

# Gaps and Bits: Conceptualizing Measurements for Digital Divide/s

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Three arguments are raised in this article with regard to the indices used to measure the digital divide. First, I criticize policymakers who rely on simplistic measures of the digital divide, at the expense of a thoughtful analysis of (1) the purpose of the tool, (2) the level of observation, and (3) the method of approaching the data. Second, I argue that networks and associated technologies are not neutral artifacts but are political and social spaces in their structure as well as in their content levels. Accordingly, we need to factor in the context as an important actor in conceptualizing and measuring the digital divide. Third, two general types of indices are used for the measurement of the digital divide(s): focused monotopical indices and comprehensive indices. Monotopical indices are more widely available, while comprehensive ones are rare. I argue that policymakers need to promote comprehensive indices over monotopical indices. Finally, I present a conceptual definition of the digital divide and a framework for developing a comprehensive index to measure it.

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“To be conscious that you are ignorant is a great step to knowledge.” Benjamin Disraeli (1804–1881)

There has been much discussion and debate about the definition of the digital divide and of the empirical analyses of its components (Chen, 2004; Compaine, 2001; Cooper, 2002; Dewan & Riggins, 2005; DiMaggio et al., 2004;

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Hargittai, 2003; Norris, 2001; Warschauer, 2003). In the 1990s the traditional focus was mainly on infrastructural access. Today the discourse about the digital divide has expanded to other concerns and factors that generate digital inequality (e.g., differential modes of use and economic development) (Benkler, 2006; Bridges.org, 2005b; ITU, 2003; Lebo, 2003; Wilson, 2006). 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. Still, in both analyses—traditional and contemporary—the emphasis is on single-factor, or monotopical,<sup>1</sup> relations rather than on integrative frameworks and measurements.

Elaboration on what exists and what could be a more useful way of conceptualizing the digital divide (and thereby its measurement) is put forward in the following sections.

## CALLING FOR A POLICY FRAMEWORK

There are two ways of approaching the measurement and analysis of the digital divide: through atomic and monotopical lenses or through holistic and comprehensive lenses. The choice of an appropriate index or set of indices is, of course, of vital importance for both theory and practice. The decision whether to employ monotopical or comprehensive lenses should take into consideration (1) the purpose of the tool, (2) the level of observation, and (3) the method of approaching the data. Each of these considerations is a matter of much debate and tension. In this section I identify and reflect on key issues for construction of effective tools for measuring the divide.

### Purpose of the Tool: Can “Comparative” and “Contextual” Live Together?

Decision makers often fall into the trap of seeking data that exist, instead of putting in the effort to first systematically conceptualize the digital divide, operationalize it as appropriate to the context, and only then collect data.

Consider the position of the Bush Administration (Cooper, 2002, 2004), which is nicely captured by the much quoted remarks of Michael Powell, the former U.S. Federal Communications Commission Chairman, who compared the digital divide to a “Mercedes divide,” said, “I would like to have one, but I can’t afford one.”<sup>2</sup>

This quote illustrates the tendency of the policymakers to approach the divide from a technologically deterministic perspective. Single factors such as “access” are convenient since they are easy to measure. Additionally, these simple measures can be used to influence public opinion since lay people can relate to them. However, the major reason policymakers gravitate toward technologically deterministic measures is their need to justify allocation of resources, a task that is made easier if they can create benchmarks and compare one nation to another against this benchmark. Policymakers like to have an “objective” comparative tool. In other words, the fact that these measures may be appropriate in particular contexts is given little thought.

The problem is that the context of the unit of analysis is overlooked. Often the benchmark is set artificially according to some lowest common denominator for all countries, resulting in a narrow view of the digital divide, which creates a distorted picture of the divide. Furthermore, these benchmarks, which are typically developed in technologically advanced countries, may suffer from the opposite problem of the “highest common denominator,” and may not be appropriate for countries that are behind technologically. The fixed and therefore arbitrary importance and weight that are given to each factor are a compromise that accommodates most countries or perhaps the strongest ones and does not reflect the real relations in each one of the countries. It is easier to look for basic elements of a digital divide (e.g., network connectivity), rather than delving into aspects that require an appreciation of context and may call for differentiation. For example, it is meaningless to ask for factors of usage in a country where connectivity is almost zero or to ask about affordability of infrastructure in countries that give it for free. In sum, this article argues that context should be one of the most important frameworks when conceptualizing the digital divide and constructing an index.

Another challenge that decision makers face is the limited number of “ready-to-use” tools for assessing a nation’s digital divide (Bridges.org, 2005a). According to Bridges.org (2005a), “there is a wide range of reports and other resources that can be re-worked into assessment tools” (p. 2) but there are not many ready-to-use tools. More “ready-to-use” tools would give decision makers incentives to consider factors more diverse than infrastructure oriented.

Moreover, the literature is full of single-issues studies that are local and tied to a specific context. Monotopical measures of digital divide typically identify one

or a few variables that influence a dependent variable, which, in turn, reflects one aspect of the divide, such as awareness, access, attitudes, or application. Each of these may serve as a gauge of the gap. Among these mono- or single topics, the literature mentions the following: income (Ebo, 1998), occupation (Losh, 2004; McLaren & Zappalà, 2002), gender and age (DiMaggio et al., 2004), education (Cornfield & Rainie, 2003), geographic centrality (Chen et al., 2003; Cornfield et al., 2003), ethnicity and race (Hoffman et al., 1999; 2000; Novak et al., 1997), religiosity (Bell et al., 2004), language (Foulger, 2001), family structure (Kennedy et al., 2003), physical capacity (Le Blanc, 2000; Lenhart et al., 2003), frequency (Fox, 2004), time online (Spooner & Rainie, 2001), purpose (Center for the Digital Future, 2004), skills (Robinson et al., 2003), autonomy (Dasgupta et al., 2002), affordability (OECD/DSTI, 2001), competitive market structure (Dutta & Jain, 2004), ownership and density of computers and web sites (Sicherl, 2003), and communication infrastructure (Horrigan & Rainie, 2004; Horrigan, 2004a, 2004b; Katz et al., 2003; Wareham et al., 2004).

Monotopical subjects are important as ends by themselves, but not when they serve as the mean or as the only common denominator. I believe that context and ability to compare are not mutually exclusive concepts. So the first challenge to confront when conceptualizing a complex concept like the digital divide is to ask, “What is the purpose of the tool being constructed?” Instead of falling into the trap of the common denominators in all nations, I suggest an index that takes into account the context of the digital divide in each nation. That is, each nation will have factor weights that reflect its specific context and needs, but the overall concept would be what is ultimately compared. If the purpose of the tool is to compare connectivity, do not look for an index that reflects the digital divide; look instead for one that simply compares this monotopical subject without entering into context consideration. But if the purpose is to reflect the digital divide, then context has to be included. For example, countries that do not have infrastructure will put more weight on infrastructure factors, while countries that already have good connectivity will put the weight on other factors, like usage or political context.

Finally, I would like to note that networks and other technologies are nonneutral spaces, and this nonneutrality means that a contextual index is superior to other types of indices. The Internet, arguably one of the most representatives of the information society technologies, with its different levels of applications, creates a space of human interaction that is not neutral. The Internet is nonneutral, not only in its content and logical layers, but also in its foundations and structure (Barabasi, 2001; Cohen, 2002). Any conceptualization of the digital divide that ignores looking at the Internet as social and political spaces will

have limited utility. Fortunately, consciousness about the Internet as a social and political space is starting to arise in academia and other sectors (for example, see the Access to Knowledge conference in Yale in 2006, where Jack Balkin and Yochai Benkler announced the beginning of a new movement, the social movement).<sup>3</sup> If one agrees with this perspective, then one is led to a contextual conceptualization of the digital divide.

Next let us consider another dimension—*level of observation*—that needs to be taken into account by policymakers when they make a decision about what kind of index (i.e., monotypical or comprehensive) to use and the characteristics of this tool.

### Level of Observation: At What Level Should We Measure?

Unfortunately, most of the existing indices are almost exclusively at the international and national level. Nevertheless, digital inequalities exist in variety of other levels: sector, community, and individual levels (Dewan & Riggins, 2005). The current focus on these higher levels of analysis short-changes detailed and vitally important data collection and analysis at more micro levels. For example, many communities within nation-states are far removed from the rest of the country with regard to information and communications technology (ICT) access and use. Such communities reshape ICT to their culture and norms. Barzilai-Nahon and Barzilai refer to this as *cultured technology* (Barzilai-Nahon, 2004; Barzilai-Nahon & Barzilai, 2005). We cannot disregard the discrepancies at local levels and the variance in digital use in access, even if such variance is below the nation-state threshold, since in many cases this level of resolution is more meaningful than the national and international levels that tend to be more popular.

Our proposal is not to include all the levels in one index, but rather to use a similar index design for all levels, while the importance and weights of the different factors are altered according to the specific context. This would allow maximum flexibility in the level of measurement, whether it is at sector, communal, national, or international level. For example, an index measuring the digital divide in an immigrant community will emphasize weights that reflect language factors over other factors in the index.

### Method of Approaching the Data: Which Framework to Choose?

In contrast to monotypical approaches for measuring the digital divide, integrated indices propose a more ambitious or encompassing prism but with more risks. Such integrative approaches have been proposed and implemented by various institutions and scholars. But not many “ready-

to-use” integrated indices, or even reviews of assessment tools, exist. Yet these integrated indices are widely used (Bridges.org, 2005a; Grigorovici et al., 2002). Bridges.org (2005a) offers a comparison of the following assessment tools to determine e-readiness:

1. Ready-to-use questionnaires like these of CID (Center for International Development), APEC (Asian Pacific Economic Cooperation), or CSPP (Computer System Policy Project).
2. Case studies like those of USAID (U.S. Agency for International Development) and InfoDev (The Information for Development Program).
3. Third-party surveys and reports like KAM (Knowledge Assessment Methodology), MI (McConnell International’s Risk E-Business), SIBIS (Statistical Indicators Benchmarking the Information Society), NRI (Networked Readiness Index), and more.

I do not assume that the e-readiness question overlaps the digital divide issue, and therefore I do not believe all the integrated assessment tools compared in the Bridges.org study would fit our discussion here. For example, I do not think that *trust* in e-commerce relates directly to digital divide. Moreover, that study also refers to tools that only partially measure e-readiness.

Prominent among the integrated indices are SIBIS (Statistical Indicators Benchmarking the Information Society), DIDIX (Digital Divide Index) (Dolnicar et al., 2003; Husing & Selhofer, 2004), NRI (Network Readiness Index) (Dutta & Jain, 2004), the Digital Access Index, and other more traditional inequalities measures such as the Gini Coefficient (Riccardini & Fazio, 2002).

SIBIS, a project of the European Commission, is an ambitious large-scale effort that attempts to analyze and compare different indicators of digital divide (SIBIS, 2003). However, the SIBIS project has concentrated only on variables of access and use (SIBIS, 2003): computer use, Internet use, home access, Internet dropouts, broadband extensiveness, and more. Even indicators of readiness and awareness, which are more social and behavioral in nature than other indicators such as infrastructure and affordability, were constructed and operationalized from measures of access and use, not from social and psychological metrics. Moreover, all the indicators that were compared under SIBIS have been mainly monotypical or bitypical except the DIDIX, which was specially developed as a more comprehensive index and will be elaborated upon later. The comparison of various indicators, including the digital divide contained in SIBIS, demonstrated two trends: first, that there is a lack of emphasis on socioeconomic divides and social inequalities, and second, that there exists a need for a more comprehensive index. Although SIBIS moved forward from a monotypical toward an integrative stage, the index suggested was only partial.

The second tool examined was DIDIX (Digital Divide Index), which was an attempt to construct a more integrative index by the SIBIS project (Husing et al., 2004; SIBIS, 2003). It concentrates on four “risk” groups, (i.e., women, people aged 50 and over, people with low level of education, people with low level of income). At the same time, DIDIX treats the digital divide from access and use perspectives only. Weights in the calculation of the integrative DIDIX index were assigned to each component that constructs the index (i.e., computer usage 0.5; Internet usage 0.3; and Internet usage at home 0.2). I identify at least three methodological flaws in this process: (1) Importance weights are assigned somewhat arbitrarily, (2) the risk groups are not mutually exclusive, and (3) the current form of constructing the index might obscure some internal dynamics at the national and lower levels of analysis (SIBIS, 2003). Consequently, it is important to construct a compound index where dynamics between the variables are taken into consideration.

The third tool I examined was the Digital Access Index that was proposed by the ITU (International Telecommunication Union) and considers the following factors: infrastructure, affordability, knowledge (adult literacy, and school enrollment), quality (bandwidth per capita and broadband subscribers), and usage (ITU, 2003). The greatest challenge and the largest payoff are in the construction of a unified index that reflects multivariate dimensions and illuminates both social and technological aspects. The construction of such a metric may prove valuable for policy formation, may contribute to public discourse, may aid rational decision making, and would of course be useful for research. In this context, the ITU’s efforts to combine different aspects of digital divide into one index are especially appropriate. Nevertheless, the ITU has concentrated mainly on international differences and divides (ITU, 2003) and tends to overlook more local and micro levels of analysis, such as communities. The ITU has linked infrastructure factors with other factors like the factor of affordability (e.g., access price as percentage of gross national income per capita); the knowledge factor (examined through adult literacy and combined primary, secondary, and tertiary school enrollment); the quality factor (measured through international Internet bandwidth per capita and broadband subscribers per 100 inhabitants); and the usage factor (examined by looking at Internet users per 100 inhabitants). All of these measurements, therefore, are more aggregative at the international and national level rather than at the community and individual levels. My argument is that the digital divide is present and problematic at each of the individual, local, community, and sector levels as well as in the international arena, and therefore, a digital divide assessment tool should address, bridge, and measure at each of those levels.

The fourth assessment tool, the NRI (Network Readiness Index), is part of the Global Information Technology Report and was prepared by the World Economic Forum, INSEAD, and InfoDev. This Index seeks to find the degree of preparedness of a nation or community to participate in and benefit from ICT developments. Unlike the Digital Access Index, the NRI succeeds in offering an index that also analyzes communities, and not just national and international divides. The components that NRI takes into consideration are the environment for ICT, readiness of the community’s key stakeholders (individual, business, and government) to use ICT, and the actual use of ICT among these stakeholders. NRI progresses further toward a full integrative measurement. The Achilles heel of the index is the issue I discussed earlier: NRI uses fixed arbitrary weights to assign the importance of the various factors and ignores the context and specific situation in the country or community it measures.

In sum, I argue that comprehensive indices are a result of serious investments and efforts, and some useful insights have been collected through the use of these indices (Chen & Wellma, 2003; ITU, 2003). However, the integrative indices could benefit from a scientific validation of weights, reference to different levels, and reference to internal dynamics between the various variables. Constructing a composite measure for inequality poses several methodological and substantive challenges (Atkinson, 1970; Berrebi & Silber, 1985; Gastwirth, 1972; Martin, 2003; Tichenor et al., 1970). When the inequality in question is expressed in monetary terms for the purpose of policy analysis and discussion, the issues may seem mainly statistical: For instance, does one focus on measures of centrality or variance? At the confluence of measurement and policy formation, one often encounters a tension between counting for decisions and counting for understanding. The (understandable) impatience of policymakers gets in the way of developing a deep understanding of the causes and long-term processes of divides and how these can be bridged. Conversely, scholarly insistence on reliability and validity often slow down much-needed intervention. In a way, this article is a call for greater patience from policy and research communities on matters concerning the digital divide. Policymakers and researchers need to converge on better measures, though this might take some time.

While I direct criticism toward the design of the index from a structural perspective (like validating weights, allowing application by different levels, and contemplating the internal dynamics between the various variables), attention should be placed on a serious examination of the ingredients used in measuring such a complex and controversial construct as the digital divide (Davison & Shelia, 2003; Hoffman et al., 2000). The next section addresses this challenge and suggests the

factors that should be included in the concept of the digital divide.

## DEFINING THE DIGITAL DIVIDE AND A FRAMEWORK FOR AN INTEGRATIVE INDEX

There are many definitions of the digital divide. Chen and Wellman (2003) suggest a conceptualization based on factors of access and use, weighted by socioeconomic status, gender, life stage, and geographic location. Bridges.org (2001) proposes using the number of users or computers, infrastructure access, affordability, training, relevant content, information technology (IT) sector (size of ICT sector and integration into existing industries), poverty, and demographic lines (geography, race, age, religion, gender, and disability).

It is interesting to note that most of the indices mentioned earlier do not define and conceptualize up front the digital divide and subsequently operationalize their definition. Instead, they start their design process with variables and indicator levels and thereby enter the “loop of decision makers”; they are trying to come up with factors that are measurable, and they overlook what is truly meaningful in any particular context.

I would like to suggest a way to conceptualize the components of the digital divide and suggest a model that reflects interrelations among these factors. Table 1 is a compilation from diverse sources that refer to relations of indicators of the digital divide.<sup>4</sup> This table illustrates the numerous theoretical, empirical, and summary attempts at defining and measuring the digital divide, and provides us with the basis for a comprehensive model and framework.

Table 1 lists potential factors for inclusion in a cross-sector, cross-construct validation study of digital divide indices. This summary organizes the available literature

and theoretical claims by sources of study, type of study, and origin of use for particular constructs.

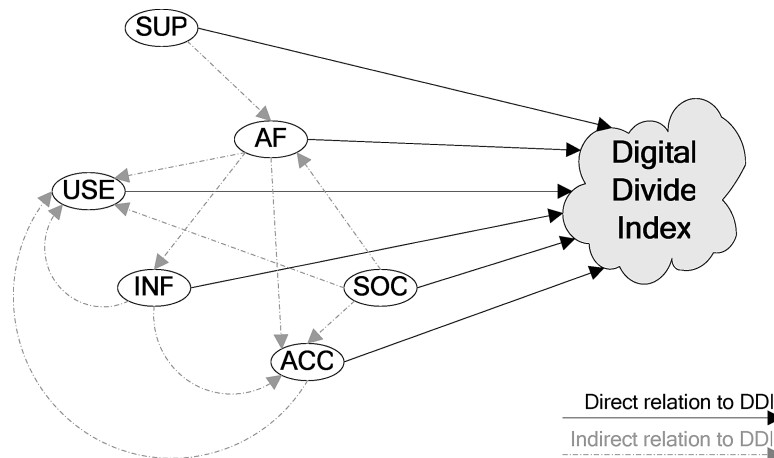
Drawing from these studies and the summary in Table 1, I can generate a conceptual map of the interrelations of the above factors. This preliminary conceptualization is shown in Figure 1.

Figure 1 proposes a conceptual model of the causal relations that lead to the digital divide according to different atomistic studies that have been done in the area. The indicators mapped in Figure 1 suggest that we not only should take into account the direct relations of different indicators such as sociodemographic, accessibility, use, infrastructure access, affordability, and social and governmental support, but also should examine the interrelationships among the various indicators. For example, accessibility may affect the Digital Divide Index directly, but also affects it indirectly through the *use* indicator.

Each one of the factors presented in Figure 1 is an index by itself (hereafter named “factor index”). The *factor indices* were chosen after an extensive literature survey. The relationships among the different elements shown in Figure 1 have been proposed by different studies. Figure 1 integrates these relationships into one model (see also Albright, 2005). For example, in the factor index of *use*, we can find studies that measure how the length of time surfing online or frequency of surfing reflect the digital divide, but they do not measure the whole index that I refer to as “use” (e.g., (Cultural Access Group, 2001; Hargittai, 2002; Hoffman et al., 2000).

The model relies on the following relationships (acronyms as in Figure 1):

- SUP impacts the index directly—Most studies show that training and institutional support help in reducing the gaps (Bill & Melinda Gates Foundation, 2004; Curtin, 2001; Foulger, 2001). Studies



**FIG. 1.** Digital divide indicators relations modeling.

SUP = social and government constraints/support; AF = affordability; USE = use; INF = infrastructure access; ACC = accessibility; SOC = sociodemographic factors.

**TABLE 1**  
Toward a comprehensive metric

	Factor	Type of study*	Example studies
1	Infrastructure access <ul style="list-style-type: none"> <li>• Communication channels and capacity</li> <li>• Computers per capita</li> <li>• Web sites per capita</li> <li>• Number of ISPs per capita</li> <li>• ISPs: governmental incumbent or private</li> </ul>	T SE PEC PES	(DiMaggio & Hargittai, 2001; Norris, 2004) (Bridges.org, 2001; Chen & Wellman, 2003; Hoffman et al., 2000; Husing & Selhofer, 2004; ITU, 2003; ITU Telecommunication Development Bureau, 2003) (The Mosaic Group, 1996–2004; Warschauer, 2002) (Horrigan & Rainie, 2004)
2	Affordability (relative to other expenditures and average income) <ul style="list-style-type: none"> <li>• Physical layer (infrastructure)</li> <li>• Logical layer (applications and software)</li> <li>• Content</li> </ul>	T SE PEC PES	(Martin, 2003; Norris, 2004) (Bridges.org, 2001; ITU, 2003; ITU Telecommunication Development Bureau, 2003; Martin, 2003) (Cooper, 2002; The Mosaic Group, 1996–2004) (Lenhart et al., 2003)
3	Use <ul style="list-style-type: none"> <li>• Frequency</li> <li>• Time online</li> <li>• Purpose</li> <li>• Users' skills</li> <li>• Autonomy of use</li> </ul>	T SE T PEC PES	(DiMaggio & Hargittai, 2001; Norris, 2004) (Chen & Wellman, 2003; Husing et al., 2004; ITU, 2003; ITU Telecommunication Development Bureau, 2003) (Warschauer, 2002) (Crump & McIlroy, 2003; Hargittai, 2002; Lenhart et al., 2003)
4	Social and governmental constraints/support <ul style="list-style-type: none"> <li>• Training</li> <li>• Active help</li> <li>• Support/suppression/apathy</li> <li>• Investments and funding</li> </ul>	T SE PEC PES	(DiMaggio & Hargittai, 2001) (Chen & Wellman, 2003) (Warschauer, 2002) (Crump & McIlroy, 2003)
5	Sociodemographic factors <ul style="list-style-type: none"> <li>• Socioeconomic status</li> <li>• Gender</li> <li>• Age</li> <li>• Education</li> <li>• Geographic Dispersion</li> <li>• Ethnic diversity</li> <li>• Race diversity</li> <li>• Religiosity</li> <li>• Language</li> </ul>	T SE PEC PES	(Martin, 2003) (Bridges.org, 2001; Hoffman et al., 2000; Martin, 2003) (Donnermeyer, 2003; The Mosaic Group, 1996–2004) (Bell et al., 2004; Lenhart et al., 2003)

**TABLE 1**  
Toward a comprehensive metric (*Continued*)

	Factor	Type of study*	Example studies
6	Accessibility (disabled and special needs populations)	T SE PEC PES	(Luke, in press; Perry et al., 1998) (Kaye, 2000) (Luke, in press; Waddell, 1999) (Kaye, 2000; Lenhart et al., 2003)

*Note.* T, = theory papers; SE, = secondary data empirical papers; PEC, = primary data empirical papers that focus on cases; PES, = primary data, empirical papers, surveys.

also show that institutional constraints are definitely a factor in adopting and using the Internet. (Barzilai-Nahon & Barzilai, 2005).

- SUP indirectly affects the index through AF—Investments in ICTs and funding projects by institutional agencies, according to studies, have a strong role in reducing the gap (Dutta et al., 2004).
- AF impacts the index directly—Studies show that as products, services, and content become more affordable, the digital divide is reduced (ITU, 2003). Most studies have concentrated more on analyzing affordability of infrastructure rather than content.
- AF indirectly affects the index through INF, USE, and ACC.
- SOC is correlated directly with the index—Studies show that different elements of socio-demographic factors are correlated to the gap. Among other factors, lower income (Bill & Melinda Gates Foundation, 2004; Chinn & Fairlie, 2003), lower education (Bell et al., 2004; Hargittai, 1999), living in rural areas (Drysdale, 2004; Flores, 2003), and affiliation with some ethnic groups (Bell et al., 2004; Novak et al., 1997) are associated with a higher digital divide.
- USE impacts the index directly—Most of the current studies actually concentrate on this factor (Center for the Digital Future, 2004; Cornfield & Rainie, 2003). One also finds that most of these studies combine the *use* factor with *sociodemographic* subfactors.
- INF impacts the index directly—This is actually the traditional look at the factors that determine the digital divide.
- INF indirectly affects the index through USE, ACC—This type of relation is scarcely analyzed: how the use affects the digital divide while different infrastructure settings serve as a moderator variable.

- ACC impacts the index directly—This factor in many cases is neglected, and it refers to disabilities as widening gaps and the need to address special populations with physical disabilities (Kaye, 2000; Lenhart et al., 2003).
- ACC indirectly affects the index through USE.

#### FACE TO THE FUTURE: NOT REPEATING HISTORY

I claim that technology is not a neutral artifact in society. Rather, technology and its various facets should be comprehended and explicated within a given context. It is part of daily politics and social life, and as such it should be approached as a social and behavioral phenomenon. In this article I argue that the policymakers are inclined toward erroneous policymaking on the subject of the digital divide. I suggest three dimensions—purpose of the tool, level of observation, and method of approaching the data—that should be taken into significant consideration when policymakers are deciding on types and characteristics of measurement tools that they should use. Even existing “ready-to-use” tools that are more comprehensive than monotypical indices lack certain significant characteristics, which are analyzed in the article.

The conceptual framework proposed in this study should be considered a call to arms for a more comprehensive approach for measuring the digital divide. This article is by no means the final word or a comprehensive survey of global digital divide(s). If we are serious about understanding the complexity of the digital divide, further efforts that build on the model presented above are required. International cooperation to construct a data set specifically for each of the factors outlined in Table 1 would provide the basis for refining the model. A refined model would enable more informed policy decisions at the international, national, local, and personal levels.

## NOTES

1. In monotopical studies, researchers examine how certain factors have an impact on a certain aspect of the digital divide (e.g., how did low-income factors affect the use of technologies?).
2. This comment was made in a press conference on 8 February 2001.
3. See Benkler's and Balkin's speeches in the plenary session on 21 April 2006 in the Access to Knowledge conference at Yale University (<http://research.yale.edu/isp/eventsa2k.html>).
4. Due to lack of space, only examples of relevant literature are provided here.

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