

Taxonomy of Information Society Measures

Payam Hanafizadeh

Department of Industrial Management, School of Management & Accounting
Allameh Tabataba'i University

Tehran, Iran

hanafizadeh@gmail.com

Received: May 21, 2011- Accepted: July 31, 2011

Abstract -To benefit from the advantages of information society on one hand, and afraid of being left further behind of Global Society and increasing in the digital divide on the other hand, stimulating countries to become inclusive Global Information Society. These issues have led policy makers to move towards such society by identifying the objectives, goals and targets. Planning for achieving these objectives needs a real understanding of current situation that can be obtained by information society measures. There has been a proliferation of information society measures in recent years that each of them follows a certain objective. This paper elaborates and categorizes these measures that help scholars and policy makers to 1) select the measures that fitted with their objectives, 2) prevent the repetitive researches, 3) identify the defects and flaws of previous measures and correct them in their own measures, 4) use the experiences of previous measures for constructing their own ones. In this paper, e-measures are classified in three categories: Digital Divide, E-Readiness, and Core ICT Indicators. The categorization of e-readiness measures are based on definitions of e-readiness, objectives, methods and results. Also, digital divide measures are categorized based on potential factors that include cross-sector and cross-construct validation studies.

Keywords: core ICT indicators, digital divide, e-readiness, information society measures

I. INTRODUCTION

Information society has indeed become one of the major driving forces for productivity, competitiveness, collaboration, and superposition of resources on both national and international level, which brings overall prosperity for countries and regions (Popova et al, 2005). But moving towards an information society requires a great deal of effort (United Nations, 2005). Countries and individuals that wish to venture into an era where knowledge and information have themselves become commodities must be willing to exert that effort. With this in mind, the process of monitoring and evaluating progress in achieving the goals of an information society is crucial in actually realizing such a society. Without some indication of how all elements of society are adapting to the installation and application of ICTs, there can be no way of understanding whether the shift towards an information society is actually taking place, or indeed, working in positive ways.

Furthermore, there can be no understanding of future policy steps without reference to the current status of ICT implementation and application procedures. Such real information can add substance to the visions of governments and heads of state, and can also be used to inform policy makers on achievements in terms of strategies and visions related to the information society. The use of measures to monitor these objectives is critically important, particularly in the developing world, where the digital divide is a prominent political issue. However an appropriate measurement system allows for both, the monitoring of current market development and the detection of obstacles and market failures (Guislain, 2003). Also, these measures aimed at tackling the digital divide; including implementing policies to eradicate or at least minimize the deleterious impact of new technologies, have the potential to enable less developed countries to contribute to forging a global information society (United Nations, 2005). In order for all this to happen, an understanding of where each country currently stands vis-a-vis the information

society must be achieved that is called 'e-readiness'. At the same time, the status of each country must be analyzed to encourage movement towards a future, more advanced information society that caters for the specific needs of its participants whilst at the same time working towards commonly held objectives. In this context, on the one hand, most contributions that have analyzed the phenomena have complained about the lack of adequate data and statistical information for the measurement process (Corrocher and Ordanini, 2002). On the other hand, comparable statistics on access to, and use of ICTs, are critical to formulating policies and strategies concerning ICT-enabled growth, for social inclusion and cohesion, and for monitoring and evaluating the impact of ICTs on economic and social developments (Partnership on Measuring ICT for Development, 2005). To close the ICT data gap, some international organizations proposed internationally agreed ICT indicators that called Core ICT indicators. The current paper addresses current widely diffused measurement instruments aiming to measure e-readiness, digital divide and Core ICT indicators.

The general process of the research is demonstrated in Figure 1.

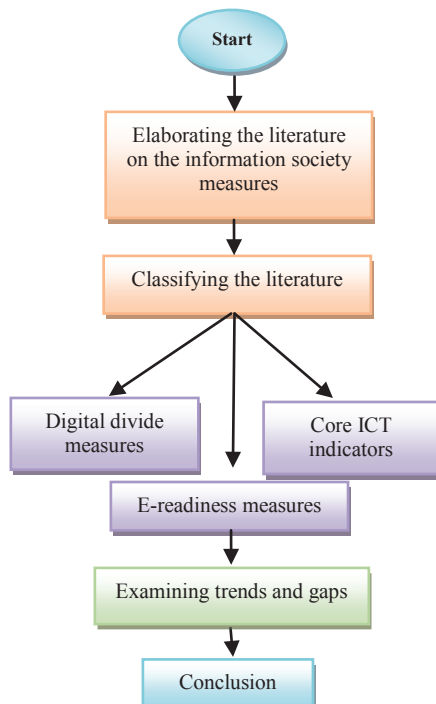


Figure 1. The general process of the research

II. RESEARCH METHODOLOGY

Due to its nature, research on the digital divide is difficult to confine to specific disciplines, and so the relevant material is scattered across various journals. Based on the frameworks of Norris (2001) and van Dijk (2003), work on the digital divide can be found in three types of journals: (1) Information technology and information systems (2) Economics and business and management and (3) Social science (see Figure 2).

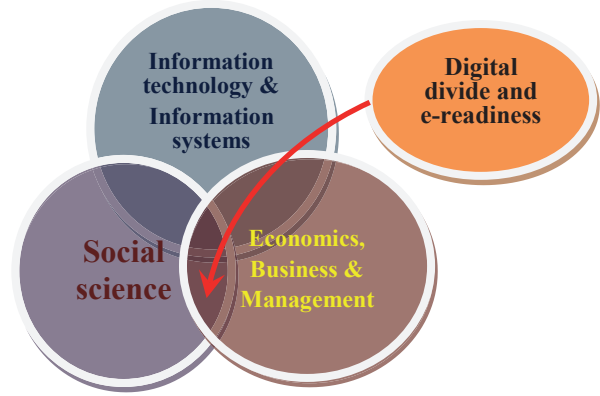


Figure 2. The digital divide in three types of journals

Consequently, the following online journal databases were searched to provide a comprehensive bibliography of the digital divide and e-readiness literature (Table 1).

Table 1. The Selected Online Databases for the Digital Divide and E-Readiness Literature

Academic Search Elite	IGI Global	Scopus
ACM Digital Library	Inderscience Publishers	Social Science Citation Index
Catch Word	Ingenta Journals	Springer Link
Compendex	Mendeley	Web of Knowledge
Emerald Full text	SAGE Publications	Web of Science
IEEE Xplore	Science Citation Index	Wiley InterScience

Regarding the research methods, the findings suggest that although a total of eight different research methods were record in the literature survey, the majority of digital divide and e-readiness research employed survey (26.2%) and data analysis methods (20.5%). The other categories of methods that were employed were case study (17.9%), content analysis (11.3%), conceptual (8.7%), mixed method (8.2%), interview (6.2%) and experimental (1.0%) (Table 2).

Table 2. Research method

Research method	Number	Percentage
Conceptual	17	8.7%
Content analysis	22	11.2%
Case study	35	17.9%
Data analysis	40	20.4%
Experimental	2	1.0%
Interview	12	6.1%
Mixed method (i.e. survey & in-depth interview)	16	8.2%
Survey	52	26.5%
Total	196	100%



The results of our investigation into the most common unit of analysis employed suggested that the majority of articles examined digital divide issues at the individual level (34.4%), follow by studies focusing on country (33.3%), household (15.4%), public sector organization (10.8%), private organization (2.6%), industry (2.1%) and small and medium enterprises (SMEs) (1.5%) (Table 3).

Table 3 Unit of analysis

Unit of analysis	Number	Percentage
Individual	68	34.7%
Household	30	15.3%
SMEs	3	1.5%
Private organization	5	2.6%
Public sector organization	21	10.7%
Industry	4	2.0%
Country	65	33.2%
Total	195	100%

III. DIGITAL DIVIDE MEASURES

As the Information Revolution has become a significant driver of the global economy, the Digital Divide – the gap in access to information technologies (IT) between developed and developing countries – is receiving increasing attention from researchers and policy makers (Dewan et al, 2004). The first scholarly papers appeared around 1997 (Vehovar et al, 2006) and were followed by a growing series of publications. Also there are several international organizations within the group of studies that have analyzed the differences in the level of digitalization and have dealt with the digital divide for a long time (Corrocher and Ordanini, 2002). Hargittai (1999) examined a dataset of OECD (The Organization for Economic Cooperation and Development) countries in 1998 and realized that, while GDP is a large driver of Internet connectivity, telecommunications policy can also have a large effect on it (Hargittai, 1999). He found that the telecommunications policy is highly correlated with the telephone density level. Similarly, Oxley and Yeung (2001) presented a study of 30 countries in the same year and found that Internet host penetration is positively associated with physical communication infrastructure, rule of law and credit card use. It is also, correlated with the telephone service costs negatively (Oxley and Yeung, 2001; Dewan et al, 2004). The United States Department of Commerce developed one of the first contributions in 2000 (Corrocher and Ordanini, 2002). This research measured the differences in access to digital technologies within the US population, business system and public administration. Using a different and new approach, Norris (2001) examined the dispersion of Internet use by grouping the information on Internet use in over 100 countries into a “New

Media Index” (Norris, 2001). Then, she compared it with an “Old Media Index” representing the distribution of radio, TV sets and newspaper readership in each nation. She found that the two Indices are highly correlated, and concluded that the basic non-technology problems of access to earlier communication technologies are also considered with respect to Internet access. Atrostic and his colleagues (2000) advocated the gathering of metrics to measure the electronic economy that align with the traditional economic production function approach. In a similar effort, IBM Corporation (2003) developed the e-readiness rankings based on some one hundred quantitative and qualitative criteria for sixty odd countries in order to establish the extent to which country-level markets are conducive to Internet-based opportunities (Kirkman, 2004). They found that economic factors, government policies, and infrastructure advantages are the major contributing factors for a high e-readiness score. Robison and Crenshaw (2001) examined the level of economic development, political openness/democracy, mass education, the presence of a sizeable tertiary/services sector as drivers of Internet diffusion (Robison and Crenshaw, 2002). They did a cross-sectional analysis for 74 countries over 1995-1999, using the number of Internet hosts per ten thousand people as their dependent variable. They found that Internet penetration is driven most significantly by development level, political freedom, and education. DiMaggio and Hargittai (2001) pointed out that there are at least five dimensions for digital inequality: equipment, autonomy of use, skill, social support, and the purpose of using the Internet. Similarly, Mossberger, Tolbert, and Stansbury (2003) distinguished between an access divide, a skills divide, an economic opportunity divide, and a democratic divide. Using a diffusion model, Kiiski and Pohjola (2001) examined data from 60 countries over the years 1995-2000. They used a Gompertz model of technology diffusion, with explanatory variables of per capita income, telephone access costs and the average years of schooling, while the dependent variable was five-year growth rate of Internet hosts. They found that, contrary to education, GDP per capita and Internet access cost are important factors in OECD countries. Mosaic Group designed a framework as part of the 'Global Diffusion of the Internet (GDI) Project' (Wolcott et al, 2001). The GDI framework consists of six discrete dimensions: pervasiveness, geographic dispersion, sectoral absorption, connectivity infrastructure, organizational infrastructure, and sophistication of use. This framework provides useful information on the digital divide, as well as on the adoption and diffusion of ICTs. Dasgupta et al (2001) examined Internet use in a sample of 44 countries from 1990-1997. They used the measure of Internet hosts/telephone mainlines as the dependent variable. They conducted a log-log regression against measures of the baseline value (1990) of the ratio, the urban population, per capita income and an index of competition policy and some regional dummies. They found that the ratio is



significantly and positively related to policy and urban population percentage and negatively to the baseline value. Guillen and Suarez (2001) also studied the number of Internet hosts and the number of Internet users per capita, using a matched set of independent variables in a cross section of 141 countries in 1998/1999. They included variables related to telecommunications policy and infrastructure and also two predictable policymaking and democracy indices. They found that when the entrepreneurship variables aren't included, policy variables have an impact, but they lose their effect when the entrepreneurship variables are considered. Caselli and Coleman (2001) undertook an extensive longitudinal cross-country study of IT use, examining 89 countries from 1970-1990. They used a measure of computer imports/worker ratio as a proxy for the investment in IT and regressed a large set of explanatory variables on the measure in a cross-sectional analysis. They found that openness to imports from OECD countries, the level of educational attainment, and the index of property rights are statistically significant (Kauffman and Kumar, 2005). Arquette (2002) developed a comprehensive instrument with a sociological focus on the digital divide. After evaluating over 100 countries in a cross-section in 1999, he found that the digital divide parallels the gap in economic and human development. Wong (2002) evaluated the digital divide in Asian countries based on penetration levels of telephone main lines, PCs, and Internet use. He reported a gloomier picture of wider disparities in IT diffusion between Asian and non-Asian economies. Analyzing comparisons of the scale of IT adoption relative to national income, he found that the digital divide in Asia is wide and has the potential to become more severe. Kraemer and Dedrick (2002) compared over 40 Asian and non-Asian countries from 1995 to 2000 on similar but expanded measures, and also found a large and growing digital divide within Asian countries (Shih et al, 2003). More significantly, they found a large and growing gap between the Asian and non-Asian countries. Selhofer and Husing (2002) suggested a method for measuring the digital divide on an aggregate level by defining a digital divide index (DDI). They identified likely knowledge gaps that are associated with the digital divide and studied four socio-economic factors: gender, age, income and education. They recognized some of the flaws related to the selection and definition of disadvantaged groups as well as regarding the indicators of ICT involvement. Corrocher and Ordanini (2002) proposed a digitalization measure for digital divide (Corrocher and Ordanini, 2002). Their composite digitalization index is based on six factors, each with sub-indicators: markets, diffusion, infrastructures, human resources, competitiveness and competition. Principal component analysis was used to aggregate the indicators. This method had not been widely applied for measuring the digital divide. In this article, an application of the methodology was used within a set of ten developed countries for 2000 and 2001.

Mansell (2002) suggested that special attention with regard to the digital divide should be given to human capital development through knowledge advancement and training. He added dimension of "having adequate knowledge and skills to operate computers" to dimensions of "access" and "use of computers" for measuring the digital divide. Sciadas (2003) has presented a model in order to design a methodology for measuring the digital divide and monitoring the digital divide assessment inter and intra countries. This is one of the most precise measures for measurement and one of the embryonic efforts for preparing a stable theoretical basis for indicators (Grigorovici, 2004a).

The mentioned model includes 3 factors: infostate, infouse and infodensity. Infostate is technically obtained from aggregation of two other factors. This model contains 21 indicators and has assessed 192 countries (Sciadas, 2003). Alvarez (2003) examined Inequality between Whites and Blacks, using the years 2000 and 2002 general social survey. Results indicate surprisingly similar levels of online time, social support, navigational sophistication, and Internet knowledge. Fink and Kenny (2003) concurred that when the digital divide is measured in absolute terms, the evidence shows that it is growing. Their findings highlight the four facts that different measures of the digital divide can result in very different inferences about its nature. Jackson and her colleagues (2003) identified personal and situational factors that predicted internet use during the first year of home internet access (Cornfield and Rainie, 2003). In this survey 123 adult participated who were primarily African American, female, never married and had annual household incomes of less than \$15,000. They recognized that while both personal and situational factors influenced Internet use during the first six months, race and age influenced Internet use across the entire year. Martin (2003) analyzed the data of U.S. Department of Commerce Report using odds ratios and concluded that computer ownership and Internet use may actually be spreading less quickly among poorer households than among richer households. United Nations Conference on Trade and Development (2003) presented a framework for recognizing the current scientific and technological aspects with emphasis on their effects in developing countries (UNCTAD, 2003). This framework was used for benchmarking and analyzing the distribution of ICT capabilities among 160 to 200 countries in 1995-2000. Based on that, countries were categorized into three main groups of falling behind, keeping up and getting ahead and the digital gap between them was measured. Quibria et al (2003) examined a data set of more than 100 countries in 1999 that included the number of PCs and the number of Internet users per capita. They found that GDP, education level and infrastructure play critical roles in the levels of these and other information technologies (Quibria et al, 2003). Lenhart and Horrigan (2003) visualized online access as a continuum, using data from a 2002 national random digit dial survey. They analyzed the



social, demographic and psychological predictors of internet users and nonusers. They found that 1) internet access may be intermittent for some users, nearby for others and a remote possibility for others, 2) demographic factors are associated with more internet adoption 3) controlling for other variables, Hispanics and African-Americans are less likely to be online. Pohjola (2003) examined a data set over the years 1993-2000 that included the measures of per capita income, relative price of IT equipment, human capital measures, share of agriculture and openness to international trade. He found that IT investment is tightly related to income and human capital measures, and inversely related to the importance of agriculture in the economy. Beilock and Dimitrova (2003) examined the impact of GNP, including the log and exponential forms, the level of civil liberties, infrastructure and regional variables on internet use. It was conducted in a sample of 105 countries from a dataset published in 2000. They found that GNP is the most important determinant and that the relationship appears to be non-linear. Also the increasing civil liberties have a positive and significant impact even in the presence of infrastructure advantages. Losh (2003) tracked gender differences in the dramatic growth of digital access between 1983 and 2000. For this purpose, she used several nationally representative surveys of American adults. She pointed out that Outside of the stronger gains by the high-school educated, gender and educational gaps in IT access and use remained roughly stable. Wallsten (2003) used a 45 country data set from 2001 to conduct a cross sectional analysis of similar variables. As mentioned in the previous studies, these two dependent variables are the number of Internet users and the number of Internet hosts per capita. He focused on variables of regulatory regime characteristics and price regulation, and found that the more formal and controlled a country's regulatory system, the fewer Internet users and hosts will be. Digital Access Index was proposed by the ITU and considered the following factors for measuring the digital divide: infrastructure, affordability, knowledge, quality and usage (ITU Telecommunication Development Bureau, 2003). In this context, the ITU's efforts to combine different aspects of digital divide into one index are especially appropriate. Kennedy, Wellman and Klement (2003) used two large North American sources of national survey data to compare women's internet use with men's. Consistent with the earlier literature on gender roles, they showed that women use the internet more for social reasons, while men use it more for instrumental and solo recreational reasons. Care-giving for children at home limits mothers more than fathers in the use they make of the internet. Using a flexible accelerator investment model, Shih et al (2003) studied 39 countries from 1985-1999 (Shih et al, 2003). They found that there is a positive correlation between IT development with the existing stock levels of IT capital, GDP and education levels and a negative correlation with interest rates. Neustadtl and Robinson (2003) examined the question

of whether the divide between users and nonusers is continuing to expand or is not. They used reinterview data from the General Social Survey (GSS), in which 1538 respondents interviewed in person in 2000 were reinterviewed by telephone in the Fall of 2002, using items that most discriminated Internet respondents in 2000 (Neustadtl and Robinson, 2003). Of the 15 GSS attitude questions, only the three dealing with interpersonal trust were notably related to changes and continuity in Internet use, and of 8 behavior questions only the increases and decreases in TV viewing mirrored the changes found in the static 2000 data. Cho and his colleagues explored the relationship between internet use and gratifications gained within the context of the digital divide framework (Cho et al, 2003). Analyses within sub-samples defined by age and socio-economic status reveal that there are notable differences in uses and gratifications across subgroups. Donnermeyer and Hollifield (2003) examined the utilization of email and the Web, based on a sample of 471 residents from four rural communities in Nebraska and Wisconsin, in which the study found nearly identical levels and patterns of use across the communities. The findings are discussed in terms of the two variations on the digital divide. The first is a digital divide between rural people at the same place and the second divide is between rural communities that have growing economies and populations and those that are no growing. Chinn and Fairlie (2004) used the same two dependent variables with a panel of 161 countries over 1999-2001. They found that GDP, telephone density and regulatory quality are important determinants of PC and Internet density. Another stream of research has used approaches akin to economic growth models to study the problem at hand. Martin and Robinson (2004) replicated previous findings that the diffusion of the internet is becoming more polarized by family income in the United States (Martin and Robinson, 2004). They used multiple logistic regression and other odds-based analyses to assess internet access in the United States from 1998 to 2001. The unique divide in the U.S. is further evidenced by the lack of such static and dynamic income differences in the U.S. compared with income differences in data from 15 European nations. Hüsing and Selhofer (2004) proposed a relatively simple indicator, DIDIX, which was developed in EU member states. Based on the relative diffusion of computers and the Internet in four disadvantaged socio-demographic groups, results suggest an increasing North-South gradient of cross-national inclusion prevailing in Europe. Spennemann (2004) went over the nature of the digital divides that exist in the Pacific region, considering divides within countries, between the countries, and between the Pacific region and the rest of the world. The varied but generally high costs of Internet access are exacerbating the digital divide along socio-economic lines; but they also create regional imbalances, with certain countries effectively isolated. Haan (2004) presented the outlines of a needed multifaceted theoretical model in which Internet access is seen as



dependent on the user's 1) motivation, 2) possession, 3) digital skills and 4) use patterns. Various causes and consequences of differential IT access are being taken into account (Haan, 2004). He found out that having access to IT can be seen as only one factor that produces differences in social, cultural and economic outcomes. Kubicek (2004) presented statistical data on trends in computer and internet penetration in Germany and provided a critical review of the measures taken by the government to narrow the gaps with European Commission. According to the model of the access rainbow, these measures moved beyond improving conditions for access to supporting the development of relevant content and appropriate skills. He concluded that which skills are necessary and how they are to be acquired differs greatly for different underrepresented groups. Nurmela and Vihera (2004) examined how far and how fast Finland has advanced in its use of ICTs, which Statistics Finland has monitored with large representative surveys since 1996. The results suggest that once people have begun to use the internet (or mobile phones), their specific uses are quite similar to each other, regardless of whether the user is younger or older, employed, a student, entrepreneur or unemployed. Liang and Ning (2004) conducted a 2003 survey of 4000 adults aged 17 to 60 that examined differences by community size across 12 Chinese cities (Tien and Fu, 2008). They perceived that internet adoption in China's small cities is still in its preliminary stage and the potential of using the Internet for information seeking is far from being well developed. Thus, it is predictable that, with the popularization of internet cafe's, Internet adoption in China's smaller cities will continue to grow. The results demonstrate another way in which the internet has had unique and unanticipated democratizing effects in China. Morrone and Laura Zannella (2004) reviewed recent research on the diffusion and use of PCs and Internet in Italy, with its distinct "digital divide" in media access and usage by social and economic factors. The results showed that media usage in Italy is undergoing an important transition, especially as young people use new media that influences their socialization, leisure time, education, family life and job opportunities. Also, gender, generation, regional and other social factors affect their mixed usage of media. Linebarger, Royer and Chernin (2004) examined whether 74 very young (i.e., 4-8 year olds) children's and their parent's access to, use of, and perceptions regarding computers and the internet. It was found that while internet access varied by family socioeconomic status (SES), internet use varied by location of access to computers and the internet. Parents' attitudes about computers and the internet varied by location of access and by family SES. Barzilai-Nahon (2006) explained that two general types of indices that are used for the measurement of the digital divide(s) are monotypical indices and comprehensive indices (Barzilai-Nahon, 2006). Monotypical indices emphasize on a single-factor and are more widely available, while the comprehensive ones are rare and consider an

integrative framework. She proposed a model in which interactions among six sets of factors are used to depict the digital divide: social and governmental constraints/support, affordability, use, accessibility, infrastructure/access, and socio demographic factors. Vehovar and his colleagues (2006) similarly highlighted the limitations of current measures (Vehovar et al, 2006). They proposed three methods that can radically improve the validity of results using the first digital divide, specifically Internet usage, as an example. They showed how a multivariate loglinear modeling might correct the misleading representations resulting from bivariate analysis, as for instance in the case of urban versus rural use. While acknowledging the improvements brought by compound measures, they stressed that the picture they offer cannot be exact until intracountry variations are accounted for. Tien and Fu (2008) focusing on two dimensions of the digital divide, computer use and computer knowledge, examined the correlates of the digital divide and their impact on college student learning.

Table 4 lists potential factors for inclusion in a cross-sector and cross-construct validation study of digital divide indices. This classification is based on Barzilai-Nahon, but the number of indices is much more.

Table 4 potential factors of validation study of digital divide indices

Factor	Example studies
1. Infrastructure access	Rogers, 1995; CSPP, 1998; APEC, 2000; Hoffman et al., 2000; DiMaggio & Hargittai, 2001; KENNY, 2001; Bridges.org, 2001; OECD, 2001; Warschauer, 2002; CID, 2002; Chen & Wellman, 2003; ITU, 2003; ITU Telecommunication Development Bureau, 2003; Mossberger, Tolbert & Stansbury 2003; Sicherl, 2003; Katz et al., 2003; Husing & Selhofer, 2004; The Mosaic Group, 1996– 2004; Horrigan & Rainie, 2004; Norris, 2004; Horrigan, 2004a; Horrigan, 2004b; Wareham et al., 2004; Barzilai-Nahon, 2006; Wilson, 2006; Neustadt and Robinson, 2003; Martin and Robinson, 2004; Husing and Selhofer, 2004; Haan, 2004; Kubicek, 2004; Nurmela and Viherä, 2004; Haan and Huysmans, 2004; Linebarger et al, 2004
Communication channels and capacity	
Computers per capita	
Web sites per capita	
ISPs: governmental incumbent or private	
2. Affordability (relative to other expenditures and average income)	Ebo, 1998; Le Blanc, 2000; OECD/DSTI, 2001; Bridges.org, 2001; Gartner Group, 2001; Hargittai, 2002; Cooper, 2002; Martin, 2003; ITU, 2003; ITU Telecommunication Development Bureau, 2003; Lenhart et al., 2003; Mossberger, Tolbert & Stansbury 2003; Norris, 2004; The Mosaic Group, 1996–2004; Parayil 2005; SIBIS, 2005; Barzilai-Nahon, 2006; Spennemann, 2004; Kubicek, 2004; Haan and Huysmans, 2004
Physical layer (infrastructure)	
Logical layer (applications and software)	
Content	
3. Use	Primo Braga et al., 2000; OECD, 2001; DiMaggio & Hargittai, 2001; Gartner Group, 2001; Spooner & Rainie, 2001; Hargittai, 2002; Warschauer, 2002; Dasgupta et al., 2002; ITU, 2003; Lebo, 2003; Chen & Wellman, 2003; ITU, 2003; ITU Telecommunication Development Bureau, 2003; Crump & McLroy, 2003; Lenhart et al., 2003; Mossberger, Tolbert, & Stansbury, 2003; Robinson et al., 2003; Norris, 2004; Husing et al., 2004; Fox, 2004; Center for the Digital Future, 2004; Bridges.org, 2005b; Benkler, 2006; Wilson, 2006; Barzilai-Nahon,
Frequency	
Time online	
Purpose	
Users' skills	
Autonomy of use	



	2006; Vehovar, Sicherl, Husing & Dolnicar, 2006; Cho et al., 2003; Donnermeyer and Hollifield, 2003; Haan, 2004; Kubicek, 2004; Liang and Ning, 2004; Haan and Huysmans, 2004; Morrone and Laura Zannella, 2004; Linebarger et al., 2004
4. Social and governmental constraints/support	Welling & Kubicek, 2000; DiMaggio & Hargittai, 2001; Warschauer, 2002; Crump & McLroy, 2003; Stanley, 2003; Mossberger, Tolbert & Stansbury 2003; Chen & Wellman, 2003; Barzilai-Nahon, 2006
Training	
Active help	
Support/suppression/apathy	
Investments and funding	
5. Socio demographic factors	Tichenor et al., 1970; Silver, 1994; Rodgers et al., 1995; Novak et al., 1997; Atkinson & Hill, 1998; Hoffman et al., 1999; Hoffman et al., 2000; Attewell, 2001; Bridges.org, 2001; Cullen, 2001; DiMaggio et al., 2001; Menou, 2001; Foulger, 2001; Muffels et al., 2002; Bonfadelli, 2002; McLaren & Zappal'a, 2002; Warschauer, 2003; Kennedy et al., 2003; Martin, 2003; Donnermeyer, 2003; Lenhart et al., 2003; Cornfield & Raimie, 2003; Chen et al., 2003; The Mosaic Group, 1996-2004; Bell et al., 2004; Husing, 2004; Losh, 2004; DiMaggio et al., 2004; Parayil 2005; SIBIS, 2005; Barzilai-Nahon,2006; Vehovar, Sicherl, Husing & Dolnicar, 2006; Lenhart and Horrigan, 2003; Losh 2003; Alvarez, 2003; Haan, 2003; Cho et al., 2003; Donnermeyer and Hollifield, 2003; Martin and Robinson, 2004; Hüsing and Selhofer, 2004; Spennemann, 2004; Nurmela and Viherä, 2004; Liang and Ning, 2004; Morrone and Laura Zannella, 2004; Linebarger et al., 2004
Socioeconomic status	
Gender	
Age	
Education	
Geographic Dispersion	
Ethnic diversity	
Race diversity	
Religiosity	
Language	
6. Accessibility disabled and special needs populations)	Perry et al., 1998; Waddell, 1999; Kaye, 2000; Nurmela & Viher'a, 2000; Reddick et al., 2000; van Dijk & Hacker, 2003; Stanley, 2003; Lenhart et al., 2003; Barzilai-Nahon,2006; Luke, 2005

IV. E_READINESS MEASURES

E-readiness is a relatively new concept that has been given impetus by the rapid rate of internet penetration throughout the world, and the dramatic advances in uses of Information Technology (IT) in business and industry (Mutula and van Brakel, 2006). The E-readiness concept was originated by the intent to provide a unified framework to evaluate the breadth and depth of the digital divide between more and less developed or developing countries during the late 1990s. In recent years, a number of E-readiness measures have been developed (Grigorovici et al, 2004b). On the surface, each measure gauges how ready a society or economy is to benefit from IT and e-commerce. On closer examination, the measures use widely varying definitions for E-readiness and different methods for measurement and the assessments are very diverse in their goals, strategies and results (Bridges.org, 2005c.)

The first efforts in defining E-readiness were undertaken in 1998 by the Computer Systems Policy Project (CSPP) (Mutula and van Brakel, 2006). CSPP defined E-readiness as the degree to which a community is prepared to participate in the Networked World (CSPP, 1998; Mutula and van Brakel, 2006). Since development of the first E-

readiness definition, Centre for International Development at Harvard (2000) with the support of IBM (CID, 2000) and INSEAD, World Bank (Infodev) and World Economic Forum (WEF) (Kirkman et al, 2002) developed the same definition as CSPP. In contrast to these measures that focus on community's readiness for participating in the Networked World, Asian Pacific Economic Cooperation (APEC) in 2000 (APEC, 2000), McConnell International (MI) in 2000 (Popova, 2005) and Association of Southeast Asian Nations (ASEAN) in 2001 (ASEAN, 2001) defined E-readiness as the degree to which an economy or community is prepared to participate in the digital economy. In addition to these definitions, several E-readiness definitions have emerged through efforts of development agencies, research organizations, academies, business enterprises and individuals.

E-readiness measures in terms of different E-readiness definitions have different assessment objective. The objective of Harvard University and CSPP are determining the degree to which individuals and organizations is prepared to participate in the Networked World (Bridges.org, 2001), while the objective of WITSA (Grigorovici et al, 2004a), APEC (APEC, 2000), Choucri, Maugis, Madnick and Siegel (Choucri et al, 2003), McConnell (WITSA, 2000) and measuring the internet economy measure (Barua et al, 1999) is assessment the readiness of e-commerce and digital economy. Some others such as CIDCM, Information Society Index (ISI), Technology Achievement Index (TAI) and Digital Access Index (DAI) assesses E-readiness with objective of assessing access to and use of ICT (Minges, 2005). In addition of these measures, the objective of Crenshaw and Robison from Department of Sociology at Ohio State University (2002) (Robison and Crenshaw, 2002) and Bui, Sankaran and Sebastian (2003) (Bui, 2003) were determination of server factors in increasing a country's E-readiness.

Despite the variations in the definitions and objectives of E-readiness by different measures, they on average, measure the level of infrastructure development; connectivity; Internet access; applications and services; network speed; quality of network access; ICT policy; ICT training programs; human resources; computer literacy; and relevant content (Mutula and van Brakel, 2006).

After identifying E-readiness definition, assessment objective(s) and dimensions that should be focused on for assessment, next step is to determine the methods of assessment. As mentioned before, E-readiness measures use different methods to assess countries' E-readiness. These methods can be divided into four main categories:

- Measures that use questionnaires for asking a set of direct questions about IT and assessing policies in the country, and the same set of questions are asked for any given country. CSPP, CID, APEC, WITSA, Emperica GmbH, World Telecommunication Indicators, NRI and CIDCM use this method



(Bridges.org, 2005c; Emperica GmbH, 200h; ITU, 2003)

- Measures that use statistical methods and mathematical analysis of prior data of the country to test relationships between the individual factors. EIU, Crenshaw and Robison, Bui, Sankaran and Sebastian and Beroggi, Täube and Lévy use this method (Beroggi et al, 2005; Bridges.org, 2005c; Bui et al, 2003).
- Measures that use historical analyses of the unique political, economic and social events in the country use these unique events to explain or forecast IT in the country. Grigorovici, Schement, and Taylorl and Bui, Sankaran and Sebastian use this method (Bui et al, 2003; Grigorovici et al, 2004b).
- Measures that use best practices and experience learned in other measures. Some of these measures are as below:

On the NRI Framework, while the CID serves as a reference point, two other efforts have had an important bearing on it: The Information Age Partnership (IAP) from the United Kingdom, and the European Foundation for Quality Management (EFQM) version of the Total Quality Management (TQM) model (Kirkman, 2002). DOI follows the same methodology as DAI and Human Development Index (HDI) (ITU, 2005). SIDA studied counties using survey methodology, interviews and CID's Readiness for the Networked World guide (Bridges.org, 2005a). In UNCTAD, on the basis of earlier work, a theoretical framework has been formulated with a view to measuring ICT development (UNCTAD, 2003).

Some measures such as Mosaic and McConnell use combination of these methods for E-readiness assessment (Bridges.org, 2005c).

On the basis of the strategy and methods, measures have different results. Some measures assign to countries numerical scores depending on how well they have performed on specific components of E-readiness measures and rank them. Some of these measures are: KAM (Chen and Dahlman, 2003), NRI (Kirkman et al, 2002), EIU (EIU and IBM, 2003), IDC (IDC, 2000), DAI (ITU, 2005), TAI (UNDP, 2001), UNCTAD (UNCTAD, 2003), DOI (ITU, 2005), ORBICOM (Sciadas, 2003), McConnell (McConnell International, 2000) and Bui, Sankaran and Sebastian (Bui et al, 2003). In contrast to measures that give E-readiness rankings of countries, some others such as Mosaic (Mosaic Group, 1998), SIDA (Esselaar et al, 2001), CIDCM and CID (Choucri et al, 2003) assess E-readiness for special countries or regions.

V. CORE ICT INDICATORS

Comparable statistics on access to and use of ICTs are critical to formulating policies and strategies concerning ICT-enabled growth, for social inclusion and cohesion and for monitoring and evaluating the impact of ICTs on economic and social developments (United Nations-ESCWA, 2005). But internationally comparable information society statistics are very limited. To help overcome the existing statistical

divide, and to improve the availability, quality and comparability of statistical information to analyze the Information Society, a number of key stakeholders (including several UN agencies and regional organizations) launched the Partnership on Measuring ICT for Development and proposed core ICT indicators (ITU, 2006). These indicators have been endorsed by the international community and identified as the most important for measuring the information society (ITU, 2005).

In 2003, OECD proposed a list of core indicators for ICT measurement that was based on the gathered information and statistics by OECD (Schaaper, 2003). In more developed countries, some complementary indicators are added to this list to complete core indicators. The target society of this organization is basically all non-OECD countries, but their different phase of development is the main problem (Schaaper, 2003). At first, OECD paid attention to a set of basic indicators that figures a country's ICT readiness. These data are usually collected at national level and are available in international databases.

Recognizing the need for improved data and indicators in the Information Society, a global initiative entitled "Partnership on Measuring ICT for Development" was launched during the eleventh United Nations Conference on Trade and Development (UNCTAD XI) in Sao Paulo, Brazil, 3 - 18 June 2004 (UN, 2005). The Economic and Social Commission for Western Asia (ESCWA) and other United Nations regional commissions play a key role to enable interested stakeholders in statistical measurement of ICT to join international forces for closing the data gap, particularly in developing countries.

The United Nations regional commissions have taken several steps towards fulfilling the objectives of the Partnership. National statistics offices of ESCWA member countries adopted a core set of ICT indicators during a Roundtable on Information Society Indicators and Profiles in Western Asia (UN, 2005). They categorized indicators into 2 main groups: global indicators (26 indicators) and regional indicators (8 indicators). Global indicators usually consist of indicators of basic infrastructure and access, ICT sector, household, business and education. Regional indicators consist of indicators of household, policies/regulatory frameworks, local content and government.

In 2004, The United Nations Economic Commission for Africa (ECA) adopted a set of 62 core ICT indicators that were adapted to that region. These indicators were categorized into following dimensions: basic infrastructure and access, ICT sector, households, business, education, government, agriculture, health, supplementary indicators, ICT investment and expenditures, content issues and local languages, security issues, national information and communication infrastructure plans and legislation.

OECD based on substantive contributions from ITU, UNCTAD, UNESCO Institute for Statistics, UNECLAC, UNESCWA and Eurostat proposed core list of ICT indicators in 2005 (United Nations-



ESCWA, 2005). These indicators were the outcome of an intensive consultation process of the partnership with national statistics offices (NSOs) and were categorized into four following dimensions (United Nations-ESCWA, 2005):

ICT infrastructure and access, Access to and use of ICT by households and individuals, Use of ICT by businesses, and ICT sector and Trade in ICT goods

The principal objective of the list is to help developing countries about ICT surveys or adding ICT questions to existing collections, to produce internationally comparable data.

In 2006, UNESCO presented the core ICT indicators in E-education section (UNESCO, 2006). It was part of UIS contribution to the ongoing International Partnership for Measuring the Information Society. This paper discusses the information which is available from existing international school surveys with a view to identify the most commonly used indicators on ICT use in formal education, which will provide the most comparable data to monitor the action plan proposed at the end of the second phase of the World Summit (UNESCO, 2006). The paper identifies a set of common items in the international surveys which could be used to collect data on:

- The frequency and the nature of the use of ICTs in education. It is important that computer is fully embedded in the learning process in schools.
- The role of ICTs in teacher training. It is important that teachers are thoroughly trained in the use of technology.
- The adequacy of school resources for ICTs. Inadequate resources for technology will limit the benefits obtained.

VI. CONCLUSION

The rapid rate of ICT penetration throughout the world, coupled with dramatic advances in uses of it in business and society, is creating an extensive literature on various aspects of digital divide and e-readiness (Choucri et al, 2003). Methodologically, most assessments are based on statistical studies or questionnaires, country cases, ad hoc interviews and summary evaluations of IT-readiness for economic growth and/or for business opportunities defined in the most general terms. Also most studies provide little information on how their indices were constructed and why or how they might be adjusted to analyze particular e-Business opportunities. Traditional measurements are undertaken over the past several years, have focus mainly on infrastructural access (Barzilai-Nahon, 2006). But today the assessments have expanded to other concerns and factors that generate e-readiness and digital inequality (e.g., differential modes of use and economic development). While the traditional access-oriented thinking focused on questions related to measures such as ownership, availability, and affordability of infrastructure, now the focus is moving beyond technology to the users. Traditional literature on various aspects of readiness, electronic connectivity, and implications for economic

development has identified a large number of variables that are considered to be relevant to e-readiness and digital divide. But, the relevance to what, how and why is often obscure (Corrocher and Ordanini 2002). In this article popular studies about digital divide, e-readiness and generally information society are examined and classified. Analyzing and classifying of these studies is wealthy, since it can provide valuable inputs for researchers and top-level decision makers in the field of using or constructing e-readiness or digital divide measures.

VII. REFERENCE

- Alvarez, A.S. 2003. Behavioral and Environmental Correlates of Digital Inequality. *IT & Society* 1(5): 97-140.
- Arquette, T. J. 2002. Social Discourse, Scientific Method, and the Digital Divide: Using the Information Intelligence Quotient (IIQ) to Generate a Multi-Layered Empirical Analysis of Digital Division, Northwestern University.
- Asian Pacific Economic Corporation (APEC). 2000. *E-commerce readiness assessment guide*. Hong Kong China, <http://www.ecommerce.gov/apec> (accessed June 5, 2005).
- Association of Southeast Asian Nations (ASEAN). 2001. *e-ASEAN Readiness Assessment*, Singapore. <http://www.unpan1.un.org> (accessed August 12, 2006)
- Atkinson, A. B., and Hill, J., eds. 1998. *Exclusion, employment and opportunity*. CASE paper 4. London: Centre for the Analysis of Social Exclusion, London School of Economics.
- Atrostic, B. K., Gates, J., and Jarmin, R. 2000. Measuring the Electronic Economy: Current Status and Next Steps, Center for Economic Studies, US Census Bureau.
- Attewell, P. 2001. The first and the second digital divides. *Sociology of Education* 74: 252-259.
- Barua A., Pinnell, J., Shutter J., and Whinston, A.B. 1999. *Measuring the Internet Economy*. Center for Research in Electronic Commerce, Graduate School of Business, The University of Texas at Austin, <http://crec.bus.utexas.edu>.
- Barzilai-Nahon, K. 2006. Gaps and Bits: Conceptualizing Measurements for Digital Divide/s. *The Information Society* 22(5): 269-278.
- Beilock, R. and Dimitrova, D. 2003. An Exploratory Model of Inter-country Internet Diffusion. *Telecommunication Policy* 27 (3-4): 237-252.
- Bell, P., Reddy, P., and Rainie, L. 2004. *Rural areas and the Internet*. Washington, DC: Pew Internet & American Life Project. http://www.pewinternet.org/pdfs/PIP_Rural_Report.pdf.
- Benkler, Y. 2006. *The wealth of networks*. New Haven, CT: Yale University Press.
- Beroggi E. G., Täube, V.G., and Lévy, M. 2005. Statistical indicators for monitoring and controlling the ICT system, *International Journal of Technology. Policy and Management* 1(5): 93-120.
- Blanc, J. Le. and Anderson, R. 2000. Access and accessibility. *Communications Policy and Practice* 2(26).
- Bridges.org. 2001. *Spanning the digital divide: Understanding and tackling the issues*. Cape Town: Bridges.org. http://www.bridges.org/files/active/1/spanning_the_digital_divide.pdf (accessed 20 June 2006).
- Bridges.org. 2005a. *E-readiness assessment tools comparison* (updated). Cape Town. <http://www.bridges.org/files/active/0/> (accessed 14 June, 2007).
- Bridges.org. 2005b. *E-readiness assessment tools: who is doing what and where?* (updated). Cape Town. http://www.bridges.org/files/active/0/ereadiness_who_what_where_bridges.pdf (accessed 20 June 2006).
- Bridges.org. 2005c. *E-Ready for What? E-Readiness in Developing Countries: Current Status and Prospects toward the Millennium Development Goals* (updated). Cape Town. <http://www.bridges.org> (accessed 14 June, 2007).
- Bonfadelli, H. 2002. the Internet and knowledge gaps: A theoretical and empirical investigation. *European Journal of Communication* 17(1): 65-84.
- Bui, T. X., Sankaran, S., and Sebastian, I. M. 2003. A framework for measuring national E-readiness. *International Journal of Electronic Business* 1: 3-22.
- Caselli, F. and Coleman W. J. 2001. *Cross-Country Technology Diffusion: The Case of Computers*. Cambridge, MA, National Bureau of Economic Research.



- Center for International Development at Harvard University (CID). 2000. *Readiness for the Networked World, A Guide for Developing Countries* Cambridge, <http://www.cid.harvard.edu/ciditg> (accessed 20 June 2004).
- Chen, D. H. C., and Dahlman, C. J. 2003. *The Knowledge Economy*. Washington DC : World Bank, papers.ssrn.com.
- Chen, W., and Wellman, B. 2003. *Charting and bridging digital divides: Comparing socio-economic, gender, life stage and rural-urban Internet access and use in eight countries*. AMD Global Consumer Advisory Board (GSAB).
- Chinn, M., and Fairlie, R. 2003. *The determinants of the global digital divide: A cross-country analysis of computer and Internet penetration*. 38. Santa Cruz Center for International Economics, University of California, Santa Cruz, Working Paper.
- Cho, J., Zuniga, H. G. D., Rojas, H., and Shah, D. V. 2003. Beyond Access: The Digital Divide and Internet Uses and Gratifications. *IT & Society* 1(4): 46-72.
- Choucri, N., Maugis, V., Madnick, S., Siegel, M., Gillet, S., O'Donnel, M., et al. (2003). E-readiness for what?. Cambridge: MIT [Online]. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=535762 (Accessed August 2005).
- Cole, J. I., Suman, M., Schramm, P., Lunn, R., Aquino, J.-S., and Lebo, H. (2004). *The digital future report: Surveying the digital future, year four. Ten years, Ten trends*. Los Angeles, CA: USC Annenberg School Center for the Digital Future. <http://www.digitalcenter.org/downloads/DigitalFutureReport-Year4-2004.pdf>
- Computer Systems Policy Project (CSPP). 1998. *Community Assessment Guide*, http://www.connectedcommunities.net/assessmet_guide.htm; Self-Assessment Tool, <http://www.cspp.org/projects/readiness/23ques.htm> (Accessed 14 September 2004).
- Cooper, M. 2002. *Does the digital divide still exist? Bush administration shrugs, But evidence says "yes."* Consumer Federation of America, Consumer Union, The Civil Rights Forum, Washington DC. <http://chnm.gmu.edu/digitalhistory/links/pdf/introduction/0.26a.pdf> (accessed 20 June 2006).
- Corrocher, N. and Ordanini, A. 2002. Measuring the digital divide: a framework for the analysis of cross-country differences. *Journal of Information Technology* 17: 9-19.
- Cornfield, M., and Rainie, L. 2003. *Untuned keyboards: Online campaigners, citizens, and portals in the 2002 elections*. Institute for Politics, Democracy & the Internet. Washington DC: Pew Internet & American Life Project.
- Crump, B., and McIlroy, A. 2003. The digital divide: Why the "don't-wants-tos" wont Compute: Lessons from a New Zealand ICT Project. *First Monday* 8(12). <http://firstmonday.org/issues/> (accessed 20 June 2006).
- Cullen, R. 2001. Addressing the digital divide. *Online Information Review* 5:311-320.
- Dasgupta, S., S. Lall and D. Wheeler (2001). Policy Reform, Economic Growth, and the Digital Divide: An Econometric Analysis, Development Research Group, World Bank.
- Dasgupta, S., S. Lall and D. Wheeler (2002). Policy Reform, Economic Growth, and the Digital Divide: An Econometric Analysis, Development Research Group, World Bank.
- Dewan, S., Ganley, D., and Kraemer, K. L. 2004. *Across the Digital Divide: A Cross-Country Analysis of the Determinants of IT Penetration*, Personal Computing Industry Center, Graduate School of Management, University of California, Irvine.
- DiMaggio, P., and Hargittai, E. 2001. *From the "digital divide" to digital inequality: Studying Internet use as penetration increases*. Working Paper 15. Princeton, NJ: Center for Arts and Cultural Policy Studies, Princeton University.
- Donnermeyer, J. F., and Hollifield, C. A. 2003. Digital Divide Evidence in Four Rural Towns. *IT & Society* 1(4): 107-117.
- Ebo, B. 1998. *Cyberghetto to cybertopia?: Race, class, and gender on the Internet*. Westport, CT: Praeger.
- Economist Intelligence Unit and IBM. 2003. *The 2003 E-Readiness rankings*, New York, NY: The Economist Intelligence Unit, (accessed January 2005).
- Emperica GmbH. 2001. *eEurope Benchmarking Framework*, Bruxelles: Statistical Indicators Benchmarking the Information Society, <http://www.sibis-eu.org> (accessed June 5, 2005).
- Esselaar, M., and Associates. 2001. *A Three-Country ICT Survey for Rwanda, Tanzania and Mozambique*, Stockholm, South Africa, Final Report prepared for the Swedish International Development Cooperation Agency.
- Fink, C., and Kenny, C. J. 2003. *W(h)ither the Digital Divide?* Washington DC. The World Bank. <http://www.developmentgateway.org>.
- Fouglou, D. 2001. *Seven bridges over the global digital divide*, IAMCR & ICA Symposium on Digital Divide, Austin, TX. <http://evolutionarymedia.com/papers/digitalDivide.htm> (accessed 9 July 2006).
- Fox, S. 2004. *Older Americans and the Internet*. Washington, DC: Pew Internet and American Life Project.
- Gartner Group. 2002. *The second digital divide—The "Haves" and the "Have Hads."* The Digital Divide and American Society. www.gartnerweb.com/public/static/techies/digital_d/national/6.pdf
- Gordo, B. 2003. Overcoming Digital Deprivation. *IT & Society* 1(5): 166-180.
- Grigorovici, D. M., Constantin, C., Jayakar, K., Taylor, R. D., and Schement, J. R. 2004a. *InfoMetrics: A structural equation modeling approach to information indicators and "e-readiness" measurement*. Paper presented at the 15th Biennial Conference of the International Telecommunication Society (ITS), Berlin, Germany, September. http://userpage.fhw-berlin.de/jmueller/its/conf/berlin04/Papers/Grigorovici_Constantin_Jayakar_Taylor_Schement.pdf.
- Grigorovici, D. M., Schement, J. R., and Taylor, R. D. 2004b. Weighing the intangible: Towards a theory-based framework for information society indices. In *Global economy and digital society*, eds. E. Bohlin, S. Levin, N. Sung, and C.-H. Yoon, pp. 169-202. Boston: Elsevier Science.
- Guillen M. F., and Suarez, S. L., 2001. Developing the Internet: entrepreneurship and public policy in Ireland, Singapore, Argentina, and Spain. *Telecommunications Policy* 25(3-4): 349-371.
- Guislain, P. 2003. Society in Latin America: Challenges Financing the Information Society in Latin America: Challenges and New Models and New Models. ECLAC, Santiago, Chile: The World Bank. <http://www.worldbank.org/ict/>
- Haan, J. D., 2003. IT and Social Inequality in the Netherlands. *IT & Society* 1(4): 27-45.
- Haan, J. D. 2004. A Multifaceted Dynamic Model of the Digital Divide. *IT & Society* 1(7): 66-88.
- Haan, J. D., and Huysmans, F. 2004. IT/media use and Psychological development among Dutch Youth *IT & Society* 1(6): 44-58.
- Hargittai, E. 1999. Weaving the Western Web: Explaining Differences in Internet Connectivity among OECD Countries. *Telecommunications Policy* 23(10-11):701-718.
- Hargittai, E. 2002. Second-level digital divide: Differences in people's online skills. *First Monday* 7(4). http://www.firstmonday.org/issues/issue7_4/hargittai
- Hoffman, D., Novak, T., and Schlosser, A. 2000. The evolution of the digital divide: How gaps in Internet access may impact electronic commerce. *JCMC* 5(3). <http://www.ascusc.org/jcmc/vol5/> (accessed 15 April 2004).
- Hoffman, D.L., Novak, T.P., and Schlosser, A. E. 1999. *The Evolution of the Digital Divide: How Gaps in Internet Access may Impact Electronic Commerce*, Owen Graduate School of Management Working Papers, Vanderbilt University.
- Horrigan, J. B. 2004a. *28% of Americans are wireless ready*. Washington, DC: Pew Internet & American Life press release. http://www.pewinternet.org/pdfs/PIP_Wireless_Ready_Data_0504.pdf (accessed 20 June 2006).
- Horrigan, J. B. 2004b. *Broadband penetration on the upswing: 55% of Adult Internet users have broadband at home or work*. Washington, DC: Pew Internet Project Data Memo. <http://www.pewinternet.org/pdfs/> (accessed 20 June 2006).
- Horrigan, J. B., and Rainie, L. 2004. *The broadband difference*. Washington, DC: Pew Internet & American Life.
- Hüsing, T., and Selhofer, H. 2004. DIDIX: A Digital Divide Index for Measuring Social Inequality in IT Diffusion. *IT & Society* 1(7): 21-38.
- International Data Corporation (IDC). 2000. *World Times Information Society Index*, Framlingham, MA. <http://www.idc.com>.
- International Telecommunication Union. 2003. *World telecommunication development report 2003: Access indicators for the information society (Executive Summary)*. ITU. <http://www.itu.int/ITU-D/ict/>
- International Telecommunication Union. 2005. *Measuring digital opportunity*. Paper presented at the WSIS Thematic Meeting on Multi-Stakeholder Partnerships for Bridging the Digital Divide,



- Seoul, Republic of Korea, June. <http://www.itu.int/itu-wsis/2005/DOI%20V2.pdf>.
- International Telecommunication Union. 2006. *World telecommunication development report 2003: Access indicators for the information society (Executive Summary)*. ITU. <http://www.itu.int/ITU-D/ict/>
- ITU Telecommunication Development Bureau. 2003. *Gauging ICT potential around the world*. Geneva: ITU Publications. http://www.itu.int/ITU-D/ict/dai/material/DAI_ITUNews_e.pdf (accessed 20 June 2006).
- Jackson, L. A., Barbatsis, G., von Eye, A., Biocca, F., Zhao Y., and Fitzgerald, H. 2003. Internet Use in Low-Income Families: Implications for the Digital Divide. *IT & Society* 1(5): 141-165.
- Katz, J. E., and Rice, R. E. 2003. Comparing internet and mobile phone usage: digital divides of usage, adoption, and dropouts. *Telecommunications Policy* 27(8-9): 597-623.
- Kauffman, R. J., and Kumar, A. 2005. *A Critical Assessment of The Capabilities of Five Measures For ICT Development*. Carlson School of Management, University of Minnesota, Minneapolis.
- Kaye, S. 2000. *Computer and Internet use among people with disabilities*. Disability Statistics Report (13). Washington, DC: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.
- Kennedy, T., Wellman, B., and Klement, K. 2003. Gendering the Digital Divide. *IT & Society* 1(5):72-96.
- Kenny, C. 2001. Prioritizing countries for assistance to overcome the digital divide. *Communications and Strategies* 41: 17-36.
- Kiiski, S., and Pohjola, M. 2001. *Cross-country Diffusion of the Internet*. United Nations University. World Institute for Development Economic Research.
- Kirkman, G. S., Osorio, C. A., and Sachs, J. D. 2002. The Networked Readiness Index: Measuring the preparedness of nations for the networked world. In *The global information technology report 2001-2002: Readiness for the networked world*, eds. G. S. Kirkman, J. D. Sachs, K. Schwab, and P. Cornelius, pp. 10-29. Oxford: Oxford University Press. http://www.cid.harvard.edu/cr/gitrr_030202.html (accessed 29 June 2005).
- Kirkman, G. S., Osorio, C. A., and Sachs, J. D. 2004. The Networked Readiness Index: Measuring the preparedness of nations for the networked world. In *The global information technology report 2003-2004: Readiness for the networked world*, eds. G. S. Kirkman, J. D. Sachs, K. Schwab, and P. Cornelius, pp. 10-29. Oxford: Oxford University Press. http://www.cid.harvard.edu/cr/gitrr_030202.html (accessed 29 June 2005).
- Kraemer, K. L., and J. Dedrick (2002). Information technology in Southeast Asia: engine of growth or digital divide? In C.S. Yue and J.J. Lim (eds.), *Information Technology in Asia: New Development Paradigms*. Singapore: Institute of Southeast Asian Studies.
- Kubicek, H. 2004. Fighting a Moving Target: Hard Lessons from Germany's Digital Divide Programs. *IT & Society* 1(6): 1-19.
- Lebo, H. 2003. *The UCLA Internet report: Surveying the digital future—Year Three: 89*. Los Angeles: UCLA Center for Communication Policy.
- Lenhart A., and Horrigan J.B. 2003. Re-Visualizing the Digital Divide as a Digital Spectrum. *IT & Society* 1(5): 23-39.
- Liang, G., and Ning, W. 2004. Internet Adoption in China's Smaller Cities. *IT & Society* 1(6): 36-43.
- Linebarger, D. L., Royer, S., and Chernin, A.R. 2004. Young Children, Parents, Computers and the Internet. *IT & Society* 1(6): 68-86.
- Losh, S. C. 2003. Gender and Educational Digital Gaps: 1983-2000. *IT & Society* 1(5): 56-71.
- Losh, S. C. 2004. Gender, educational, and occupational digital gaps, *Social Science Computer Review* 22(2): 152-166.
- Luke, R. 2005. Access and accessibility: Some notes on digital diversity. In *Navigating the network society: The challenges and opportunities of the digital age*, eds. S. Kretchmer and R. Carvety. Thousand Oaks, CA: Sage.
- Mansell, R. E. 2002. From digital divides to digital entitlements in knowledge societies. *Current Sociology* 50(3): 407-426.
- Martin, S. P. 2003. Is the Digital Divide Really Closing? A Critique of Inequality Measurement in A Nation Online. *IT & Society* 1(4): 1-13.
- Martin S. P., and Robinson, J. P. 2004. The Income Digital Divide: An International Perspective. *IT & Society* 1(7): 1-20.
- McConnell International with World Information Technology and Services Alliance (WITSA). 2000. *Risk e-business: seizing the opportunity of global e-readiness*. www.mcconnellinternational.com.
- McLaren, J., and Zappal'a, G. 2002. The "Digital divide" among financially disadvantaged families in Australia. *First Monday* 7(11). http://www.firstmonday.org/issues/issue7_11/mclaren/index.html (accessed 20 June 2006).
- Menou, M. J. 2001. *Digital and social equity? Opportunities and threats on the road to empowerment*. Paper presented at the LIDA (Libraries in the Digital Age) 2001 Annual Course and Conference, Dubrovnik, Croatia, May. http://www.cnam.fr/instituts/INTD/Menou_intd-er.pdf.
- Menou M. J., and Taylor, R. D. 2006. A Grand Challenge: Measuring Information Societies. *The Information Society An International Journal* 22(5): 261-267.
- Minges, M. 2005. *Evaluation of E-readiness Indices in Latin America and the Caribbean*. United Nation's Economic Commission for Latin America and the Caribbean, NewYork, <http://www.eclac.org>.
- Morrone, A., and Zannella, L. 2004. IT and Mass Media Use among Italian Youth. *IT & Society* 1(6): 59-67.
- Mosaic Group. 1998. *The Global Diffusion of the Internet Project: An Initial Inductive Study* <http://www.mosaic.unomaha.edu>.
- Mossberger, K., Tolbert, C. J., and Stansbury, M. 2003. *Virtual inequality: Beyond the digital divide*. Washington, DC: Georgetown University Press.
- Muffels, R. J. A., Tsakoglou, P., and Mayes, D. G., eds. 2002. *Social exclusion in European welfare states*. Cheltenham: Edward Elgar
- Mutula, S. M., and van Brakel, P. 2006. An evaluation of e-readiness assessment tools with respect to information access: Towards an integrated information rich tool. *International Journal of Information Management* 26: 212-223.
- Neustadt, A., and Robinson, J.P. 2003. An Expanding Digital Divide? Panel Dynamics in the General Social Survey. *IT & Society* 1(4): 14-26.
- Norris, P. 2004. The bridging and bonding role of online communities. In *Society online: The Internet in context*, eds. P. N. Howard and S. G. Jones, pp. 31-43. Thousand Oaks, CA: Sage.
- Norris, P. 2001. *The digital divide: Civic engagement, information poverty & the Internet worldwide*. Cambridge: Cambridge University Press.
- Novak, T. P., Hoffman, D. L., and Venkatesh, A. 1997. *Diversity on the Internet: The relationship of race to access and usage*. Queenstown, MD. Paper prepared for the Aspen Institute's Forum on Diversity and the Media.
- Nurmela, J., and Viher'a, M.-L. 2000. *Communication capability is an intrinsic determinant for the information society*. (Unpublishedmanuscript). Helsinki.
- Nurmela, J., and Viherä, M. L. 2004. Patterns of IT Diffusion in Finland: 1996-2002. *IT & Society* 1(6): 20-35.
- OECD. 2001. Understanding the digital divide. Paris: OECD. <http://www.oecd.org/dataoecd/38/57/1888451.pdf>.
- Oxley, J. E. and Yeung, B. 2001. E-Commerce Readiness: Institutional Environment and International Competitiveness. *Journal of International Business Studies* 32(4): 705-723.
- Parayil, G. 2005. Digital divide and increasing returns: Contradictions of informational capitalism. *The Information Society* 21(1): 41-51.
- Partnership on Measuring ICT for Development. 2005. *Core ICT Indicators*. Beirut, Lebanon: United Nations-ESCWA. <http://measuring-ict.unctad.org/QuickPlace/measuring-ict/Main.nsf/hIndex/21B143B6971D3863C12570C70037130A/?OpenDocument&Form=hPageUI> (accessed 6 June 2006).
- Perry, J., Macken, E., Scott, N., and McKinley, J. 1998. Disability, inability and cyberspace. In *Designing computers for people—human values and the design of computer technology*, ed. B. Friedman, Stanford, CA: CSLI Publications.
- Pohjola, M. 2003. *The Adoption and Diffusion of ICT Across Countries: Patterns and Determinants*. Chapter 4 in D. C. Jones (Ed.), *The New Economy Handbook*, Elsevier Science and Technology Books, Amsterdam, Netherlands.
- Popova, I., Popov, O., and Dalin, R. 2005. ICT Knowledge for ICT Diffusion. Information and Communication Division. Department of Information Technology and Media, Mid Sweden University.
- Primo Braga, C. A., Kenny, C., Qiang, C., Crisafulli, D., Di Martino, D., Eskinazi, R., Schware, R., and Kerr-Smith, W. 2000. *The networking revolution: Opportunities and challenges for developing countries*. Global Information and Communication Technologies Department, The World Bank Group. <http://www.infodev.org/>



- Quibria, M. G., Shamsun, A. N., Tschang, T., and Reyes-Macasaquit, M.-L. 2003. Digital divide: Determinants and policies with special reference to Asia. *Journal of Asian Economics* 13:811–825.
- Reddick, A., Boucher, C., and Groseilliers, M. 2000. *The dual digital divide—The information highway in Canada*. Ottawa: Public Interest Advocacy Centre. http://olt-bta.hrdc-drhc.gc.ca/download/oltdualdivide_e.pdf
- Robinson, J. P., Dimaggio, P., and Hargittai, E. 2003. New social survey perspectives on the digital divide. *IT & Society* 1(5): 1–22.
- Robison, K. K., and Crenshaw, E. M. 2002. Post-industrial transformations and cyber-space: a cross national analysis of Internet development. *Social Science Research* 31: 334-363.
- Rodgers, G., Gore, C., and Figueiredo, J. B. 1995. *Social exclusion: Rhetoric, reality, responses*. Geneva: International Institute for Labour Studies.
- Rogers, E. M. 1995. *Diffusion of innovations*, 4th ed. New York: Free Press.
- Schaaper, M. 2003. A proposal for a core list of indicators for ICT measurement, presented at the United Nations Conference on Trade and Development Expert Meeting on Measuring E-Commerce as an instrument for the development of the Digital Economy, Geneva, September 8-10: UNCTAD, retrieved January 2004 from http://r0.unctad.org/e-commerce/event_docs/measuring_programme_en.htm.
- Sciadas, G., Ed. 2003. *Monitoring the Digital Divide ... and Beyond*, Montreal, Canada: Orbicom. www.orbicom.uqam.ca (accessed January 2004).
- Selhofer, H., and Husing, T. 2002. "The Digital Divide Index: A Measure of Social Inequalities in the Adoption of ICT." Working paper, Statistical Indicators Benchmarking the Information Society (SIBIS), Information Society Programme, European Commission. Available on the Internet at www.empirica.biz/sibis/files/Husing_Selhofer_DDIX_2002.pdf. (accessed March 2005).
- Shih, E., Kraemer, K. L., and Dedrick, J. 2003. An extended accelerator model of country level investment in information technology. Irvine, CA, Center for Research on Information Technology and Organization (CRITO).
- Sicherl, P. 2003. *Different statistical measures provide different perspectives on digital divide*. 6thESACConference. http://www.sicenter.si/pub/Sicherl_Digital_divide_Murcia.pdf (accessed 27 June 2005).
- Silver, H. 1994. Social exclusion and social solidarity: Three paradigms. *International Labour Review* 44(2): 219–231.
- Spennemann, D. H. 2004. Digital Divides in the Pacific Islands. *IT & Society* 1(7): 46-65.
- Spooner, T., and Rainie, L. 2001. *Hispanics and the Internet*. Washington, DC: Pew Internet and American Life Project.
- Stanley, L. D. 2003. Beyond access: Psychological barriers to computer literacy. *The Information Society* 19: 407–416.
- Tichenor, P., Donohue, G., and Olien, C. 1970. Mass Media Flow and Differential Growth in Knowledge, *Public Opinion Quarterly* 34: 159-170.
- Tien, F. F., and Fu, T.T. 2008. The correlates of the digital divide and their impact on college student learning. *Computers & Education* 50:421–436.
- UNCTAD. 2003. *Information and Communication Technology Development Indices*. New York & Geneva: United Nations.
- United Nations. 2005. *Information Society Indicators*. New York: UN, <http://www.un.org>.
- United Nations Development Program (UNDP). 2001. *Human development report 2001*. New York: Oxford University Press. <http://hdr.undp.org/reports/global/2001/en/pdf/techindex.pdf>
- United Nations Educational Scientific and Cultural Organization (UNESCO). 2006. *ICTs and Education Indicators: Suggested core indicators based on meta-analysis of selected International School Surveys*, New York: UN, <http://www.unescobkk.org>.
- Van Dijk, J., and Hacker, K. 2003. The digital divide as a complex and dynamic phenomenon. *The Information Society* 19 315–326.
- Vehovar, V., Sicherl, P., Hüsing, T., and Dolnicar, V. 2006. Methodological Challenges of Digital Divide Measurements. *The Information Society An International Journal* 22(5): 279–290.
- Waddell, D. C. 1999. *The growing digital divide in access for people with disabilities: Overcoming barriers to participation in the digital economy*. Washington, DC: U.S. Department of Commerce.
- Wallsten, S. 2003. Regulation and internet use in developing countries. Washington DC, AEI and Brookings Institution.
- Wareham, J., Levy, A., and Shi, W. 2004. Wireless diffusion and mobile computing: Implications for the digital divide. *Telecommunications Policy* 28(5–6): 439–457.
- Warschauer, M. 2002. Reconceptualizing the Digital Divide. *First Monday* 7(7).
- Warschauer, M. 2003. *Technology and social inclusion: Rethinking the digital divide*. Cambridge, MA: MIT Press.
- Welling, S., and Kubicek, H. 2000. *Measuring and bridging the digital divide in Germany*. Report presented at the International Conference, Stepping-Stones into the Digital World, September, Bremen. <http://www.digitale-chancen.de/transfer/downloads/MD35.pdf>.
- Wilson, E. J. III. 2006. *Why we need a negotiation model to explain Internet diffusion*. Access to Knowledge Conference, Yale University, New Haven, CT.
- Wolcott, P., Press, L., McHenry, W., Goodman, S. E. and Foster, W. 2001. A Framework for Assessing the Global Diffusion of the Internet. *Journal of the Association of Information Systems*. 2:1-50.
- Wong, P. K. 2002. ICT Production and Diffusion in Asia: Digital Dividends or Digital Divide?. *Information Economics and Policy* 14(2): 167-187
- World Information Technology and Services Alliance (WITSA). 2000. *International Survey of E-Commerce*, <http://www.witsa.org/papers/EcomSurv.pdf>.



Payam Hanafizadeh is an Assistant Professor of Industrial Management at Allameh Tabataba'i University in Tehran, Iran and a member of the Design Optimization under Uncertainty Group at the University of Waterloo, Canada. He was a visiting research fellow at the University of Canberra, Australia in 2010 and a visiting scholar at the University of Waterloo, Canada in 2004. He received his MSc and PhD in Industrial Engineering from Tehran Polytechnic University and pursues his research in Information Systems and Decision-making under Uncertainty. He has published more than 50 articles in such journals as the Information Society, Internet Research, Systemic Practice and Action Research, Management Decision, Journal of Global Information Management, Telecommunications Policy, Electronic Commerce Research, Mathematical and Computer Modeling, Expert Systems with Applications, Higher Education Policy, International Journal of Information Management, Energy Policy to name only a few.