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Digital disability divide in information society: A framework based on a structured literature review

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Abstract

Purpose – The purpose of this paper is to create a conceptual framework, based on a structured literature review, to analyze the digital disability divide and help find solutions for it. A digital disability divide exists between people with impairments and those without impairments. Multiple studies have shown that people without impairments are less likely to own a computer or have an Internet connection than are people with impairments. However, the digital disability divide is seen in relation not only to access but also to accessibility and use. For people with impairments, new technological innovations offer solutions for everyday challenges, such as finding information, communicating with others and using electronic services.

Design/methodology/approach – For this study, 4,778 conference and journal publications were systematically analyzed.

Findings – A number of key findings emerged. This field is relatively new, and the literature is highly focused on the technological and social aspects of the digital disability divide, with technology and societal attributes being the core sub-attributes for a comprehensive model. The previous literature did not significantly study the consequences of the financial situation of individuals; rather, the predominant focus was on the have-nots and countries with low income potentials. Furthermore, motivation reveals a compelling case within the digital disability divide subset.

Originality/value – The review provides a consolidated view of past research on the general topic of the digital disability divide and the attributes that affect it.

Keywords Information society, Digital divide(s), Inequalities

Paper type Literature review

1. Introduction

The digital divide is a multidimensional, complex phenomenon that exists within and between countries (Bertot, 2003). Early research on the digital divide concentrated on its technological dimensions (DiMaggio and Hargittai, 2006). In particular, studies were conducted to track user access to Internet and computers, either in private homes or in community access points such as workplaces, schools and libraries (Kaye, 2000; Dobransky and Hargittai, 2006). Over time, the criticism toward technically biased research on the digital divide has generated multiple streams of research. These streams

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include studies on the economic, information accessibility and information literacy dimensions of the digital divide (Bertot, 2003; Hawkins, 2005).

Within the national context, the digital divide is noticeable between people with different financial (Wei and Hindman, 2011), educational (Lengsfeld, 2011), regional or racial statuses (Hoffman and Novak, 1998; Fairlie, 2004). This gap also exists between people with impairments and those without impairments. Although some researchers (Dobransky and Hargittai, 2006) refer to this gap as the disability divide, we use the term "digital disability divide" in this paper because it indicates that the gap is studied in the context of information and communication technologies (ICT). We define the digital disability divide as one type of digital divide that can overlap with other types of digital divides, such as linguistic or cultural digital divides (Keniston, 2004). Much like other digital divides, the digital disability divide can be studied in both national and international contexts (Borg *et al.*, 2011), and it has multiple dimensions, such as access, accessibility and use (Dobransky and Hargittai, 2006).

Multiple studies on access to ICT (Kaye, 2000; Dobransky and Hargittai, 2006; Hollier, 2007) have revealed that people with impairments are less likely to have a computer or Internet access at home than people without impairments. This lack of access can be associated with socioeconomic status. Accordingly, people with impairments use the Internet less often than do people without impairments; this phenomenon is seen even when they are compared with people who have a computer and Internet access at home (Kaye, 2000; Dobransky and Hargittai, 2006). The gap is even greater when the comparison is made with people who do not have a computer or Internet access at home and thus must access the Internet at community access points.

According to Dobransky and Hargittai (2006), people with impairments are less likely to engage in multiple online activities compared to those without impairments. For example, citizens with impairments are less likely to use the Internet to communicate with others, make purchases, look for particular services, use online banking or search for jobs. On the other hand, they are more likely to play games and, as can be expected, look for health-related information and search for information on public organizations online.

People with impairments are not a homogeneous group, and they face different types of barriers according to their type of impairment, economic situation and social background. Impairment is independently related to a lack of Internet access for those who are visually impaired or who have difficulties typing (Dobransky and Hargittai, 2006). Functionally blind people have trouble reading scanned documents and graphics on the computer, even when using state-of-the-art screen readers (Lazar *et al.*, 2007). Difficulty in typing can be related to different types of disabilities, such as cognitive impairments or motoric impairments. For example, a cognitive impairment can affect a person's ability to acknowledge letters and thus prevent him/her from using a keyboard (Friedman and Bryen, 2007).

Those with functional blindness or cognitive impairments might need specific tools to use computers and other technological devices; these tools are referred to as assistive technology. Assistive technology can also include computers and robots, as long as these devices function to help person with impairments accomplish a task or acquire information. The ability to access technology – both recreational and utility-based – is related to a person's financial standing; thus, gaps based on economic conditions are also seen in the case of people with impairments. The financial costs of technology

devices are carried by individuals, their families and society, which is represented by different communities through social benefit systems. The ability of these units to carry these costs can vary a lot between different settings, making the financial aspect of the digital disability divide well worth studying.

Increasing technology adoption for citizens with impairments is the first step toward bridging the disability divide. Continued usage can be promoted once a clear understanding of the factors governing the accessibility and usage of these technologies has been established. People with disabilities rely on various technologies to carry out daily tasks, so even minor modifications in the form of technology re-construction or delivery can make continued usage difficult (Phillips and Zhao, 1993). Technology has recently evolved to become more interactive, especially because of social networks (Birchmeier *et al.*, 2011). However, citizens with impairments have struggled with this change, which for them is a hindering instead of an aiding factor (Johnson and Moxon, 1998).

The purpose of this paper is to define the digital disability divide and present a concept for studying its importance to people with impairments. This paper focuses on the digital disability divide among people with physical impairments and people with cognitive impairments in the context of well-developed information societies, although the preliminary empirical study from which this framework is taken was conducted only with the physically impaired (Sachdeva *et al.*, 2013). Our research questions are as follows:

RQ1. What critical factors govern the adoption and continued usage of technology in people with impairments?

RQ2. What sub-factors combine to affect the accessibility and use of technology?

RQ3. To what extent have these aspects been talked about in past research, and what can be done to re-engage those factors that are not at the forefront?

To answer these questions, we analyze relevant academic literature concerning the digital divide in the context of disability. The following sections discuss how the review was conducted. First, the methodological aspects of literature review are presented. The "results" section highlights a research framework for understanding the digital disability divide. The last section presents the discussion, the conclusion and future research possibilities within this field of study.

2. Review methodology

2.1 Selection of articles

Journal and conference articles were retrieved from four major databases: Academic Search Premier, ABI/INFORM Complete, IEEE/IEE Electronic Library and Association for Computing Machinery (ACM). The aim of this selection was to locate a variety of research publications focusing on both the digital divide and people with impairments. To capture a wide range of papers in the initial search, multiple keywords and keyword combinations were selected. This selection was extensive to avoid incomplete data; the keyword list is shown in Figure 1. Within a single database, the first iteration of the search was run with a single keyword, followed by combinations of two and three keywords. This process was then replicated to multiple databases, thus resulting in multiple duplicates.

This search revealed 4,778 results across the four databases. Quality control was achieved by three reviewers (two at a time) going through the entire list and excluding any articles that did not directly relate to information technology and people with disabilities. The preliminary elimination round focused on titles, followed by a closer inspection of abstracts and in certain cases – where a decision could not be made – the complete paper. Prefaces, editorial notes, book reviews, interviews and articles with only abstracts were also excluded from this set. Many papers were excluded because the search criteria produced clearly inapplicable papers. Approximately 250 papers were read through to various degrees. Based on the relevance to the areas of disability and the digital divide, 173 articles remained, which is approximately 3.79 per cent of the overall results (Figure 2).

2.2 Review process and inter-rater reliability

Four core dimensions and ten sub-dimensions were identified based on the model described in our previous research (Sachdeva *et al.*, 2013), and the articles were classified within these dimensions. Three authors acted as reviewers and were randomly assigned articles to review. Each article was reviewed by two independent authors to ensure objective classification. If any of the authors disagreed, leading to a dispute, each author read the abstract, and if necessary, the complete paper until consensus was reached. One author then combined all the results to better understand the frequency of how often the core and sub-dimensions were discussed in these articles.

digital disability divide, digital divide, disab*, digital inclusion, impairment, digital exclusion, disability divide, ICT, computer, Internet, technology, social exclusion

Figure 1.
Keyword list

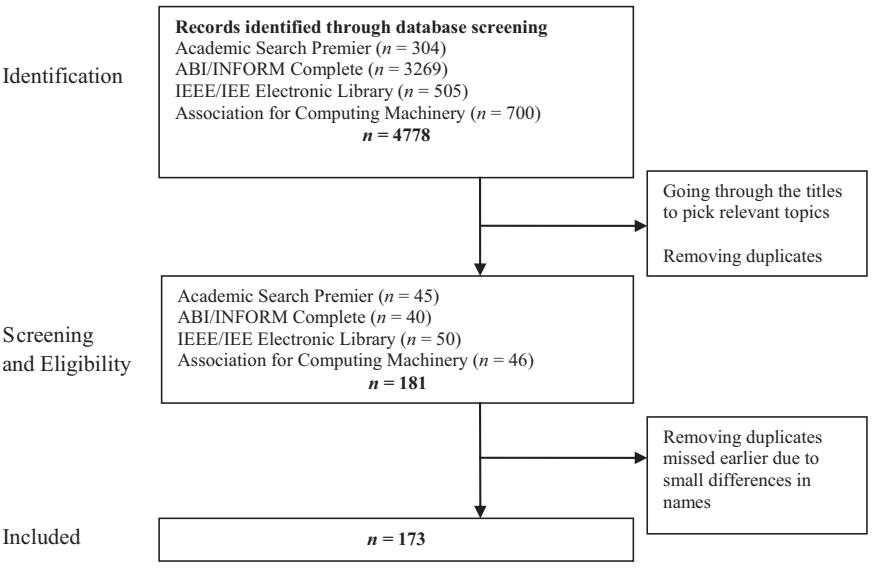

Figure 2.
Literature analysis flow

3. Concept for digital disability divide

3.1 Framework of reasons for the digital disability divide

The digital divide can negatively affect people who suffer the consequences of a lack of technology availability, accessibility and usability. While technology developers and manufacturers do not intend to make everyday technology unusable for some segments of the population, they may unintentionally create mass-produced technology with only competent users in mind. This flawed design process alienates marginal segments of users, including people with disabilities. Empowering people with impairments requires consolidated efforts. One such measure includes participation in the technology design process (Newell and Gregor, 2000). With respect to technology, a lack of participative measures, among others, results in a large divide between able people and those with disabilities – a divide we refer to as the digital disability divide. It is important to understand the framework within which the digital disability divide affects citizens with impairments. The framework in Figure 3 was created based on the structured literature review. One of the aims of this paper is to determine conditions that should be considered when designing for those suffering from the digital disability divide, thus helping designers equalize the playing field between those with disabilities and those without as much as possible. We find trying to benefit those who are least advantaged in the society to be a morally laudable goal in the spirit of Rawls (1999, p. 266). The literature review revealed a distributed focus on various impairments, including visual (Ando *et al.*, 2011; Wentz and Lazar, 2011), cognitive (LoPresti *et al.*, 2008), sensory (Peres and Suárez, 2012), intellectual (Kennedy *et al.*, 2010) and motor (Bonilla *et al.*, 2010) impairments.

The framework contains four main reasons for the digital disability divide (see Table I). The social, technical, financial and motivational dimensions of our framework are not unique to the digital disability divide because they can also be valid to other digital divides, such as the linguistic digital divide (Gorski and Clark, 2002). However, these dimensions often present differently in the digital disability divide and can require different solutions. For example, the technical dimension of the linguistic digital divide involves the lack of software and websites developed in Telugu, which is one of the languages spoken in India (Keniston, 2004). Theoretically, this problem could be solved in the social and motivational dimensions by teaching English to those Indians who speak Telugu and wish to use ICT. A comparable example of the technical dimension of the digital disability divide is the lack of Braille monitors for a deafblind person. This

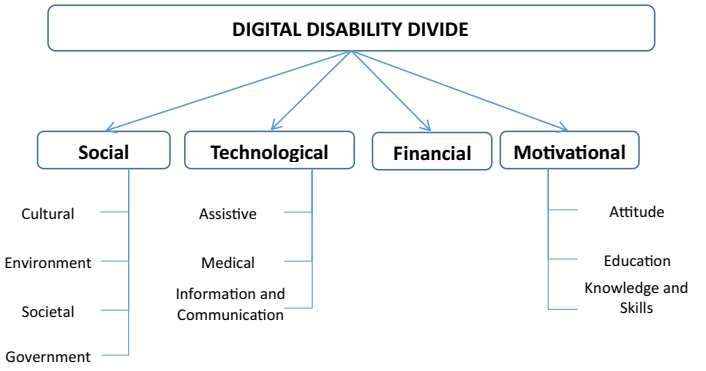

Figure 3.
Framework for the digital disability divide

problem cannot be solved through education alone, as in the previous example, because the deafblind person cannot read or hear what is shown by the software or on the website. Instead, this person must obtain access to a Braille monitor to use the software or the website. Whether or not this person can obtain access to a Braille monitor is affected by his or her financial situation and social context. This person may be able to rent a Braille monitor at an affordable price from an organization that supports the use of ICT among blind and deafblind people. However, it is also possible that such an organization does not exist in the area where the person lives. In this case, this person probably needs to save money to buy the Braille monitor.

3.2 Social

During the literature review, we located 99 articles with common themes surrounding social model perspectives (Guo *et al.*, 2005; George *et al.*, 2010), government policies (Frix and Pal, 2010; Mavrou, 2011) and inclusion (Dijana *et al.*, 2012; Ratliffe *et al.*, 2012). People with impairments are affected by everyday social mechanisms, leading to a lack of immediate resources (Abberley, 1987; Goodley, 2001; Corker and Shakespeare, 2002). A rapid growth in population results in an imbalance of opportunities (Holdren and Ehrlich, 1971). This is reflected in all walks of society, including schools, workplaces, and playgrounds. This imbalance leads to inequalities in technology availability, as can be seen in the lack of web technology (Adam and Kreps, 2006).

The digital disability divide further worsens the social aspects of living conditions for citizens with impairments. During our literature review, we found four main social factors that affect digital disability divide: cultural, environmental, societal and governmental.

3.2.1 Cultural. It is highly unlikely that people living in two different locations would have similar opportunities or same behavior. For example, developing and developed countries show different attitudes toward the incentives and treatment made available to people with disabilities (World Health Organization, 2012). However, culture as a factor in digital disability has not been discussed often in prior literature; the review revealed only five instances of a discussion on culture. The usability and accessibility of assistive technology (Jhangiani, 2006; Zetterström, 2012) in culturally different environments was a common theme in this subset.

3.2.2 Environmental. People with impairments must often deal with vagaries of the environment that are outside their control (Steinfeld and Danford, 1999; Wahl *et al.*, 2009; White *et al.*, 2010). These environmental factors could inhibit technology adoption or use, thus amplifying the presence of the digital disability divide. The literature review revealed six articles centered on this topic, with a focus on mobility for dependent people and those with impairments. Rifon *et al.* (2013) discussed the need to plan a physical environment to provide a positive environment by using everyday devices, such as a television set, to create a tele-assistance system.

Table I.
Main dimensions of the digital disability divide

Dimension	Phrase	Core problem
Social	No support	Unsupportive social environment for ICT use
Technological	No tools	Inadequate ICT tools
Financial	No money	Insufficient financial means to use ICT
Motivational	No interest	Insufficient interest to use ICT

3.2.3 Societal. Society is a large part of our overall social construct. A well-formed society allows increased participation for those who are interested. However, a lack of societal incentives for the increased inclusion of those with disabilities could aggravate the digital disability divide. The literature review revealed 60 unique sources focused on the societal aspect of the digital disability divide, with the main contributions focused on accessibility (Mavrou, 2011) and inclusion (Dijana *et al.*, 2012). Better societal rehabilitation opportunities can help reduce this digital divide (Imrie, 1997). Furthermore, Imrie (1997) also lamented the view that a disability is an individual's problem rather than a problem for the society and environment in which the individual resides.

3.2.4 Governmental. Legal and government decisions can be important in reducing the effect of the digital disability divide or removing the divide altogether. The literature review revealed 25 instances in which governmental attributes were discussed, although these instances were primarily in the scope of web and technology accessibility (Kelly *et al.*, 2007; Cooper *et al.*, 2012) and policy making to assist people with impairments (Sloan and Phipps, 2003). Government initiatives can be crucial in empowering people with technology to reduce the digital disability divide.

3.3 Technological dimension

An important component in digital living is technology; therefore, it is a crucial factor in the digital disability divide framework. While many forms of technologies are easily available, complications related to their accessibility and use are problematic. Citizens with impairments often find that technology must be personalized and customized to suit their needs (Hurst and Tobias, 2011). The literature review revealed that this sub-group was highly relevant, with 129 unique publications discussing ICT in the context of disability. Within these publications, the core focus was on designing technologies for better web (Sevilla *et al.*, 2007; Cooper *et al.*, 2012) and environmental (within the user's physical location) (Wills *et al.*, 2010) accessibility and usability (Jhangiani, 2006; Wentz and Lazar, 2011).

Both utility-based and recreational technologies are useful in managing daily tasks. Both have been covered within this framework because of their applicability in day-to-day life.

3.3.1 Assistive technology. Hersh and Johnson (2007) defined the role of assistive technology in terms of the social model as overcoming the gap between what disabled people want to do and what the existing social infrastructure allows them to do. The social model suggests that a disability is caused by the way society is organized rather than the impairment or differences among people (Shakespeare and Watson, 2001). According to Hersh and Johnson (2007), assistive technology can be used to overcome social, infrastructural and other barriers experienced by those with disabilities that prevent their full and equal participation in all aspects of society. Similarly, Carr *et al.* (2001) noted that assistive technology allows people to continue in their normal roles and meet their expectations of life despite their physical impairments or disabilities. The literature review revealed 54 publications that actively discussed the importance and use of assistive technology, with various case studies discussing assistive ecosystems, such as creating and selling software made for people with impairments (Wills *et al.*, 2010; Verstockt *et al.*, 2009; Iacopetti *et al.*, 2008) and communication platforms for the physically impaired (Guerreiro *et al.*, 2009; Keskinen *et al.*, 2012).

3.3.2 Medical technology. Medical technologies include devices, drugs and medical procedures used in medical care and the organizational systems within which such care is offered (Behney, 1989, as cited in Timmermans and Berg, 2003). While those with impairments do not necessarily use medical technology, its applications can be pivotal in reducing the digital disability divide that exists in our society. Interestingly, our literature review revealed only five articles that discussed medical technology in the context of the disability divide, further highlighting the fact that medical technologies do not play a direct role in reducing the digital disability divide. All the studies were centered on a user's environment-based living enhancements (Kim *et al.*, 2005; Chan *et al.*, 2008).

3.3.3 Information and communication technology. In addition to assistive technology, people with impairments can also use other forms of technology. For our framework, the most essential of these technologies are ICT. For example, social media platforms offer different venues of communication for people with impairments, which often proves to be highly beneficial (Spence *et al.*, 2007). Our literature review revealed 72 unique publications focusing on information and communication systems accessibility and use. The focus on the disability divide and accessibility issues in this context was clearly visible (Ellcessor, 2010; Rowan *et al.*, 2000).

3.4 Financial

A lack of finances can seriously affect purchasing power for people who wish to use technical devices. Adults with disabilities have less access to employment (Yeo and Moore, 2003), which can have a serious effect on their financial situations. Government aids and incentives could help lessen this effect (Argyrous and Neale, 2003), although this does not always occur (Verick, 2004). A lack of money could mean that people with impairments are unable to spend money on assistive or medical technology, thus increasing the scope and effect of the digital disability divide. Surprisingly, our literature review revealed only 13 articles discussing financial factors' effect on the disability divide. This number is much lower than originally envisioned and can be explained in two ways. First, researchers in the past were more focused on the technological and social aspects of the digital disability divide and thus did not research the effect a person's financial situation can have. Second, some might argue that an individual's or a society's financial state depends on social and motivational factors and thus does not have a direct effect on the digital disability divide. These papers were commonly centered on low-cost assistive technologies within impoverished areas (Pal *et al.*, 2011; Ahamer *et al.*, 2013).

3.5 Motivational

One aspect of the digital disability divide, which is perhaps more powerful than any other, is the motivation to adopt and use technology. If an individual does not possess the skill-set required to adequately use technology and is not motivated to change this shortcoming, the effect of the social, technical and financial factors becomes marginal. Instead, an individual's motivation becomes the prime component that affects the digital disability divide. It can be argued that a combination of social, technical and financial factors can affect an individual's motivation. While this might be true, we suggest that the digital disability divide framework should contain an independent motivational element based on three aspects that form the core of an individual's motivation: attitude,

education and knowledge and skills. The literature review revealed 40 unique articles on the motivational aspects related to the digital disability divide, most of which concentrated on intellectual and learning disabilities (Banerji and Heng, 2009; De Boeck *et al.*, 2012).

3.5.1 Attitude. An individual's attitude determines his/her type of response to difficult situations. For the most part, attitude is shaped by one's object, situation and personality (Sun, 2009; Maio and Haddock, 2010), but can be changed throughout one's lifetime. A strong will and positive attitude have been found to improve technology usability (Bhattacherjee and Premkumar, 2004). On the other hand, people with impairments who are unwilling to depend on assistive technology might resist it due to a negative attitude toward technology. The literature review revealed attitude's negligible effect on the digital disability divide and a focus on the provisioning of opportunities (De Boeck *et al.*, 2012).

3.5.2 Education. Education is free in some countries, thus providing a strong platform for creating viable opportunities for future employment and healthy living. Education can be instrumental in reducing the digital disability divide; however, our literature review highlighted only 17 articles on education's effect on this divide. The publications focused on the quest for learning technologies (Armstrong *et al.*, 2006; Li, 2010) and a general focus on empowering students (Znotina *et al.*, 2008).

3.5.3 Knowledge and skills. Knowledge and skills likely play an important role in dictating motivations for technology adoption and use, thus affecting the digital disability divide. Multiple studies of adults in the USA showed that owning a computer or using the Internet strongly correlates with a person's educational background (Victory and Cooper, 2002; Fox and Livingston, 2007). The same appears to apply to people with impairments (Kaye, 2000). However, it is debatable whether education is related to the knowledge and skills needed to use computers and the Internet. Within the literature review, only nine instances related to knowledge's effect on the digital disability divide were found, with the core focus being on technology-enhanced training (Sampson and Zervas, 2010; Gkatzidou *et al.*, 2011).

4. Discussion and conclusion

In this paper, we presented a conceptual framework for the digital disability divide. The ethical reason for researching the framework was to enable software designers to understand the special needs of people suffering from the digital disability divide and thus benefit the least-advantaged in our society. In our literature review, we found a rich discussion on different topics related to the digital disability divide, even though that particular term is not yet established in the common terminology. We found that frameworks that would take a total view of the problems citizens with impairments face were missing from this discussion. Our study contributes to the discussion regarding these problems. Furthermore, our aim was to provide an overarching framework centered on people with both physical and cognitive impairments. Examples of these were found in the literature as a whole.

We feel that the motivational factors affecting the digital disability divide should be studied in more detail. Understandably, negative social, technological and financial support conditions lead to low levels of motivation to use ICT for people with impairments; however, we must ask what happens when all these factors are in place

and whether people will feel motivated to overcome this divide. This should be studied in detail.

The digital disability divide cannot be bridged if those with impairments do not want to use technologies. Attitudes can be changed when people with impairments actively try to engage each other to use information resources, including social media. Opinion leaders (Burt, 1999) are needed among people with impairments to advance the use of the Internet and other resources. It is important to personally invite people with impairments to different social forums. Needs and wants occur naturally as people search for social acceptance, regardless of their health status (Gifford-Smith and Brownell, 2003). Knowledge and skills can be improved through different training methods, including self-learning, peer-to-peer support and organized learning sessions.

Our literature review has several shortcomings. The terminology used is varied and cumbersome, as Figure 1 illustrates. We may not have touched on all the relevant and important keywords the scientific community uses in the discussion on the digital disability divide. Our data collection only covered articles written in the English language, which leaves a large amount of relevant articles untouched. The framework we arrived at is partly subjective, and other researchers might have arrived at a different framework based on the same data collection. In any case, we feel that our framework satisfactorily reflects state-of-the-art scientific discussions of the digital disability divide.

We identified several reasons behind the digital disability divide in a rather atomistic way. The next research challenge is to reveal causal relationships, including the types of reasons and challenges that lead to other types of challenges and the interrelated structure of the causes. Researchers should work to locate some root causes for the digital disability divide and examine whether these vary in different settings, e.g. different levels of impairment or different countries.

Although our research is theoretical, our framework can have multiple practical implications. For example, private companies that design and produce technology play a major role in improving the quality of life for those with disabilities because innovation, personalization and better accessibility could help people with disabilities better use and accept their devices. Our framework would be a useful tool for designers with these companies because it offers a compact presentation of the different aspects affecting technology use among people with impairments, thus revealing issues that should be considered during design process. In addition, officials in the social sector who plan incentives to empower people with impairments could use our framework to identify how those with impairments could benefit from the use of ICT and which issues negatively affect ICT use among people with impairments. The same applies to public authorities responsible for offering medical and vocational rehabilitation for people with impairments to improve their possibilities for satisfactory employment and living an independent private life. In general, our framework can be used by anyone assessing and familiarizing themselves with the situation of an individual or population group who may suffer from the digital disability divide.

Based on this research, we feel that extensive assistive, medical and communication-based technology is already available. As with any technology, technical innovation is not enough; instead, the social situation must also improve for both the individual and the community. This improvement will result in social innovation, which could lead to the social acceptance of technology and a further

motivation to use it. Systemic innovation is also necessary, as seen in the information systems design tradition (Jaspers, 2009), which makes technology affordable and socially accepted. Business innovations can play a key role in bringing affordable ICT to citizens with impairments. While this paper avoids a focus on empowerment and instead focuses on the digital disability divide itself, it is clear that providing a combination of all these innovations will empower people with impairments, thus reducing and perhaps removing the effect of the digital disability divide. Thus, these innovation types – social, systemic and business – and their possibilities for empowering people with impairments need to be further explored in future research.

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