minority owned or managed organizations to ensure equity in the marketplace. A report of minority business enterprises in the Los Angeles area notes that African-American-owned firms use cutting edge technology at a greater rate than other racial groups including whites [Merrill Lynch, 2002]. An interesting research question is: How does ICT usage in minority owned businesses (organizational level) impact the digital divide in the lives of their employees (individual level)?

Research that examines the interactions between the individual and organizational levels of the digital divide can take a variety of forms. For example, firms that have a technically sophisticated workforce will be more likely to be more accepting of new technology. Conversely, firms that employ personnel who are not adept at ICT will face resistance to new technology and difficulty finding internal IT expertise. More research is needed to investigate the role of a technically literate workforce and the adoption of ICT by the organization. As systems become more user-friendly, this problem should decline. What are the implications of better systems on overall social welfare value? If value is dissipated throughout society, does the creator of these user-friendly systems have adequate incentives to develop them in a socially optimal way?

> **RECOMMENDATION 7:** Researchers should examine how individual (i.e., owner, manager, or employee) characteristics result in the digital divide at the organizational level.

Other important questions include the need for new ways to measure the extent of the digital divide at the organizational level. What is the current level of access to ICT and what factors inhibit access? Looking back at the previous section, we might ask what potential negative consequences are there for bridging the divide at the organizational level? Under what competitive circumstances will some players in the market have an incentive to not have the divide bridged? Further, since ICT use will impact a firm's competitive position and cost structure, there are implications on price which then can be translated into public policy implications for tax revenue. How does ICT influence the competitive potential in an industry? What are the resulting public policy implications?

Organizations that operate in certain locations where individuals are more technically sophisticated will be more likely to be advanced in their usage of advanced ICT. Similarly, firms that promote computer literacy to their employees will contribute to a given area being more technically advanced. This symbiotic relationship is the essence of many technically advanced regions. Further research is needed to understand the drivers that contribute to technology growth in certain high-tech regions. What local public policy initiatives best drive technology growth in an area? How does the individual digital divide contribute to the lack of technical growth in the region? Also, how might location influence an organization's decision to outsource ICT development and management?

> **RECOMMENDATION 8:** Researchers should examine how public policy makers might best respond to the organizational digital divide, if at all.

The role of top management in championing IT solutions increases in highly-complex, task-dependent situations. This implies that the role of top management increases in highly-complex competitive environments. As global competition increases and the complexities of bringing new products to market faster involve more and more alliances with trading partners, we can hypothesize that the role of top management in successful IT implementation will increase, especially in certain complex industries. This is an area ripe for future research comparing different industry scenarios.

The case study approach used by Iacovou et al. [1995] and the analytical modeling by Riggins et al. [1994] are examples of work that examines the role of large buyers putting pressure on their trading partners to adopt certain network technologies

such as EDI. This work is a start. But further modeling and empirical work are needed to fully understand the role of subsidies and mandates in encouraging trading partner adoption, particularly by small companies hesitant to adopt. This preliminary work stimulates several important research questions. What are the social welfare implications of increased adoption by smaller firms when larger trading partners subsidize or mandate adoption of networking technologies? To what extent are smaller organizations at a competitive disadvantage in these situations where network externalities play an important role? How do these theories of interorganizational system deployment vary with different technologies? What technical design features are important in determining differences in system deployment?

Another important question to ask in this context is, to what extent are organizations that lag behind necessarily at a disadvantage? Carr [2003] has asserted that IT doesn't matter. His argument is that that being a leading innovator is problematic, since the technology has become ubiquitous. He recommends that firms should be followers in ICT adoption. To what extent do firms actually gain advantage with early adoption? What impact will the digital divide at the organizational level have on economic stratification and corporate strategy within and between countries? How quickly can lagging firms catch up with early adopters? In a competitive context, what are the implications of the digital divide at the organizational level for online commerce?

> **RECOMMENDATION 9:** Researchers should examine how the competitive environment and trading partner involvement impact the organizational digital divide.

Finally, how does the digital divide at the organizational level affect corporations that operate across national boundaries? And, how does it impact those that engage in offshore outsourcing of IT services? These last points regarding the firm's global position leads us to the third and final level of analysis in the impact of the digital divide at the global level. Since multinational firms are a major source of technology transfer, how firms that operate in multiple countries adopt technology should have a bearing on the adoption rate of different countries as a whole.

5. THE DIGITAL DIVIDE AT THE GLOBAL LEVEL

5.1 Antecedents of Research at the Global Level

Social scientists and policy makers have long been interested in the drivers of comparative development and growth across countries. Indeed, some of this research has gone back to the colonial origins of the impact of institutions on income per capita [Acemoglu et al., 2001]. Barro [1991] examined the impact of human capital stock on future growth, while De Long and Summers [1991] study the association between machinery and equipment investment and GDP growth in a cross section of countries. Acemoglu [2003] examines the role of skill-biased technical change as a driver of output and wage inequalities among countries in general, and between continental Europe and the United States in particular.

Of more immediate relevance are studies that examine the impact of ICT on country output and growth. Jorgenson and Stiroh [1999], as well as the earlier work of Dewan and Min [1997], document evidence that the sharp declines in the price of ICT is leading to a substitution of ICT for other labor and capital factors of production, generating substantial economic returns for the producers and users of ICT. A broader impact of the IT revolution on the stock market is studied by Hobijn and Jovanovic [2001], providing intriguing evidence that the sharp decline in stock prices in the 1970s was in part driven by "new capital destroying old capital." Investors devalued the market capitalization of "old capital" in anticipation of the inevitable shift in future investments toward the newer information technologies.

Dewan and Kraemer [2000] conduct an analysis of the aggregate impact of ICT investments on national output of developed and developing countries. Estimating a cross-country production function, they find that the two groups of countries differ sharply in terms of the structure of returns on capital investments. ICT capital investments are associated with higher output in developed countries, but non-ICT capital investments are not associated with higher output at the margin. The situation is exactly the reverse for developing countries, where ICT capital investments are not productive, but non-ICT capital investments generate a healthy positive return at the margin. They conclude that developing countries should first concentrate on building out their stocks of ordinary capital investment, before ramping up their investments in ICT capital. That is,

ordinary capital investments are a necessary prerequisite for the productivity of ICT capital investments. The differing emphases in capital investments across the two groups of countries might explain in part the reason for the global divide in ICT adoption. At the same time, some developing countries might be reaching the end of the build out of physical capital, so that investments and returns might be shifting to ICT-related capital investments. Hence the research interest in the global digital divide, and its future evolution, as we summarize in the following section.

5.2 Overview of Research on the Global Digital Divide

There is considerable research on the global digital divide, as summarized in Table 3. For each study, the table highlights the scope of the analysis (years and countries covered by the data), along with the dependent variable, and key findings. The typical study seeks to explain ICT penetration (e.g., Internet users per capita) based on a variety of socio-economic and policy variables, such as national income (i.e., GDP per capita), ICT infrastructure, human capital (e.g., years of schooling), structure of the economy (e.g., importance of trade), etc. In what follows, we describe the main findings of this stream of research, starting with studies that examine computer or ICT penetration in general, followed by studies that specifically examine Internet penetration, and finally studies that look at multiple technologies, including computers, Internet and digital wireless technologies.

5.2.1 Research on ICT Penetration

We start with Caselli and Coleman [2001], who study patterns in the adoption of computer technology using data based on computer imports per worker from 89 developed and developing countries over the 1970 to 1990 timeframe. They find that computer adoption is most strongly (and positively) associated with human capital and the importance of trade with the OECD. Other significant predictors of computer adoption are property rights protection, capital investment per worker, and share of manufacturing versus agriculture in the economy. Interestingly, after controlling for the afore-mentioned variables, English-language speaking skills of the population are not important. The importance of human capital, and the negative role of agriculture share in

Table 3. Summary of Research on the Digital Divide at the Global Level

Topics/ Papers	Scope		Dependent Variable(s)	Key Findings
	Years	Countries		
ICT Penetration				
Caselli and Coleman [2001]	1970 to 1990	89 developed and developing countries	Computer imports to worker ratio	Human capital, trading with OECD, property rights, and manufacturing share of the economy are significant determinants of PC adoption.
Pohjola [2003]	1993 to 2000	49 countries	ICT investment per capita	Income and human capital increase ICT penetration, while agriculture's importance is negatively related.
Wong [2002]	1985 to 1998	11 Asian countries	ICT penetration per capita	Asian countries have below average ICT adoption. Inside Asia, there is a divide between the five most advanced economies and their developing counterparts.
Quibria et al. [2003]	1999 to 2000	Asian countries	ICT per capita penetration	Income, education and infrastructure are key determinants of ICT penetration.
Venkatesh and Shih [2005]	2001 to 2002	U.S., Sweden, and India	Rate of Use and Variety of Use	No one diffusion theory accounts for the differences and similarities across the three countries.
Internet Penetration				
Hargittai [1999]	1998	OECD countries	Internet hosts per capita	Wealth and telecommunications policy are the most important predictors of Internet penetration.
Dasgupta et al. [2001]	1990 to 1997	44 countries, developed and developing	Internet to mainline ratio (intensity), and per capita Internet users (connectivity)	Urban population and competition policy drive Internet intensity. No gap in Internet *intensity* between developed and developing countries, but a significant gap in Internet *connectivity.*
Kiiski and Pohjola [2002]	1995 to 2000	23 OECD and 37 developing countries	Internet hosts per 1000 inhabitants	Growth of Internet penetration is influenced by income, telephone access cost, and schooling.
Wallsten [2003]	2001	45 developing countries	Internet users and Internet hosts	Internet penetration related to measures of regulatory regime characteristics, such as agency independence, transparency, and price regulation.
Chinn and Fairlie [2004]	1999 to 2001	161 developed and developing countries	PC and Internet per capita penetration	The digital divide is mainly explained by income differentials; differences in telecom infrastructure and regulatory quality are also important.
Dewan et al. [2005] and Ganley et al. [2005]	1985 to 2001	22 developed and 18 developing countries	Penetration of mainframes, PCs and Internet	Positive association between income and penetration, stronger at higher levels of penetration. Significant co-diffusive effects between focal ITs, stronger in developing relative to developed.
Digital Wireless				
Kauffman and Techatassanasoon torn [2005a; 2005b]	1992 to 1999	46 developed and developing countries	Diffusion rates and states for digital wireless technologies	Different diffusion drivers are important in early and later diffusion states; Multiple standards and high-er prices slow the rate of diffusion.
Kauffman and Techatassanasoon torn [2005c]	1992 to 2002	43 developed and developing countries	Penetration of digital wireless technologies	Gaps in penetration across regions, but divide will narrow over time; Telecom infrastructure, standards and level of competition are key drivers of penetration; significant regional contagion effects.

the economy, was also found in the analysis of Pohjola [2003], who looked more broadly at general ICT investment per capita in a sample of 49 countries over the 1993 to 2000 time frame. Also important are income (GDP per capita) and the price of computing faced by the country.

Other research has a more regional focus. For example, Wong [2002] and Quibria et al. [2003] look specifically at ICT adoption by Asian countries. Wong [2002] examines ICT adoption in 11 Asian developed and developing economies over 1985 to 1998. A notable finding is that Asian countries as a group exhibit lower levels of ICT adoption than what would be predicted based on their level of development. Further, there is a significant divide between the advanced Asian countries and their less advanced neighbors. Quibria et al. [2003] also focus on Asian countries, and examine cross-country determinants of ICT adoption over the 1999 to 2000 period. They also find a divide between the more and less developed Asian countries, driven by differences in income, education, and infrastructure.

In an interesting study that would span our global and individual level of analyses, as well as the first and second order digital divides, Venkatesh and Shih [2005] conduct a comparative study of ICT adoption by *households* in U.S., Sweden and India. The research is designed to examine the relative efficacy of four different diffusion theories — evolutionary, leapfrogging, structural, and agentic (see Rogers [1995]) — in explaining the diffusion of computers and Internet in households of the three countries in consideration. The results suggest that no single diffusion theory fully accounts for the similarities and differences across the three countries. The results suggest that while there are cultural differences in the adoption and use of ICT, the determinants of integration of the technology in the households is similar across the countries. The research design employed in this work can be extended to the study of other technologies for the home, such as smart appliances and networked home entertainment systems.

5.2.2 Research on Internet Penetration

A substantial branch of the literature on the global digital divide has examined the diffusion of the Internet. One of the earliest such studies is Hargittai [1999], which studies cross-sectional determinants of Internet hosts per capita in OECD countries in

1998. In addition to economic wealth (GDP per capita), she reports that telecommunications policy is an important predictor of Internet penetration. Specifically, telecommunications industry structure (monopoly versus competition), pricing, and phone density have varying degrees of significance in explaining Internet penetration.

Dasgupta et al. [2001] also study Internet penetration in a total of 44 countries, including both developed countries (OECD countries, along with Korea, Singapore and UAE) and developing countries (from Asia, Eastern Europe and Latin America), over the period 1990 to 1997.[5] Urban population and competition policy are important determinants of Internet intensity, which is defined as the ratio of Internet subscriptions to telephone mainlines. Surprisingly, they find no gap between developed and developing countries in terms of Internet intensity. In other words, among those with telephone access, the proportion subscribing to the Internet is not different in developing countries as compared to developed countries. However, there is an absolute gap in Internet connectivity, defined as the number of Internet users per capita. This suggests that available and affordable telecommunications access is a key prerequisite for Internet penetration. A technical point is that how the digital divide is measured can have a strong influence on what conclusions are drawn.

Kiiski and Pohjola [2002] examine Internet penetration in 23 OECD and 37 developing countries, over the period 1995 to 2000. Using a Gompertz model of technology diffusion, they find that GDP per capita and Internet access cost are the biggest drivers of Internet host penetration. Education is significant for developing countries, but not for developed countries. Wallsten [2003] makes the interesting point that regulations of Internet use in developing countries themselves have important implications for Internet penetration in those countries. Analyzing data from a survey of telecommunications regulators in 45 developing countries, Wallsten [2003] finds that increased regulation of Internet service provider (ISP) entry results in reduced Internet users and hosts, while heavier pricing regulations generally result in higher Internet access prices.

Some of the most recent research has examined the penetration of multiple information and communication technologies. For example, Chinn and Fairlie [2004]

[5] They do not provide a detailed breakdown of countries in each of the categories.

study the penetration of both PC and Internet users in 161 developed and developing countries over the period 1999 to 2001.[6] They find that the digital divide is mainly explained by differences in income, telecommunication infrastructure and regulatory quality.

Using a more comprehensive research design, Dewan et al. [2005] examine penetration of three distinct generations of IT — mainframes, PCs and Internet — based on data from 40 developed and developing countries over the period 1985 to 2001. Using a combination of least squares and quantile regression (new to this literature), they document evidence that GDP is not only positively associated with ICT penetration, but it tends to increase the digital divide at the margin. Proportion of trade and schooling (a measure of human capital) are positively associated with ICT penetration, but these factors tend to narrow the divide at the margin.

In a related study, for the same countries and data period, Ganley et al. [2005] study the implications of the co-diffusion of successive information technologies for the global digital divide. They find significant co-diffusive effects across the ICT generations. Most notably, there are strong interactions between the diffusion of PCs and Internet, and these PC/Internet co-diffusive effects are stronger for developing countries as compared to developed ones. These complementary co-diffusive effects will contribute to the narrowing of the digital divide over time and across successive generations of ICT.

5.2.3 Research on Digital Wireless Penetration

Extending the discussion to a new and emerging technology, Kauffman and Techatassanasoontorn [2005a; 2005b; 2005c] examine the diffusion of digital wireless phone technologies. The latest of these papers appears in this issue, and will be discussed in the concluding section. The other two papers in the series examine the impact of country characteristics on the rate of growth in penetration of digital wireless technologies, based on data from 46 developed and developing countries, over the period 1992 to 1999. Using a variety of sophisticated diffusion models (coupled-hazard survival

[6] The countries are categorized into regions East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, South Asia, and Sub-Saharan Africa. A detailed breakdown of the number of countries in each category is not reported.

models, and state-based diffusion models), the results suggest that GNP and advanced telecommunications infrastructure are positively associated with penetration, while an increase in the number of phone standards and service prices tends to retard adoption. The effects of the factors is different in developed versus developing countries, and vary with the stages of diffusion.

5.3 Future Research Directions

The research on the global digital divide has generated much insight into the drivers of the gaps in technology access between developed and developing countries. However, the research to date is for the most part restricted to analyses of *technology adoption*. Understanding the determinants of technology access and adoption is clearly important, but that is just the first step: it is perhaps time to start examining second order effects of the *use* of technology, as this has a direct bearing on the value that can be derived from technology adoption. As most countries achieve measurable levels of ICT and Internet penetration, or will do so in the near future, variation in technology value will be driven more by *use* than mere *adoption*. Indeed, a promising area of further research is the development of empirical measures of ICT impact in different countries that captures not only ICT penetration levels, but the heterogeneity of ICT uses in the countries as well. (See Kauffman and Kumar [2005] for an interesting discussion of this.)

One aspect of the use of technology that would be of great interest would be the complementarity between skills and the newer technologies. As demonstrated by Acemoglu [1998], among others, the strength of association between specialized skills embodied in human capital and newer technologies is of paramount importance in explaining growth and dispersion in labor productivity and wage rates. Countries that create the conditions (through their policies and investments) for tapping into this complementarity would be better positioned to exploit the newer technologies than ones that do not create the right environment. In other words, it is an open research question whether, and under what conditions, the first-order digital divide in technology *adoption* might give way to a second-order digital divide in technology *use* and impact. Such research might parallel the analyses at the individual level of the determinants and

impacts of Web skills, as opposed to Web access (see the article by Hargittai 2006 in a future special issue of the journal).

> **RECOMMENDATION 10:** Researchers should examine the second order digital divide at the global level, and investigate what complementary policies and investments are required for the productive use of ICT.

The policy implications of the digital divide at the global level have not been sufficiently studied. To the extent that there are obvious network effects associated with larger penetration of ICT, there is a role for government policy and regulation. For an example of network effects, consider the growing prevalence of e-government, whereby citizens and companies have access to a whole host of services via the Web (e.g., permits, licenses, tax payments, etc.). As long as most citizens do not have access to the Web, local, city, state and federal governments cannot fully exploit the interactive capabilities of the Web, and must maintain multiple physical distribution channels (such as offices and paper forms), which is clearly inefficient. Policy levers for effecting more widespread adoption of computers and Internet include regulation of the IT and Internet industries, as well as their prices and products. As discussed above, restrictions on entry and ISP pricing have generally constricted penetration of the Internet and higher access prices. From a research perspective, a key question is to analyze the extent to which the governments should subsidize access and use of computers and the Internet — or leave it to market forces.

> **RECOMMENDATION 11:** Researchers should examine the policy implications of the digital divide at the global level, including the key questions of whether to subsidize access to ICT, and how best to promote the skills that are complementary to the productive use of ICT.

As cross-border trade and offshoring increase in importance, the potential network effects of technology adoption and use cut across borders and even continents. This phenomenon raises important policy implications not just for internal governments but for external constituencies as well, such as global trading partners, technology vendors, and aid organizations. For example, how should multinational technology vendors price their products and services to best exploit the multi-sided network effects described above? Also, what are the implications for the formulation of tariffs and trade?

Finally, how does the digital divide at the national level affect corporations that operate across national boundaries or those that engage in offshore outsourcing of IT services?

> **RECOMMENDATION 12:** Researchers should examine the cross-border implications of the digital divide, including issues such as technology transfer, and tariffs and trade of technology products and services.

In summary, there is a variety of open research questions with respect to further understanding the digital divide at the global level. As the forces of globalization continue to gather steam, it would be interesting to see whether the same forces will serve to narrow or further widen the global digital divide.

6. CONCLUSION

In this paper, we have highlighted current and potential future work on issues related to the digital divide at three levels of analysis: the individual level, the organizational level, and the global level. In doing so, we have attempted to emphasize that the digital divide extends beyond the lack of adoption of ICT for a variety of reasons (first order effects), to include how ICT is used in different ways that put some individuals, organizations, and countries at a disadvantage (second order effects). Further, we have attempted to highlight these issues with a particular emphasis on the impact to businesses and how businesses may or may not be part of the solution of bridging the divide. For each issue, we have identified a variety of research questions to stimulate more work in this area.

While much debate on the digital divide has occurred within the realm of public policy, communications, philosophy, and even economics, there has been little discussion of this issue within the business and management domains. In August 2004, the Symposium on the Digital Divide was held at the MIS Research Center of the University of Minnesota with the theme "The Impact of the Digital Divide on Management and Policy — Determinants and Implications of Unequal Access to Information Technology." The symposium included presentations and panel discussions from over twenty researchers from a variety of fields including information technology management, marketing, strategic management, sociology, communications, and public policy. To conclude this paper, we introduce the six remaining papers in this and a future special

issue which represent refinements of the best research presented at the symposium, and which serve to illustrate the type of research we hope to spawn with this survey paper. There are two papers at the individual level (by Rensel et al. 2006 and Hargittai 2006, respectively, in a future issue), one paper at the organizational level (by Forman et al. 2005b in the current issue) and three papers at the country level (by Dewan et al., 2005 and Kauffman and Techatassanasoontorn 2005 in this issue, and Crenshaw and Robison 2006 in a future issue).

Starting with the individual-level studies, Rensel et al. [2006] examine the issue of individuals engaging in private transactions in public places. They first develop a conceptual model of the impact of physical and virtual facilitating conditions of public Internet access points on the individual user's willingness to engage in online commerce transactions. While people may be willing to access general information from public places, they reason that engaging in private transactions in public places may be quite different. They apply their model with a survey of library patrons' attitudes toward library-based Internet access. Because the public library has often been mentioned as a solution to the individual digital divide problem, if users of the Internet in such public locations are inhibited in their use, then the digital divide may be more problematic than typically expected. The results indicate that the physical and virtual factors of using the Internet in such public places do impact users' perceptions, which impact their willingness to engage in private transactions in public places. Further, these findings are moderated by differences in perceptions of the importance of privacy.

The other paper at the individual level, Hargittai [2006], is a good example of research into the second order effects associated with the digital divide. Based on the premise that productive use of the Internet requires basic Web skills, this paper focuses on the likelihood that Internet users make spelling or typographical mistakes, which can be a significant hurdle to Web use. Analyzing data obtained from an in-person field study of 100 individuals, she finds that education level is the most significant predictor of the likelihood of Web users to make mistakes, suggesting the role of social networks to, in part, remedy this problem.

Turning to the only study at the organizational level of analysis, Forman et al. [2005b] extend their previously mentioned work by using their large sample of nearly

80,000 companies across 55 industries in the U.S. from 1998 to 2000 to examine whether company location and industry type impact the adoption of advanced Internet applications by organizations. The findings indicate that location does matter, particularly when explaining the tendency to adopt Internet-based technologies that will be used within the organization versus those that will promote information transfer across company boundaries. These results are interpreted using urban leadership theory and global village theory. In addition, the analysis shows that whether a firm operates within an IT-usage-intensive industry versus an IT-producing industry impacts its tendency to adopt internal and external focused Internet applications.

Finally, the three country level studies complement each other nicely in covering a range of issues relevant to the global diffusion of ICT. Dewan et al. [2005] examine the extent of the digital divide at the country level from 1985 to 2001 to test the magnitude and changing trends of the divide across three technology eras: mainframe, PC and the Internet. Using data from 22 developed countries and 18 developing countries, this analysis tests a model to examine the impact of several factors on the divide, including economic, demographic and environmental factors. As other studies have shown, this analysis confirms that national income level is a primary driver of the adoption of IT at the national level. In addition, further analysis using quantile regression methods shows that in the more recent Internet era, mainline telephone density and economic trade activity are helping to narrow the divide as less developed countries seek to catch up to more developed countries.

In a related effort, Crenshaw and Robison [2006] use diffusion theory to empirically examine the drivers of Internet diffusion in 65 developing countries over the 1995 to 2000 time frame. The analysis emphasizes the role of similarity to (structural conduciveness) and contact with (globalization) developed countries. The results suggest that teledensity, political openness and other structural conduciveness factors, as well as such globalization factors as aid share and tourist share, are significant drivers of the distribution and growth of Internet usage.

Kauffman and Techatassanasoontorn [2005b] examine the existence and extent of the digital divide in wireless phone technologies, based on data for three technology

generations (2G, 2.5G and 3G) from 43 countries around the world.[7] They characterize technology adoption gaps in terms of differences in subscriber penetration levels and generational penetration gaps — the latter based on a novel *regional contagion theory*. The analysis reveals substantial gaps in technology adoption both across individual countries and regions of the world, however, the pattern of the divide reflects that of other ICTs, such as the Internet — that is, North America and the Pacific Rim countries are among the leaders, while countries from Africa and South Asia are at the other end of the digital spectrum. The key drivers of wireless technology diffusion are found to be telecommunication infrastructure, the number of competing standards, and competition among the providers. The effect of multiple standards is stronger in developing countries relative to developed countries, whereas the impacts of market competition and non-price competition are substantially stronger in developed countries. The analysis also finds strong regional contagion effects whereby the diffusion of the technology in a country is affected by the diffusion in neighboring countries in the region. In terms of the future digital divide in this technology, the results suggest that the substantial gaps in penetration today will narrow over time.

In closing, we note that understanding the drivers and future trends of the digital divide continues to be a rich research area for social and political scientists and business researchers alike, including the reader population of this journal. As has been noted earlier, how the digital divide is defined and measured, as well as the theoretical perspective and research methodology, all have important bearing on the study and the conclusions to be drawn. As we have pointed out earlier, we believe this area is wide open for further research in this area. We hope the papers in this and a future special issue provide good surveys of the state of knowledge on the digital divide, as well as an effective launching pad for future research in this important area.

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[7] From the regions Africa, Asia Pacific, Middle East, North America, South Asia and Western Europe.

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