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Accessibility Experience Design (AxD): A Bi-directional Accessibility Perspective for e-Business Services

Aghaegbuna Obinna U. Ozumba and Chineme Ozumba

Abstract

This chapter proposes the idea of accessibility experience design for e-business services, as a bi-directional accessibility perspective for e-business growth in market share. The study is based on the needs for social justice, inclusion, and access on one hand, and business profit on the other. e-Business services have continued to grow with advancement of web and mobile business applications, which give better access to customers and influence the public. Awareness of the need for universal accessibility, to the services which are progressively being offered online, has also increased. Recently, accessibility policies and regulations have become more visible. However, even with the current COVID-19 situation and the shift to online mode, e-business services still lag in web and document accessibility. The resultant loss of access to the sub-population of impaired people results in missed business and market expansion opportunities. Therefore, this chapter explores the current drivers of accessibility practices, adoption by e-business services, and their market implications. The bi-directional accessibility perspective is proposed through the notion of accessibility experience design. The chapter is based on secondary research, which is complimented with demographic analysis of existing population data sets.

Keywords: a11y, accessibility, design, disability, document, e-business, impairment, ux, user experience, web

1. Introduction

Our research interest here is the apparent lack of access to the population sub-group of people living with disabilities and the economy they possess, due to the currently sub-optimal provision of accessibility in e-business services. The study is centered around the link between concepts of social justice, inclusion, and access on one hand, and concepts of market share and business profit on the other. It is based on the view we put forward here, that the sub-population of people living with disabilities is substantially and continually increased by those who are progressing in various aspects of impairment, and that they possess the capacity to make economic decisions and effective demand of business services, including e-business services.

People living with disabilities have certain conditions, and due to the lack of enablement by their circumstances/environment, they are unable to function fully and independently in life. It should be viewed as an outcome of the complex relationship between the impaired person and their environmental factors which essentially result in the situation of disability in human functionality [1–3]. It could be obvious or hidden, temporary, progressive, permanent, continuous, or situational, etc. [1]. There are various types and degrees of impairment. It generally refers to the senses and motor ability, such as sight, hearing, touch/feeling, mobility, and cognition [1, 4]. These types and their respective degrees of impairment, place limitations on how well individuals can use conventional systems of information and communication. Such systems arguably include physical products, the internet, digitized information such as apps, websites, electronic documents, and other digital media such as video, audio, graphics, and animation. There is therefore arguable need to provide accessibility to such nature of information for people with relevant disabilities.

Accessibility in digital information refers to the provision of ways and means through which people with various disabilities can access digitized information. It is the application of the principles of universal accessibility (UA), as expressed by the UN convention on the rights of persons with disabilities [5], UN disability and development report [6], UN DESA-UNESCO forum on disability and development [7]; and whose general approach and methodology is provided in the International Standard Organization (ISO) ISO/IEC GUIDE 71: 2014 [8]. Digital accessibility is provided for in the ISO 30071-1 standards [9]. There is the Web Content Accessibility Guidelines 2.0 (WCAG20) by the World Wide Web Consortium (W3C), which is universally adopted [10], with the four principles emphasizing that content must be perceivable, operable, understandable, and robust for current and future technologies [11]. As highlighted in the e-Accessibility policy toolkit, the approach should be to balance relevant factors, in providing access to full participation and independent living to all. The factors include “utility, usability, accessibility, desirability, affordability, viability and compatibility” [12].

Apps, Web and electronic document accessibility, are areas of concern for e-business services, being the medium through which, electronic services are offered to the public, by companies offering e-business services [13, 14]. e-Business is the use of information and communication technologies, with electronic means, in the digital realm, to transact information in the supply and value chains of business, as opposed to the traditional, manual, physical human interface and agency-based models [15, 16]. e-Business services are applied in various aspects of life including general e-commerce, supply chain management, customer relationship management, business intelligence, enterprise application, etc. [16, 17]. Most, if not all, currently available e-businesses, offer services to a wide range of customers, including the population sub-group of disabled people. This chapter deals with accessibility for the web, electronic document, and digital media, through which e-businesses package and deliver their services.

The provision of relevant types of accessibility for impaired people is viewed as an ideal goal and necessity. There are other initiatives such as the Web Accessibility Initiative [18], WAI-ARIA, the Accessible Rich Internet Applications suite of web standards [19], and A11Y Project [20]. In some cases, digital accessibility is regulated and enforced. For example, there is the European accessibility act of 2019 [21]. There are relevant laws in various countries, from Asia to Europe and the Americas [22–24]. In the context of the United States of America (USA), there is the Section 508 of the US Rehabilitation Act of 1973, as amended, with the Information and Communication Technology (ICT) Standards and Guidelines, under enforcement in USA agencies [25]. There is also the Americans with Disabilities Act of 1990

(ADA) with the ADA Standards for Accessible Design (1991 Standards), and the 2010 ADA Standards for Accessible Design [26].

The need and awareness for accessibility, the global conventions and policies, and regional and national laws, should constitute substantial legal, social, and economic motivations for the speedy adoption of accessibility standards globally. However, the visible level and rate of adoption is still low, and absent in some cases. For example, the WebAIM case study of top 1million websites in February 2020, found that 98.1% of home pages exhibited automatically detectable WCAG2 failures [27].

Apparently, the general view of accessibility has not evolved into that of a business opportunity, which will be inherently motivating to the business community, and therefore drive more adoption. In the USA for example, the total number of ADA lawsuits in 2019 was 11, 053, while the state of California recorded 1885 lawsuits in 2019 [28]. Furthermore, 4, 759 lawsuits were filed in federal courts within the first half of 2020 [29]. Considering the trend of lawsuits, there is a need for more motivation towards the speedy adoption of accessible design. The reported legal trends will only support the current trend of minimal adoption, and at the level of minimum requirements. Our argument in this chapter is that e-businesses need a perspective that sees the provision of accessibility, as a means to gain access to the sub-population of people living with disability. The concept of Bi-directional Accessibility in e-business services, if adopted, would achieve substantial improvement in the approach to accessibility, which will increase adoption, especially in e-business service delivery.

1.1 The concept of Bi-directional accessibility for e-business services

Bi-directional accessibility can be thought of as a philosophical view of accessibility which says that when a barrier between two parties is removed, access is achieved, not only for one party, but for the two. Using the analogy of a physical space with secure access: When the door is opened, it gives access to the person without to enter the room, while giving access to the person within, to exit the room into the space from where the other person enters the room. Using the analogy of the internet service: When someone uses a computing device such as a tablet computer to access a website, the unique internet protocol (IP) address of the device is registered with the service provider. The act of accessing the website automatically makes it possible for the website administrator to determine the IP address of the device, which can be used to trace it. The idea of bi-directional accessibility is currently applied in internet services. A key example is where websites offer free resources, which require visitors to enter contact details such as email address. Some websites will send a link to the free resource, to the email address as a validating measure. Currently, due to regulations on the use of personal information [30], visitors would be made to agree to privacy policies, before accessing some of these free resources online. By accessing the free resource, the visitor willingly gives the website administrator their email address and agrees to receiving information from them such as promotions and newsletters. This simple transaction gives many web-based businesses access to an ever-growing customer base. In practice, many such visitors evolve into customers in their database, which is an increase in market share. The Bi-directional accessibility perspective says that if e-business services make accessibility a priority and implement it fully, they will gain access to the market share that is made up by people with various disabilities. Essentially it provides a combined view of accessibility, where the inclusivity factor is balanced with the business case. Adopting this view will make businesses more proactive in the provision of accessibility in their digital space, as opposed to being compelled by

the threat of lawsuits. Businesses will then go beyond providing basic accessibility, to providing what we have classified as 'Accessibility Experience Design' (AxD), in the design of their e-business services. However, this notion may not be enough to drive more adoption of UA in e-business services. To promote this paradigm shift, the business case needs to be made and a deeper understanding needs to be built.

1.2 The case for bi-directional accessibility for e-business services

The case for accessibility is emphasized by the global charters and standards which have been referred to earlier. Furthermore, there are historical precedents supporting the case for accessibility. Such precedents include the conventions, regulations, and ordinances that are available at the global, regional, and country levels. There are also accessibility standards from W3C.

Regardless of these developments, the concept of e-Business Accessibility seems not to have taken root with the right perspective, as businesses which have internet presence have all not become universally accessible. Also, efforts to make internet presence accessible, seem to be driven by concerns about possible legal liabilities. The apparent notion seems to be that of providing access to people with limitations/impairments, as opposed to creating an avenue through which both service provider and client can access each other. The mutuality of the benefits of Web and electronic document accessibility is not emphasized in the business case for the provision of accessibility by e-business services.

An important issue is the 2020 Covid-19 global lockdowns, which have continued into 2021. It has resulted in a massive shift to provision, or supplementation of services through electronic channels. Although it would be a welcome development for many people with disabilities because it should present ease of access, this is not the case. Many websites, apps and e-documents are still inaccessible to people with disabilities. The people most affected are those with vision, hearing, motor, and cognitive disabilities. However, the result of this limited access to e-business services by people with disabilities, also means that those businesses have limited access to the wealth base controlled by such people.

This is a pertinent issue since businesses are set up for profit. It follows then, that a paradigm shift is needed from mere provision of access to disabled people, to creating mutual access between businesses and the sub-population group of disabled people. This philosophy is what we refer to as Bi-directional Accessibility for e-business services, the business case for accessibility. Arguably, it is applicable to other areas of life where there is need to improve the extent of transactional relationships. There is a need to view accessibility holistically, beyond the issue of social justice. There is a need for a wider and more balanced view, which includes the perspective of accessibility as a meaningful business expansion tool, for accessing a substantial section of the market.

For this paradigm to be adopted from a business profit perspective, the business case needs to be substantiated by providing data, from where relevant conjectures can be drawn. Hence a research design was set up on the derived aim of the study:

To identify and substantiate the relevant market population factors which justify the need for bi-directional accessibility for e-business services and build a basic understanding of its application.

2. Research design for the study

Due to the nature of the study as dictated by the stated aim, a mix of quantitative and qualitative data was needed. Additional research was carried out through

a pragmatic process, using a rather abductive reasoning approach [31, 32], through a multi-staged, mixed method approach [33, 34]. The research involved a review of purposively selected research documents and reports, demographic analysis of existing population data, and scenario and user analyses. Review of literature has been used to identify the drivers or market factors, in the preceding background to the study. Relevant population research output was analyzed, while existing population data set was used to perform additional demographic analysis. Through this multi-layered approach, the demographic dynamics of the disabled sub-population groups and their market implications, are determined and used as basis for scenario building [35, 36], and analysis of the user experience of disabled persons. The research design exploits the strengths of Survey strategy, literature review [37, 38], Design research, empathy probe and persona analysis [39, 40], and user experience research [41, 42].

For manageability, the study was scoped down to the geographical region of the USA as a country. However, comparison with non-US data is used to introduce the themes under which results are presented. A purposive sampling approach was adopted for the study, for relevant sources of data, which are grouped under, fact sheets, research publications, design manuals, and the US census data set. A sample size of 12 data sources was used for the study. A systematic literature survey using Google Scholar and the plain Google search engine were used to identify and select key research. Data was extracted and interrogated through content analysis of fact sheets and research publications, and descriptive statistical analysis of the US census data set. **Table 1** shows details of the data sources.

The hybrid methodology provides a framework for highlighting the potential strength of the disabled sub-population. It sheds light on the negative customer

Source	Source Details
Fact Sheets	WHO [43] Disability and Health Key Facts
Fact sheets	Center for Disease Control [44] fact sheet on disability
Fact Sheets	UN Department of Economic and Social Affairs factsheet on persons with disabilities
Research Output	Okoro et al. [45] - Prevalence of Disabilities and Health Care Access by Disability Status and Type Among Adults
Research Output	Yin et al. [49] - A Hidden Market: The Purchasing Power of Working-Age Adults with Disabilities
Research Output	Duffin [50] - U.S. population by generation
Research Output	World Data Lab [51] – The silver-economy-richer-older
US Census Data Set	US Census data set on persons with disabilities
Research Output	Williams and Brownlow [48] UK 2019 Click-Away Pound Report
Research Output	World Data Lab research of 2020
Research Output	Ozumba [53] Cognitive Impairment Spectrum
Working paper	Ozumba [54] Working paper on empathizing with people who work from home
Design Manual	Microsoft [52] Inclusive, a Microsoft design toolkit

Table 1.
 Details of the study sample of data sources.

experience and loss of business opportunities, and the possible gains of applying bidirectional accessibility. Results are presented hereunder.

3. Results of the study

Results are presented by layering disability statistics in an integrative manner with discussions following, covering the study aim. This approach provides for robust analysis and cross validation of results, as relevant facts are presented and discussed to build the evidence.

3.1 Demographic dynamics of disabled persons by age

Firstly, from a global view, the first population statistic to discuss is the WHO 2020 fact sheet on disability. It shows that there are about 1 billion people or 15% of the world’s population who live with disabilities. The numbers are also increasing due to population growth, advances in medicine and healthcare, and the aging process [43]. Considering the global statistics, it is arguable that a substantial portion of every nation’s population would be increasingly disabled.

Secondly, in the case of the USA, using the Center for Disease Control (CDC) fact sheet on disability [44], based on [45], the global statistic translates into 26% or 1 in 4 adults in USA having a disability. The fact sheet and original research report also show that, 2 in 5 adults aged 65 and above, have a disability [44, 45]. While a quarter of the adult population segment has disabilities in the USA, it is noteworthy that the ratio increases appreciably for retirees, pensioners, and senior citizens. This group would progress in impairment as they get older, thereby needing more accessibility.

Thirdly, analysis of 2019 data from the United States Census Bureau’s (USCB) 1-year estimates, indicates that 41 million people or 12.7% of the US population have a disability [46]. While there seems to be a gap between [44–46], the census figures here refer to documented and non-hospitalized cases. Notwithstanding, there is a baseline of at least 41 million disabled persons who need access to independent living, including access to e-business services. The stated 12.7% of the population constitutes an appreciable market share that could be exploited. Furthermore, **Figure 1** derived from USCB data supports the phenomenon of a positive correlation between disabilities and aging.

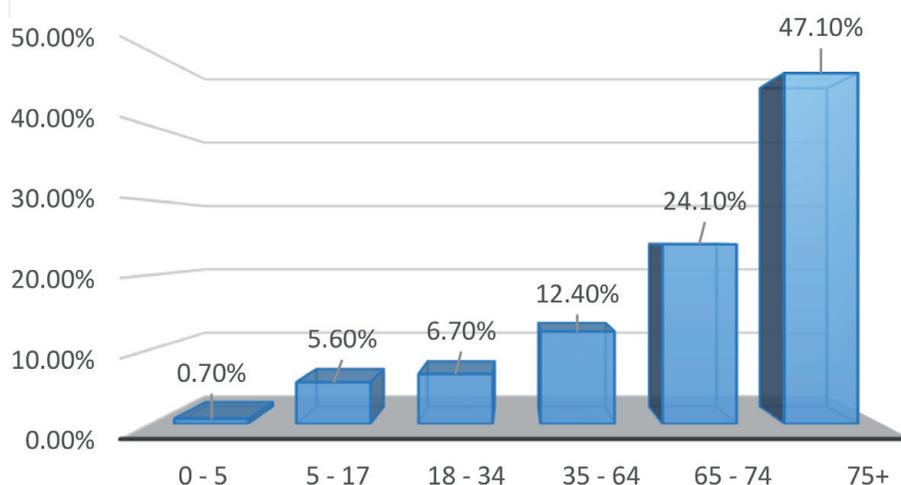


Figure 1. Percentage of US population with a disability by age (derived from [46]).

Figure 1 shows that the proportion of people with disabilities increases with age. There is also the phenomenon of ‘sudden leap’ in the rate of increase at some stages, which occurs in the age ranges of 5–17, 35–64, and above 75. Perhaps the most significant trend is that by 75 years and above, about half of the population have a disability. This trend supports [44, 45]. Chronic medical conditions and aging process are major drivers of disability in the US. Chronic conditions increase with age. Since the percentage of people with a disability increases with age, it follows that a substantial portion of those in the range of 35–64 have disabilities, and they will progressively join the group of 65–74 and above 75. The collective volume of this population segment would be made up of people who are still working and those who are retired. In each case they would control substantial amounts of funds to make economic decisions, which could benefit e-business services.

3.2 Demographic dynamics of disabled persons in relation to financial capacity and market implications

To discuss the market implications, we start with another external (non-US) view by reviewing UK, a comparative economy to USA. The UN-DESA factsheet on persons with disabilities shows that 75% of the companies on the Financial Times Stock Exchange (FTSE) 100 Index, miss out on more than \$147 million in revenue. The loss is due to their lack of basic levels of web accessibility. Their e-business services are largely inaccessible [47]. To further support our argument, the UK 2019 Click-Away Pound Report, shows that 69% of website visitors with disabilities, will leave a website, once they experience inaccessibility. In their telecom sector, about 92% of persons with access needs, will not contact the website owners about their experience. As such it may seem that there are no accessibility problems on a website, while the people who click away, move on to more accessible sites and spend their money [48]. Such is the nature of direct loss of market share and business opportunity, due to lack of accessibility. Within the US context, it is important to note that 15% of the economic decision makers (those aged 18 years and above) have a disability. See **Figure 2**.

If they do not have access to desired e-services, it translates to missing out on 15% of 18–34, 35–64, 65–74, and above 75 age ranges, and the funds they control. Furthermore, among this 15%, the greater proportion is made up of people who will access the internet on their own, apart from those who have self-care and independent living difficulties. See **Figure 3**.

Results of the “Hidden Market” research by [49], shows that the total disposable income for working-age people (18–64) with disabilities in the US, is about

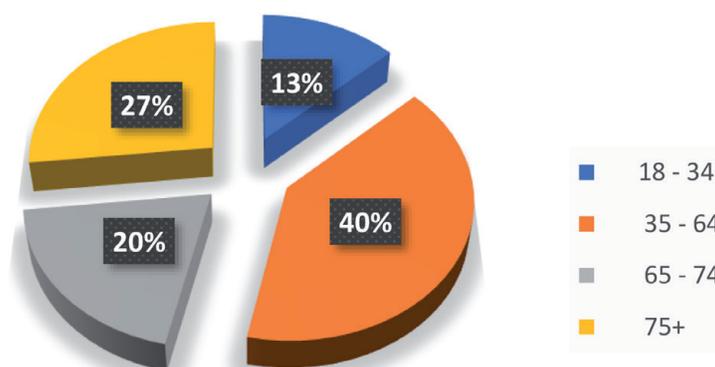


Figure 2.
Economic decision makers with a disability by age group (derived from [46]).

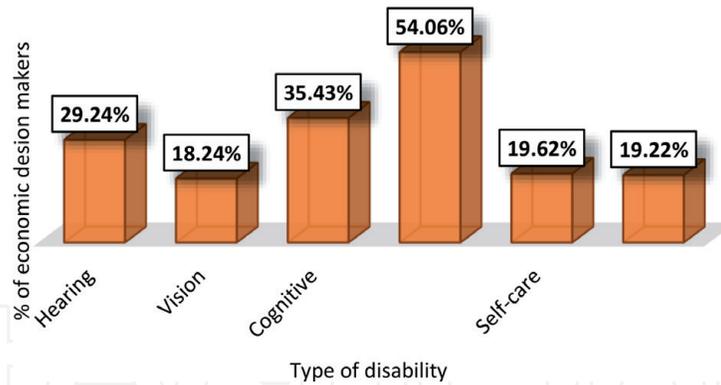


Figure 3. Economic decision makers with disability by type (derived from [46]).

\$490 billion. Though it is only 7.2% of the disposable income of people without disabilities (\$6,787 billion), it remains substantial. It is closer to the total disposable income of other market segments including African Americans (\$501 billion) and Hispanics (\$582 billion) [49]. This comparison highlights the appreciable nature of the disabled persons’ market share.

At a deeper level, research by [50], shows that by 2030, the last of the baby boomer generation would be older than 65 years. With a population of 69.56 million, baby boomers constitute the second largest population group in the US. Due to the positive aging–disability correlation, as they transit to 65 years and above, their rate of disability will increase, thereby increasing the total proportion of people with disabilities. Baby boomers fall within the population sub-group known as ‘Silver Economy’, those aged 60 and above [50].

Research by World Data Lab in 2020, shows that within the US, the silver economy population, currently have a spending power of \$3.4 trillion. Their wealth control is expected to grow to \$4.4 trillion in the next 10 years [51]. The silver economy falls within the age group that experiences rapid increases in the rate at which disabilities progress, as shown in **Figure 1**. They have greater financial control and greater occurrence of disability at the same time. It means that they have more accessibility needs, more spending power, and more capacity to make economic decisions quickly. Furthermore, the implications of the current COVID-19 lockdowns and restrictions for this population sub-group will keep them appreciably indoors, for health reasons. They will need to access more services online than before. Moreover, most services have gone ‘e’ since the COVID-19 pandemic, making it imperative that more people will need accessible e-services. Since members of the silver economy control a substantial financial base, and are at home, they will have appreciable need for online purchasing and client services. This makes accessibility experience design imperative for accessing the market they represent.

3.3 User experience analysis and its implications for business opportunity

With the analysis and discussion thus far, there is an appreciable population of disabled persons who control substantial amount of the money within the US economy. To explore their user experience, it is important to highlight an outlying population, which is not usually addressed in accessibility studies. We refer to the population working remotely and online. They are better understood through their experience, and the types of access needs they have.

3.3.1 The outlying group who work online, remotely, and from home

Greater percentage of this group are classified as able-bodied people without impairment. As such there is little, if any, sensitivity towards them in accessibility discourse. However, user research shows that they experience different types of impairment. Disability used to be defined only as a limiting condition which a person moves around with. Currently disability is defined more as a complex thing involving any pre-condition and the features of a person's environment, hence it is dependent on context [52]. The temporal and situational disability occurrence in the US, accounts for up to 21 million impaired persons yearly [52]. The Microsoft accessibility persona spectrum highlights that injuries and illnesses create temporary impairment. However, the situational impairment could arise due to anything within the environment which the person responds to. It could be due to a factor the person must accommodate to perform a task, or a situation between two persons. This type of impairment happens to people who are normally classified as non-disabled, turning them into disabled persons within a specific time interval, context, and situation. Essentially, just as with a permanent disability, the person who is situationally disabled, remains a disabled/impaired person for as long as the disabling situation and contextual features remain. The implication is that an appreciable amount of the able-bodied working population will experience some type of accessibility need at various intervals. Though more dynamic, that is an additional market share to exploit for business opportunities.

Therefore, universal design is encouraged in contemporary IT design. Designing for the worst-case scenario, or for the permanently disabled will essentially accommodate all other cases [52].

In addition, the more subtle aspect of disability is cognitive impairment, especially temporary and situational cognitive impairment. According to [53] it ranges from permanent to situational. See **Figure 4**. Here we highlight situational impairment, in Ref. to those working online remotely, especially those working from home. While the extremes have been presented here, there are other psychological levels that fall between the three key points presented under situational disability. All the possible cases can arise while working remotely from home, thereby creating situational needs for accessibility.

The user experience implications are that the situationally disabled person who needs access to a web site or an app, needs it immediately, and in that situation.

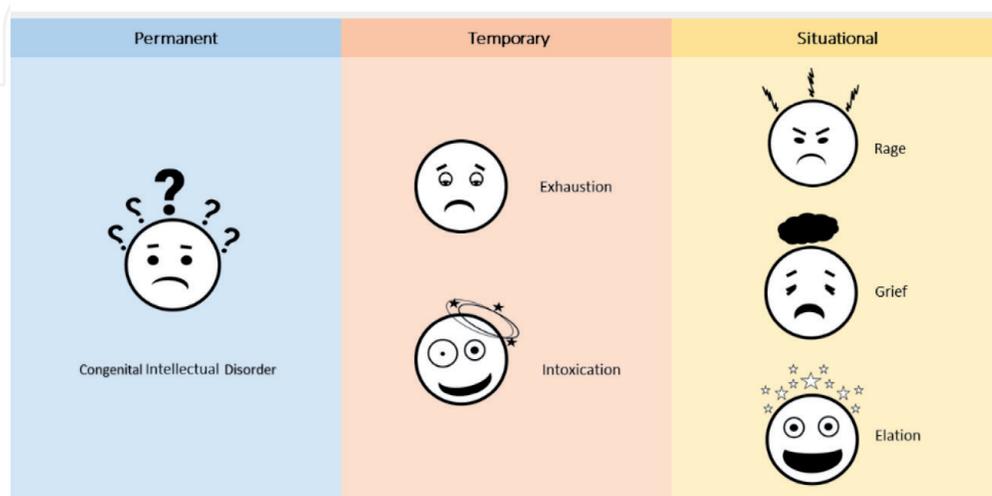


Figure 4. Persona spectrum for cognitive disability [53].

Usually, it is to perform a task that is needful within the same disabling situation. Therefore, they would move across e-services quickly to find the one that serves their purpose.

Furthermore, the user experience implications are substantiated by recent user research showing, that cognitive load is a major frustration for a lot of people working from home. They experience the need to multi-task and manage the friction between the home and the encroaching office environment [54]. The COVID-19 pandemic has driven up the adoption of work from home mode, which has prospects of increasing permanently [55]. Before the pandemic, about 80% of employees in the US wanted to work from home for some of their work time [56]. However, research also shows that those who work from home experience various levels of stress, which arguably, lead to increase in cognitive load [57]. Therefore, while most persons in the working population do not have any known impairments, the phenomenon of situational disability would create access needs for them, which could result in loss of opportunities for the e-businesses, which they are not able to access.

3.3.2 Scenario analysis of a typical disabled user and an e-business owner

Here we introduce and analyze the user experience scenarios, probing into the disabled persona and deriving empathy, to fully contextualize the business implications. Three scenarios are simulated for this purpose.

Scenario 1 refers to the physical business service scenario for a typical person with visual disability. It is the normal setting where human interface is used, which inherently addresses the issue of accessibility, with simple practice of customer relationship skills. Probing into the personas, the business representative (REP) will welcome and help the prospective customer to make the decision to buy. In this case, it is basically natural and there is little danger of losing a business opportunity due to lack of accessibility on the part of the business owner. Unfortunately, business owners could move their services online with the wrong assumption because the person with disability sought out the business in this normal case. It is possible to erroneously expect that all types of customers will maintain loyalty regardless of the level of accessibility on their website.

Scenario 2 is about the situation where the e-business is inaccessible. The business has moved online with an assumption based on a different scenario. Thus, the prospective customer with disability feels excluded and unwelcome. However, being desperate for the service, he does not wait, and does not bother to complain, but moves on to find an accessible alternative, while making a point of duty to tell his network. On the side of the business, accessibility is not prioritized. The budget is devoted to optimizing SEO and increasing advert campaigns, with more focus on persons without disability. The outcome at best would be that the conversion rate on the website remains the same while the bounce rate remains the same also. This would be due to the business competing only for the same market share, without accessing 'the hidden market'.

Scenario 3 is about the case where the e-business service provider recognizes the 'hidden market' of persons with disabilities and prioritizes accessibility experience design, to target them. In so doing their e-business services become more accessible to other groups of customers, including those with temporary and situational disabilities. Targeting the population of persons with disabilities would have a relatively competitive cost to the other priorities for driving sales. Research shows that the persona of disability will generate more loyalty for accessible sites, just as they would easily avoid inaccessible sites. Another important note is that while they would not complain to the business service provider, they will spread the news

through their network. Hence while the inaccessible e-business service may not be alerted to the problems of their website, many potential customers will know in a short while. It could result in a case of undetected loss of business opportunities.

From the three scenarios, Scenario 3 is successful because it mimics the natural process in scenario 1, albeit in the digital realm.

4. Conclusions

This book chapter discussed the importance of the sub-group of persons living with disabilities, from the more holistic perspective of bi-directional accessibility. It provides better motivation for e-businesses to embrace what we have described as Accessibility experience design, taking user experience to an inclusive level. The study was motivated by the lingering sub-optimal adoption of accessibility practice among e-businesses, despite the existence of drivers. The case for balancing the social and moral requirements for accessibility, with the need for business profit, through the bi-directional accessibility perspective, was established. The case was made for targeting the population of persons with disabilities as a market share, offering them e-business services with accessibility as a package, and therefore accessing the economy they control. To substantiate the argument, there was a need to explore the different types of disabilities, to determine the various types and the proportion of the population which fall under each category. It was necessary to understand in broad and specific terms the strength of the population, who they are, understand the world they live in and therefore empathize with them.

Through the bespoke methodology for the study, appreciable insight has been derived on the dynamics of disabilities and the market implications. This chapter arguably adds a lot of value to the accessibility discourse, introducing new thinking such as AxD and bi-directional accessibility for business services, and introducing new research on accessibility such as [53, 54]. The case for bi-directional accessibility has been articulated and substantiated through analysis of existing reports, and statistical analysis of census data set. Qualitative data from user research was used to construct and analyze the scenarios and realities of the key people concerned, making it possible to empathize with them. Arguably, the information in this chapter should assist relevant people to make the right advocacy and proposal for investment in accessibility. It provides a basis to motivate for the adoption of bi-directional accessibility among e-businesses. The concept of experience design has existed for some time, and many prefixes have been added to it, such as UxD, CxD, etc. However, the notion of AxD, accessibility experience design, invokes a mental model which places accessibility above mere compliance.

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