Digital Divide, Citizenship and Inclusion in Amsterdam

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DIGITAL DIVIDE CITIZENSHIP AND INCLUSION IN AMSTERDAM

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Participatory Action Research

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De Digitale Kloof wordt vaak geassocieerd met die delen van de wereld, waar toegang tot Internet en Web slecht is of zelfs geheel ontbreekt. Maar ook daar waar Internet infrastructuur en toegang wijd verbreid zijn zoals in Amsterdam, blijkt er een zeer serieus te nemen Digitale Kloof te bestaan.

Onderzoek laat namelijk zien dat maar liefst 1 op de 5 inwoners praktisch gesproken niet in staat is gebruik te maken van Internet. Dit als gevolg van verschillende factoren zoals armoede, dakloosheid, laag-geletterdheid, problemen met spreken en lezen van officieel Nederlands (Amsterdam herbergt maar liefst 180 verschillende nationaliteiten), of gebrek aan digitale vaardigheden.

Dit vormt een groeiend probleem, omdat overheden zowel als bedrijven steeds meer hun communicatie doen verlopen langs elektronische weg. Tegelijkertijd wordt het gebruik van traditionele communicatiekanalen, zoals brieven en persoonlijk contact, moeilijker of zelfs onmogelijk (gemaakt). Dit treft kwetsbare groepen in de samenleving extra hard, zowel in de rol van consument als van burger. De reeds bestaande "gewone" problemen in het leven worden zodoende verergerd door bijkomende communicatieproblemen. Deze stapeling van problemen heeft een sociaal uitsluitende werking.

Dit boek geeft een concreet beeld hoe de Digitale Kloof in een geavanceerde metropool-context de levens van kwetsbare groepen in de samenleving beïnvloedt. Het is het resultaat van een aantal Action Research afstudeerprojecten door Infor-

mation Science master studenten en stafleden van de Vrije Universiteit Amsterdam, uitgevoerd in directe samenwerking met locale communities.

De belangrijkste vraag is: wat kan er praktisch aan de Digitale Kloof worden gedaan? in termen van oplossingen die beogen (ook digitale) ongelijkheden en sociale uitsluiting in onze maatschappij tegen te gaan — één van de Sustainable Development Goals (SDGs) van de Verenigde Naties.

Hierop geeft het werk van studenten zoals gerapporteerd in dit boek antwoorden. Bij voorbeeld: Voor laag-geletterden kun je, in plaats van schermen en teksten, spraakdiensten door een "AI agent" inzetten die uitleg geven, bij voorbeeld bij het aanvragen van een DigiD. Voor daklozen kun je een gebruiksvriendelijke mobiele app maken die up-to-date informatie bijeenbrengt voor vragen als: waar kan ik eten, waar kan ik slapen, enzovoorts. Met de hedendaagse ICT-taaltechnologie is het nu mogelijk toepassingen te bouwen die automatisch belangrijke informatie voor burgers in allerlei talen vertaalt. Je kunt applicaties bouwen die ingewikkelde teksten (zoals die in officiële brieven van de overheid) omzetten in eenvoudige woorden — van belang voor laag-geletterden en mensen met een migratie-achtergrond die de Nederlandse taal niet goed machtig zijn. Het zij gezegd dat zulke praktische oplossingen, nieuw door studenten ontwikkeld, nog niet in het stadium van grootschalige uitrol zijn. Anderzijds blijkt dat het hele traject van het ontwikkelen van een goed idee samen met de doelgroep, het ontwerpen en bouwen van de software, en het uittesten met gebruikers, met succes mogelijk is met een zeer beperkte inspanning (enkele maanden werk).

Dit boek bedoelt een wake-up call te zijn voor beleidsmakers, overheid en bedrijfsleven. Er is een serieuze Digitale Kloof die om actief beleid vraagt. Allerlei praktische oplossingen, waaronder die als besproken in dit boek, blijken realiseerbaar te zijn, maar daarvoor zijn gerichte inspanningen nodig, en wel in directe samenwerking en co-creatie met de doelgroepen.

EXECUTIVE SUMMARY

The Digital Divide is commonly associated with those parts of the world, where access to Internet and Web is poor or lacking. However, even in places such as the city of Amsterdam, where Internet infrastructure and access are commonplace, a serious Digital Divide exists.

Namely, recent research shows that a significant part of the population (1 out of 5) is currently de facto excluded, for a variety of reasons including poverty, low literacy, lack of digital skills, problems with speaking and reading the official language (Amsterdam, a city of under 1 million, hosts 180 different nationalities), and homelessness.

This represents a growing problem, as government authorities as well as businesses increasingly use electronic channels for their communication with customers and citizens, thereby reducing or even blocking alternative more traditional means of communication such as letters or personal contact. This hurts vulnerable groups in society disproportionally. On top of the existing "normal" issues in running their life, they moreover have to deal with additional problems related to digital communication. This combination of the two triggers further social exclusion.

This book offers a concrete view on how the Digital Divide works out in an advanced metropolitan context and how it influences the life of vulnerable groups in society. It is based on several community-oriented Participatory Action Research

projects by Information Science master students and staff at the Vrije Universiteit Amsterdam, carried out in direct collaboration with local communities.

The key question is: what can practically be done against the Digital Divide? in terms of solutions that aim at reducing (also digital) inequalities and social exclusion in society — one of the UNs Sustainable Development Goals (SDGs).

The work of students as reported here gives some practical answers, for example: Instead of screens with texts, for low-literate people one can offer speech services in which "AI agents" provide explanations, e.g. how to obtain a DigiD, a digital identity profile at the (Dutch) government. Simple user-friendly mobile apps can be developed for homeless people that collect and present information on important daily questions such as: where can I eat, where can I sleep, etc. With today's ICT language technology it is now possible to build applications that automatically translate important information for citizens in many different languages. One can build applications that transform difficult texts (such as those in official letters from authorities) into simple phrases — of importance to low-literates but also to people with a migration background that have a limited proficiency in the local national language. It is noted that the discussed practical solutions, as they are newly developed by students, are not yet mature for large-scale roll-out. At the same time one observes that the whole trajectory, of creating a good idea together with the target group, constructing software, and testing it with users, can be successfully realized with limited effort (in the order of a few months of work).

This book intends to be a wake-up call for policy makers, government authorities, businesses and industry. A significant Digital Divide presents itself that calls for action. A range of practical solutions can be devised, with those discussed in this book serving as examples. However, this requires continued and focused efforts, that moreover need to be performed in direct collaboration and co-creation with target groups.

The editors
Amsterdam, February 2020

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CHAPTER 1

INTRODUCTION

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Our world is digitizing at an unprecedented pace. Digital technologies such as artificial intelligence, blockchain technology, the "internet of things" are opening opportunities for economic growth and are bringing innovations to society, e.g, for improved health care and medical treatment, smart energy, sustainable agriculture, education, transport and many other sectors, to the benefit of many people[1]. Yet, digitization also raises questions and concerns. Is digitization beneficial to all citizens? Can it serve the most vulnerable and disadvantaged groups in society? Is there a path to meaningful digital inclusion, or will digitization lead to exclusion and further marginalization? In search for answers and practical solutions, we take a look at the digital divide in the city of Amsterdam. In this highly connected urban area 83000 people are living in poverty.

This book is about digital development in support of disadvantaged citizens: homeless people, digital illiterates, poor migrants, elderly people and people with limited

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[1]https://www.rijksoverheid.nl/documenten/rapporten/2019/07/05/nederlandse-digitaliseringsstrategie-2.0 – accessed 11-11-2019.

literacy skills – people who knock their heads against digital technologies that do not match their context, needs and skills.

Digital development[2] is the effort to design and make available digital technologies for social, economic, and political development, with an emphasis on people in developing, low resource contexts. Although being "unconnected" is often associated with developing regions, a "digital divide" is also found in wealthy regions of the world.

This book is the result of a community-oriented research carried out by students and researchers from Vrije Universiteit Amsterdam in 2018-2019. It is part of an overarching action research program[3] that aims to *Connect the Unconnected* and support knowledge sharing and local innovation to the benefit of people in low resource environments, anywhere in the world. This purpose-oriented research is in line with the United Nations SDGs[4]: Sustainable Development Goal No. 1: *no poverty*.

The research described in this book is a continuation of a study, commissioned by the Municipality of Amsterdam, and carried out by the Athena Institute of the Vrije Universiteit, the *Armoederegisseur* or "poverty coordinator" of Amsterdam, and OostWest[5]. This resulted in the article "Digitale ongelijkheid: Een participatieve verkenning in Amsterdam", which was published in 2017 as part of the municipality's report: "Bouwstenen voor Digitale Inclusie". Whereas the study in 2017 consisted of a context analysis and co-creative needs assessment with representatives from disadvantaged groups, the present book focuses at collaborative *socio-technical* solutions: technologies designed and built by ICT developers and end-users to practically solve some of their self-defined needs.

This book may interest a diverse readership. Policymakers and development agencies may be interested in matching needs and actions in digital development. ICT developers may be interested in sociotechnical methods, detailed case studies and underlying models. Researchers may be interested how to bridge the gap between theory and practice and how to produce knowledge in action. Students may find a source of inspiration, how to obtain context-sensitive information that cannot be collected by desktop research or online surveys at-a-distance. Illustrated with case study materials from the field, this book aims to contribute to an open and public debate about digital inclusion and digital humanism[6]. It does so from the local perspective of the least connected citizens. It shows the importance of engagement,

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[2]In 2018 the American development organization USAID launched "Digital Development' as a new term for what was previously referred to as "ICT4D". This is still under discussion, see e.g. https://www.ictworks.org/ict4d-digital-development/#.Xcfx2ktCcvo – accessed 10-11-2019.

[3]W4RA, an interdisciplinary Action Research program of the Network Institute and Centre for International Cooperation, Vrije Universiteit Amsterdam see: http://w4ra.org – accessed 11-11-2019.

[4]See: https://sustainabledevelopment.un.org/ – accessed 11-11-2019.

[5]See: https://www.oostwest.eu/portfolio/armoedebestrijding/ – accessed 11-11-2019.

[6]See: Manifesto on Digital Humanism https://www.informatik.tuwien.ac.at/dighum/ – accessed 11-11-2019.

partnerships, commitment, mutual trust and respect in the design and development process of innovative technological solutions.

This book is structured as follows. Chapter 2, by Nicole Goedhart and Christine Dedding, sketches the context of the digital divide, giving a personal insight, through interviews, into the lives and challenges of various poor families in Amsterdam.

Chapter 3, by Anna Bon and Hans Akkermans, presents a methodology and approach for collaborative digital development. This approach has been used in the practical research described in chapters 4 to 7. For reflection on the ethical aspects of this trans-disciplinary real world research (which involves academics and non-academics) six guiding principles for technical action research are proposed.

The four case studies in chapters 4 to 7 by resp. Derek van den Nieuwenhuijzen, Marc Hegeman, Carlbandro Edoga and Wouter de Boer describe how to design and build information systems and digital services with certain groups at risk of digital and social exclusion: (i) homeless people, (ii) people with low literacy skills, (iii) migrants with a low level of education or low levels of proficiency in Dutch language, and (iv) digitally illiterate people.

The studies have been carried out as technical action research, aimed at designing and building practical solutions, while learning from the process. Each of these case studies describes efforts to find and build context-aware user-centered solutions. The approach shows user needs and opportunities, and reveals barriers and limitations hampering deployment and use of digital solutions.

Carlbandro Edoga and Marc Hegeman examined the obstacles that homeless people encounter when they search for information. They investigated the needs and context of homeless people, which are unique and require specific relevant, timely and adapted information. They focused on developing and designing a user-friendly application suite that provides information e.g. where to find shelter, food bank or medical aid.

Wouter de Boer and Derek van den Nieuwenhuijzen focused on how to overcome digital problems of low-literate and digitally illiterate people, including migrants and elderly people. They applied user-centered design, and proposed adapted language tools and virtual agents. They built smart innovative solutions and tested and adapted them thoroughly, together with representatives from these target groups.

Chapter 8 by Mickaela Wedervoort and Anna Bon gives an overview of Dutch policy on digitization and digital inclusion. It assesses the state of the art of digital development, carried out by practitioners in the Netherlands. It intends to find out which guiding principles are used to ensure that digital development is sustainable and user-centric.

In Chapter 9 gives some concluding reflections on inclusive digital development and the problem of sustainability.

This study is inspired by the societal orientation of the Vrije Universiteit Amsterdam to address big challenges in society through research and education. One of the four pillars of VU's societal ambition is: The Connected World[7]. Due to the complexity

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[7]See: https://www.vu.nl/en/about-vu-amsterdam/faculties-and-institutes/cis-vu/areas/world/ – accessed 11-11-2019.

and interdependency of many factors, big gobal and local challenges such as the digital divide can only be tackled through interdisciplinary and trans-disciplinary research. This involves academics and non-academics from various backgrounds, collaborating and producing actionable knowledge, in search for practical solutions.

The present research is also part of the Vrije Universiteit Amsterdam's educational program in *Community Service Learning*. This is a pedagogical approach of learning through service to the community. Students and local communities in society work together to solve practical problems in complex, real world contexts. This aims to equip students with social, problem-solving and inter-cultural communication skills and responsable citizenship.

The cases presented in this book do not claim to be full implementations of digital services, for which sustainability has been achieved. Given the short research period (of six months) since the start of this project in December 2018, this is considered work in progress. Results, sustainability and measurable impacts are expected after a longer period. Despite these limitations in time and scope, we have decided to publish the first results, to share the experiences with a broader community. This study provides many insights how to build meaningful digital solutions, how to facilitate the dialogue between developers and targeted user groups and respectfully include user groups in co-design and co-creation, not as beneficiaries but as the domain experts of their own livelihood.

CHAPTER 2

THE CONTEXT OF DIGITAL INEQUALITIES IN AMSTERDAM

Nicole Goedhart[1] and Christine Dedding[2]

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2.1   The need to be digitized in society

> *"I saw a vacancy for a job as a street coach. So, I thought, yes, that is really me!*
> *You will deal with youth, and kids who hang around on streets, you need to give*
> *them a new direction. So, I went to the office with my CV and the man in the office*
> *just said: Yes sir, you have to send your CV and motivation by email. I went home*
> *and I thought, well, hell, yeah ... I'll just let it go..."*[1].

The above quote is just one of the examples highlighting the fact that, in our quickly digitalizing society, without access to Information and Communication Technologies (ICTs), or without digital skills, you are severely limited. For communication with the government, banking, social contact, working, studying, entertaining, raising kids, in short: ICT is vital for virtually every aspect of life. The high entan-

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[1] Quote from an interviewee in Dedding et al. 2017 "Digitale ongelijkheid – een participatieve verkenning in Amsterdam" [1]

glement of ICTs within daily practices and services makes it almost impracticable not to use ICT. At the same time, it is widely recognized that ICTs bring risks and unintended consequences. Well-known examples are the risk of invasion of privacy, cybercrime, bullying, and technology addiction. More often neglected, however, is the challenge how to address growing inequalities due to the introduction of ICTs, globally and within welfare states.

Terms as "digital immigrants", "digital literacy", "digital divide", and "digital gap" suggest that a simple division can be made between those engaged with technology and those who are not. In practice, this is much more nuanced. For example, a person who owns the newest smartphone will have better opportunities than a person with only a cheap outdated model which is incompatible with many fancy new apps. Also, for youngsters, the social environment strongly influences how they develop digital skills and gain experiences online [2]. Digital inequalities can be seen as extensions of previously existing social inequalities: poverty, gender inequality, social class [3]. The complexity of digital inequality and mutually reinforcing and interacting relationships between social structures and ICT must be strongly taken into account when designing technology for digital inclusion.

In this chapter we analyse social and digital inequalities and their complex interrelationships in the context of poverty in Amsterdam. We describe two conceptual frameworks that support the understanding how social and digital inequalities are intertwined. Also, we discuss some findings of our participatory study in Amsterdam in which we explore the perspectives, experience and needs of citizens in vulnerable circumstances and co-create some first directions for possible solutions.

2.2   Social and digital inequalities in The Netherlands

Over the past decades economic prosperity has significantly increased in the Netherlands. Still, the number of people living in poverty has not decreased. In 2017, 6.6% of Dutch citizens were living in poverty, while in 1990 5.7% were considered poor[2]. In recent years, the number of people at risk of poverty or social exclusion in the Netherlands increased from 14.8% in 2008 to 16.8% in 2016 [7]. Due to increased disparities in incomes and education levels, differences in prospects and opportunities in society also increased [4]. In 2013, the Dutch government introduced the participation society as one of the logical consequences of digitalization. The king invoked the term in his *Troonrede*, his first official annual address[3]:

> *"Undeniably, people in our modern network and information society are more out-*
> *spoken and independent than in the past. Combined with the need to reduce the*
> *government deficit, this leads to a gradual change from the classical welfare state*

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[2]Poverty refers to the living condition in a household earning less than the basic budget needed for an independent household and unavoidable basic expenditures such as food, clothing and housing. For a two-parent family with two children this so-called "basic need budget" was estimated at 1830 EUR per month, in 2014 [4, 6].

[3]https://www.rijksoverheid.nl/documenten/toespraken/2013/09/17/troonrede-2013 – accessed 21-11-2019.

to a participation society. Everyone who is capable, is asked to take responsibility
for their own life and environment"

This resulted in a shift in the discourse, in which the concept of "welfare state" was substituted by "participation society". Social security, health and long-term care have since then profoundly changed. While the role of the state has further shrunk, the emphasis on engaging civil society has increased. Individuals are held more responsible for their own lives. Unfortunately, not everyone profits of this shift, as a consequence of differences in resources, some benefit more than others, as stated by the *Wetenschappelijke Raad voor Regeringsbeleid* in the report to the Dutch government: *Weten is nog geen doen*[4].

Based on a national survey from 2019, the CBS states that 15,8% of Dutch citizens have limited or no ICT skills and 5,1% have never used the Internet[5]. Various studies point at socio-economic status, race, ethnicity, age, or geographical location, as root causes of unequal access (e.g.[8, 9]). When social inequalities result in digital inequalities and digital inequalities further enhance social inequalities, this becomes a vicious circle [10, 11]. This is called the *Matthew effect* [12], which means that already advantaged groups are enabled to improve their social position, while underprivileged groups do not directly benefit from the introduction of ICT.

Rapid and ongoing digitalization of public and private services in all life style domains makes the problem of digital inequality visible and urgent. While the state demands more and more participation, self-care and self-management for each citizen, participation becomes difficult or even impossible for some – unfortunately these are often the ones most in need. Various studies, carried out in the Netherlands [4, 12, 13] show that citizens in vulnerable circumstances – i.e. citizens who have to deal with low digital skills, low literacy, low education level, mental disabilities and/or difficult (financial) tradeoffs – are not able to meet the demands of the digitalized participation society. As a response, the national government and municipalities have put this high on the policy agendas[6]. In 2018 a national taskforce " Alliantie Digitaal Samenleven" was organized by the Ministry of the Interior.

2.3   The research landscape of the digital divide

Since the mid-1990s, despite a worldwide increase in Internet coverage and use[7] digital inequalities continued to expand. Scientific interest in this topic became more differentiated [14]. The concept of digital divide evolved, from a simple dichotomy

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[4]This is reported by the Scientific Council to the Dutch government in 2017.

[5]From Statline – Internet, toegang, gebruik, faciliteiten. https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83429NED/table?fromstatweb – accessed 11-11-2019.

[6]De Digitale Stad: see https://www.amsterdam.nl/wonen-leefomgeving/innovatie/digitale-stad/ – accessed 21-11-2019; Ministerie van Binnenlandse Zaken in een Kamerbrief uit 2018. Digitale inclusie: iedereen moet kunnen meedoen. https://www.digitaleoverheid.nl/wp-content/uploads/sites/8/2019/02/digitale-inclusie-iedereen.moet.kunnen.meedoen.pdf – accessed 11-11-2019.

[7]Source: World Internet Users Statistics and 2019 World Population Stats.
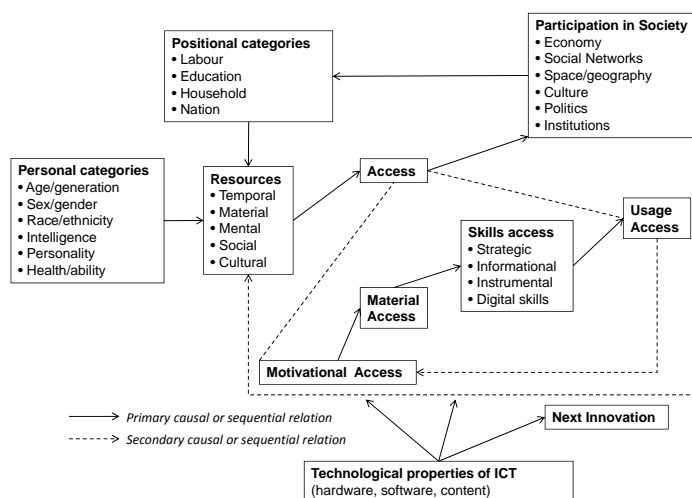
Figure 2.1   Causal and Sequential model of Digital Technology Access by Individuals in Contemporary Societies, reprinted after Van Dijk (2005) [18].

between those who have access and those who do not, to a concept of technology-related social exclusion as a consequence of a multitude of complex and multidimensional phenomena [15]. Over the course of the years, three phases of digital divide studies exist in literature.

The main question in the first phase digital divide studies is about what hinders people to get access to ICTs. This is quite logic since ICTs were considered as just another new emerging technology, like televisions or radios [16]. Several scholars showed concerns regarding this unilateral digital divide approach. Physical access to ICT was not considered the only barrier [12, 17]. The second phase of digital divide research is focused on the users' multi-layered gaps in motivation, access, skills, and Internet usage. Unequal access and use of ICTs are considered a consequence of existing social inequalities [8]. The third phase focuses not only on causes, but also on consequences [14]. Research shows that the introduction of ICTs produces 'winners' and 'losers', and report in more detail on the above described Matthew effect [12, 18].

Two largely recognized theoretical models for studying digital inequalities within welfare states are: "Causal and Sequential model of Digital Technology Access by Individuals in Contemporary Societies" by Van Dijk (2005) [18], see Figure 2.1 and the Corresponding fields model for Digital exclusion of Helsper (2012) [19] see Figure 2.2.

The "Causal and Sequential Model of Digital Technology Access" by individuals in contemporary societies, provides insight in the interrelatedness between ones off-

line resources and personal categories, inequalities regarding access to technology, and inequalities of people's level of participation in society [12]. The model shows that a person with low economic resources will have in a lesser extent access to ICT which influence one's possibilities to participate in society and have educational and/or work opportunities. This again influences ones economic resources, turning it into a vicious circle. This model highlights multiple causes and consequences of the digital divide. The aim of the model to find possible ways to intervene and thereby to close the digital divide. The core argument of the model is ([18], p.15):

1. Inequalities in positional and personal categories cause an unequal distribution of resources.

2. Unequal distribution of resources cause unequal access to technology.

3. Characteristics of the technology influence access to ICT.

4. Unequal access to technology influence unequal participation in society.

5. Unequal participation in society personal and positional categorical inequalities and distribution of resources.

Access is further conceptualized into four successive kinds of access which are supposed to be cumulative.

1. Motivational access (i.e. the appreciation of ICTs and the intention to purchase and use ICT).

2. Material access (i.e. physical access to soft- and hardware, and other secondary needs).

3. Skills access (i.e. possession of digital skills. The operationalization of skills access evolved from operational, information and strategic skills to medium related skills (operational and formal) and content related skills (Strategic, information, communication, and content creation) [33].

4. Usage access (i.e. usage diversity, usage time).

Inequalities concerning access to ICT are considered a multi-faceted concept, consisted of four successive kinds of access: (i) motivational, (ii) material, (iii) skills, and (iv) usage. These four types of access are intertwined, and all related to ones offline resources.

The "Corresponding Field Model" of Helsper (2012) is inspired by Bourdieu's understanding of capital [20] and based on the normative assumption that social exclusion is the main issue. Social exclusion is central in this model and influences how the digital inequalities are constructed. This model unpacks the offline aspects of exclusion – economic, cultural, social, and personal resources – and describes how they are linked with corresponding fields of digital resources. The directionality of this model highlights that social exclusion leads to digital exclusion, but also how
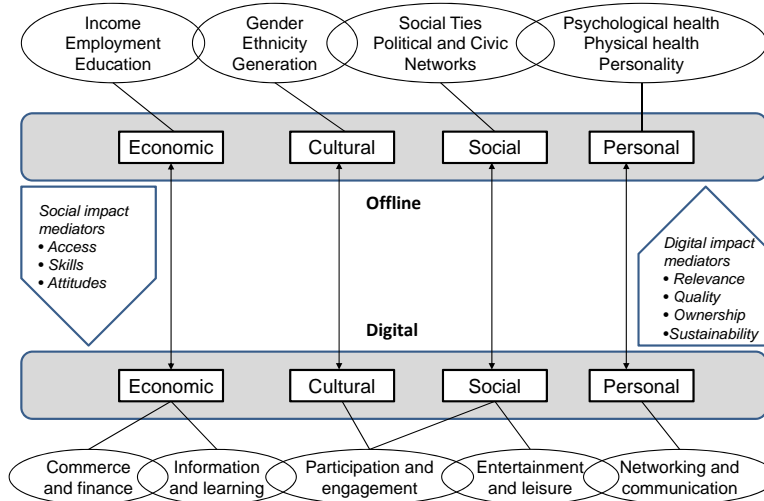
Figure 2.2   Corresponding fields model for digital exclusion. Reprinted after Helsper, E. J. (2012). A Corresponding Fields Model for the Links Between Social and Digital Exclusion. *Communication Theory*, 22(4), 403-426. [19].

digital engagement might, or might not change social exclusion. The main aim of this model is to study the interrelatedness between offline and online forms of inclusion and exclusion and, thereby, shape interventions from a holistic conception of everyday life.

This latter model connects offline fields of exclusion – economic, cultural, social, and personal – to digital field of exclusion. The aim of the model is to allow researchers to study links between social and digital exclusion and thereby shape intervention to close the digital divide. The fields of offline and digital exclusion are conceptualized. For example, the social offline field includes strong and weak ties, and political or civic networks, while the social digital field is defined as networking and communication options. The model identified two factors which mediate the impact of offline exclusion on digital exclusion and the other way around. The social impact mediator determined three mediators: Access, skills, and attitude. The digital impact mediator include relevance, quality, ownership, and sustainability. Some critical remarks on the two above models should be mentioned.

First, both models seem to have a deterministic viewpoint, focusing only on how technology influences society. They separate more technological issues from social inequalities thereby omitting the identification of embedded relationships between

Table 2.1   An overview of research activities. From: Dedding, Goedhart, Broerse, & Abma (n.d.) Numbers marked by an asterisk * indicate that some volunteers who were interviewed, were also involved in the work and/or co-creation sessions [30].

	Phase1: Understanding the problem			Phase2: Co-creation	
	Semi-structured interviews (n=55)	Participatory observations (n=18)	Work sessions (n=2)	Co-creation sessions (n=3)	Focus groups (n=6)
Mothers	7	45			21
Fathers	3	20			
Children	3	61			30
Volunteers/ professionals	42*		39*	64	

technology and social relations [21]. The models do not take into account, for example, that development of eHealth applications is most often directed by ICT developers who often take their own preferences, theoretical assumptions and skills as major guides in the design, instead of assessing the interest and competencies of their diverse user group including citizens who are digitally excluded [22, 23, 24].

Second, these models focus mostly on how some social groups are left behind in our digitalized society or what hinders them to use certain technology. To move beyond these simplified understandings of digital inequality there is a need for multi-level research that accounts for individual, family, and community-level influences in order to understand the everyday experiences of economically disadvantaged groups [25, 26]. Last, these models are most often used by quantitative researchers. These quantitative studies are helpful in mapping the correlations between social, economic, and digital inequalities. However, they are less helpful in explaining what digital exclusion actually means to people. Whereas quantitative studies questioned whether the focus on inequalities were still relevant in the Netherlands [27], where Internet penetration is currently about 90 %[8] , other studies show that access to the Internet does not equal digital inclusion [9, 28]. These new insights emphasize the need for a better understanding of everyday Internet use, including the tacit knowledge, perspectives and daily realities of citizens in their local context. It is necessary to inform policymakers about the extent and nature of the digital inequalities in this country.

[8]Source: https://www.statista.com/statistics/567514/predicted-internet-user-penetration -rate-in-netherlands/ – accessed 21-11-2019.

2.4   Exploratory Participatory Action Research in Amsterdam

In the coalition report of 2014 the City of Amsterdam stated that all citizens in Amsterdam should have equal opportunities to participate in society. With a population of which 18% is considerate low-literate, and 24% lives in conditions of poverty [29] the pressing need to better understand the extent and nature of the digital inequalities in Amsterdam was evident to all. A so-called "poverty director" was installed. In this policy context researchers from Vrije Universiteit Amsterdam were asked to conduct an exploratory participatory study on digital inequalities. The aim of this participatory research is to gain insight in the perspectives, experiences and needs of socially disadvantaged families with respect to ICT. In this approach citizens are given a voice in defining the problem and sketching solutions, as this facilitates learning and knowledge exchange between citizens, volunteers, educators and policymakers [28, 30]. The results of this study are published as technical reports titled: "Dutch report for the City of Amsterdam", "Perspectives of mothers on digitalized society", and "Critical reflection on the participatory research process" [1].

The research consisted of two phases. In the first phase we focused on understanding the problem, as experienced by families from disadvantaged neighbourhoods in Amsterdam. We conducted participant observations at language and ICT courses, interviewed professionals (n=42), parents (n=10) and children (n=3) and facilitated two work sessions (see Table 2.1). In the second phase the co-creation of solutions was central. In total three co-creation sessions were organised with volunteers and professionals (n=64). The findings of the co-creation sessions were discussed in six focus groups; four with mothers (n=21), and two with children (n=30), see Table 2.1. The following section gives a brief insight in this study.

2.4.1   Feeling limited and excluded

> *"Suddenly they [citizens who visit the volunteers language class] come with all kind of complaints about their home, they just don't know where to go. Nowadays, you need to contact housing associations online, and they just don't know how... Not seldom, it turned out they have struggling with these bad housing conditions for years..."*

This story, and many others show the (often hidden) grappling of citizens with digitalized processes. Most fathers and mothers who struggle with ICT are well aware of the importance of having access to the online world for themselves and for (the future of) their children. Without a computer and the necessary skills, they feel severely limited and excluded. Volunteer Eva often hears: "*I don't receive letters anymore, it is all delivered through that* [the computer]". Mothers also highlight that they feel excluded from the learning processes of their children. They have no idea what their children are doing on the computer, how they can help them and how to keep control of their children's activities.

The daily challenges of the families: managing sporadic income, making difficult trade-offs or dealing with low linguistic abilities, have an enormous influence on ICT

(non-) use. Volunteers highlight that citizens need to spend their time and attention on other, more pressing, issues. As for example two volunteers highlight:

> *"Parents need to focus on what are we going to eat tonight. I only have 3,50 euro left tonight or sometimes even nothing. Or dad still didn't pay the alimony. (*Pauline*) It sometimes even doesnt matter that they cant use ICT. The rent needs to be paid, the children need to have new clothes, and we also didnt pay the gas and electricity this month"* (Cas)

Kemal (12 years) explains that his mother is often "angry at the computer". He helps his mother with filling in forms or checking her mail and bank account. Other mothers affirm: "*My son always checks my bank account*". Meaning that children get involved in businesses which are not meant for their eyes. One of the debt counselors mentioned:

> *"[] these children who have access to the computer and know how to use it will read these emails [emails concerning debts]. These children will say: Hé mom we have this or that, a child cannot be a child anymore..."*

2.4.2 Most people have (access to) a mobile phone

While low literacy, poverty, and digital illiteracy may restrict most participants in their use of digital technologies, all spoken mothers, fathers and children use ICTs to some extent. In most cases this is a mobile phone.

The City of Amsterdam provides laptops to children of parents with a low income. Once every four years, parents of children between 10 and 18 years, can request a laptop or tablet for their child. The costs of an Internet subscription are also reembursable for low income families[9].

While this programme of the city of Amsterdam wants to ensure that all households dispose at least of one computer, this does not mean that everyone in the family can use it. As volunteer Fayiza explains: "*In general there is a computer in the families, however not for mum and dad*" and volunteer Kees adds: *"If you are a mum of kids then you can find the laptop in a corner, in use, or crumbled with bread and splashed with coke"*.

People who have access to multiple devices show a preference for mobile phone over computer. Some mothers say that it is easier to use a smartphone. Unfortunately, a smartphone is limited for the arrangement of more official matters like writing a CV, subvention or tax administration. Moreover, not all sites, even the ones developed for people with low ICT skills are accessible with a smartphone. One of the volunteers explained:

> *"Nowadays more than half of our participants prefer a smartphone [..] Oefenen.nl is however not compatible with a smartphone or tablet since you cannot get the whole screen. Oefenen.nl is designed for big computers"*.

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[9]Gemeente Amsterdam. (2017). Gratis laptop voor middelbare school aanvragen – Gemeente Amsterdam. https://www.amsterdam.nl/werk-inkomen/pak-je-kans/gratis-laptop/ – accessed 11-11-2019.

Moreover, the small screen of a mobile phone offers less of an overview compared to computer screen and mobile phones cannot be connected to a printer. While participants often express the need for a printer, for their own administration or for their kids' homework. The platform most often mentioned is YouTube. Children tell us how they watch videos for fun, while mothers highlight that they like to find information about cooking, health and household chores (e.g. "*how to remove this spot on my clothes*"), or beauty. Google is also often mentioned as a helpful tool to find information. Search is done in the user's own language. Other applications often mentioned are WhatsApp and Skype, which are used to keep in touch with their families.

Especially mothers highlight the use of the computer together with their children, to practice for school. Magister, an app used in secondary schools to communicate with students and their parents about grades and presence, is most often mentioned. Children also mention games like Minecraft, and social media platforms like Instagram.

However, not all participants are aware of digital online possibilities. For example, Nyah asked the researcher what a DigiD code (personal online code necessary to communicate with the Dutch government, municipalities, and health insurances) is. The fathers and mothers who are familiar with the more official websites highlight that these websites are complicated, and not user-friendly. One of the professionals highlights that citizens often get lost in the difficulties of the online world, which creates fear and stops people from acting: "*I see a lot of fear. If you don't have an overview in the digital world, if you dont understand where you are, than you won't dare act.*"

Gregory explains that the website of his health insurance is very complicated. "*Sometimes it is difficult. You search something and then you see something that might be interesting. When you click on it you go to another world.*" He has the feeling that his health insurance misleads him on purpose: "*you need to put so much effort in order to find the right page.*" He thinks this could be easier. Mistrust towards more official websites is a recurrent topic.

Mei-lan, for example, explains that she needed to apply for a public transport card for her youngest son of six. It failed, mostly because she was concerned that she was not filling in the details correctly, and afraid to pay something that would not be delivered. Also, volunteers recognize that many people do not trust the Internet. They explain that everyone knows someone in their surrounding who experienced negative consequences of filling in online forms. Volunteer Eva says:

> "*They estimated their income too low and therefore received too much housing allowance. It took two years before they [the government] realized that. So those people had to pay back a lot. I think that causes a lot of fear. It causes distrust in sharing online data and fear of using the computer.*"

2.5   Implications for digital development and concluding remarks

The above examples show how urgent and complex digital inclusion is, in the context of poverty. Citizens who are not yet (fully) connected are well aware of the

importance, and motivated to learn ICT skills. While professionals sometimes tend to say 'they are not motivated, we found reality is much more complex for people living in vulnerable circumstances. The question is: how motivated and inventive are we in developing services for citizens in vulnerable circumstances for whom other issues, e.g. managing sporadic income, poor language skills, have priority. Yet, these citizens need to survive in an online world which has not been designed for them.

Interestingly, YouTube, Google, and WhatsApp manage to reach people with low resources and low ICT skills. Unfortunately, these applications or underlying principles are still rarely or not used by official authorities in the Netherlands. Formal websites often contain an overload and too difficult language and are seldom user-friendly. This is not only the case for governmental websites; eHealth technologies are also all too often designed by and for citizens who are highly educated and have good digital skills, and not for citizens in vulnerable circumstances [22, 23].

It is clear that digitalization of work processes by public and private institutions is often done without involvement, or even consideration of those who are not connected yet [16]. The mutually evolving relationship between social structures and ICT development is also not central in the most often used theoretical frameworks for digital inclusion [18, 19]. The importance and consequences of this mutually evolving relationship resonate in other disciplinary traditions as well, e.g.gender studies [24, 31] science & technology studies and intersectionality [32]. Various studies show that technology itself is socially constructed; socio-demographics such as race, class, age, sexuality and disability interrelate with the way technologies are constructed, experienced and used [24, 31, 32, 33].

In short, we believe it is more promising to adapt digital technologies to the capabilities and strengths of the most vulnerable groups, than to teach them how to use ICT in a world that has not been designed for them. We need to improve our understanding of the daily lives of citizens and co-create (digital) solutions with them, from the start, to ensure that digital technologies fit their needs and capabilities. To do so, we propose collaboration between businesses, creative industry, policy makers, knowledge institutions, volunteers, and citizens, working all together.

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CHAPTER 3

DESIGNING FOR THE LESS PRIVILEGED: INCLUSIVE METHODS AND PRINCIPLES

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Abstract   Whereas the need to bridge the digital divide is generally acknowledged, the question remains *how* disadvantaged groups in society can be served in a meaningful way. Therefore, in this chapter we propose an inclusive methodology for developing digital technologies. It takes into account contextual complexities and the users' own goals and objectives. To support the reflective practitioner in the responsibilities and ethical aspects related to action research, a list of guiding principles is proposed.

3.1   Why are user-centered and context-aware methods essential for digital inclusion?

While the need to bridge the digital divide, as discussed in the previous chapter, is generally acknowledged, it is much less clear *how* disadvantaged groups in society can be served in a meaningful way with new digital solutions. Efforts to improve digital inclusion often focus on the *adoption* of digital technologies [1]. Adoption is based on the idea of technologies as given reality, to which people must adapt them-

selves. However, when adoption is hampered – for example due to a lack of literacy skills, language proficiency or digital skills – why not adapt the technologies? To do so, we resort to user-centered design and co-creative innovation, which are the most appropriate methods to create adaptive technologies.

Adaptive methods, user-centered design and co-creative innovation are common practice in technological innovation and creative industries [2]. For example, socio-technical approaches called *agile development, scrum* and *living labs* are widely applied in software development for business and industry [3]. However, where it comes to digital development targeting poor environments, user-centered design methods are still the less common. Since digital development is often financed through public funds[1], and end-user is not the paying customer, commercial service providers may have less incentives to invest in (costly) user-centered design to meet customer satisfaction, as discussed in Chapter 8.

The following chapters of this book present case studies that illustrate how to co-create digital solutions with the specific end-user groups. These case studies show how project goals are collaboratively set, in dialogue with user groups. Cultural differences between the digital developers and users, with respect to language, levels of education, age, and world view may be large. Developers may be unaware of the specific issues of the users' context, which is usually new and unfamiliar to them. Conversely, the possibilities of digital development may be unfamiliar to the users. The need to bridge this cultural gap is an argument in favor of user-centered and context-aware design. This is one of the recommendations of this book.

3.2   A practical framework for socio-technical digital development

The approach, which is illustrated in the following four chapters, is practical and consists of a cyclic process of prototyping, testing, analyzing, and refining the solution. User needs and objectives are central. The projects cover the full lifecycle of ICT innovation and include the intentions (purposes, goals), strategies and methodologies for each aspect, illustrating the collaborative, iterative and adaptive nature of the approach [4]. The framework is therefore displayed here as a strategy-intention map [5].

The approach and methods can be structured into a framework that consists of five distinct phases or components, as summarized in Figure 3.2: context analysis (i), needs assessment (ii), use case and requirements analysis (iii), sustainability assessment (iv), engineering, deploying, evaluating (v). The phases do not have a strict order, but can be repeated and re-iterated. For example: engineering a prototype can start briefly after the first context analysis and needs assessment. It can be evaluated and used for brainstorming about better solutions, or to elicit requirements to improve the design. During various iterations, the ideas are evaluated and the system can be redesigned based on feedback from the user group. This iterative approach

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[1]In the Netherlands the largest funds come from the national government.

Components	Possible methods	Techniques & tools
Context analysis	Action research Field research Literature review	Field visits Focus groups Demos Interviews
Needs assessment	Field research Collaborative workshops Participatory rural appraisal (PRA model suite)	Field visits Focus groups Demos Interviews
Use case & requirements analysis	Use case modeling Requirements elicitation Agile development methods	Demos & focus groups Rapid prototyping Conceptual modeling Structured narrative
Sustainability assessment	Functional evaluation Business case evaluation Technology assessment Scenarios	Interviews, focus groups e3 Value modeling Dynamic systems conceptual modeling
Engineering deploying evaluating	Living Labs Agile Development Methods User-centered evaluation	Demos Focus groups Prototypes

Figure 3.1 The iterative components of a low-resource aware framework for digital development. The methods and techniques are based on a collaborative, iterative, adaptive approach, from [4].
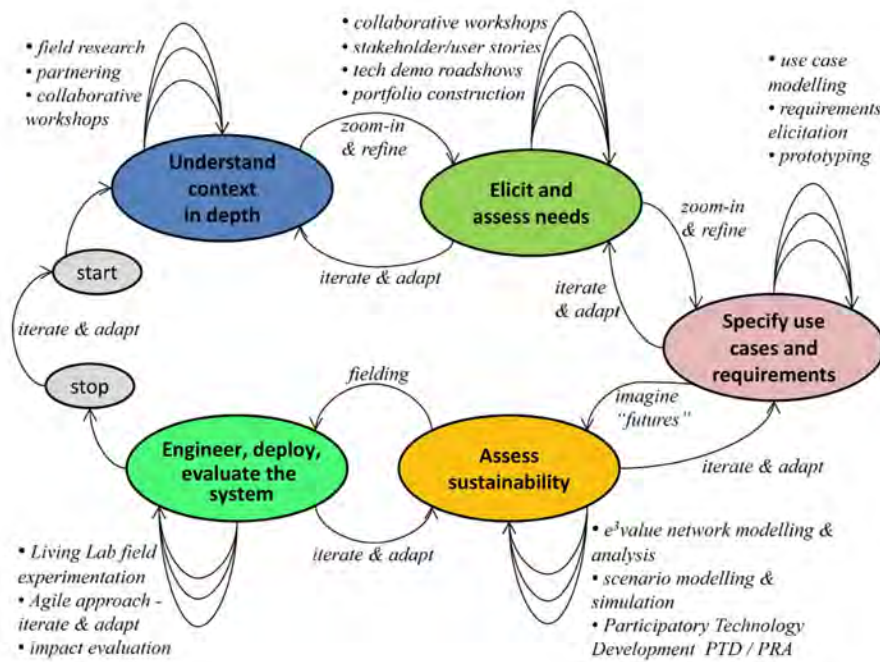
Figure 3.2   The low-resource aware framework [4], mapped as a strategy-intention map [5].

leads to design decisions in various stages of design and adaptation, until it is acceptable and meaningful when evaluated against the users' needs.

The overall approach is collaborative, iterative and adaptive. *Collaborative* in the sense that ideas and knowledge are exchanged in an open dialogue, while end-users are considered experts of context and work flows, and owners of the problem. The process is *iterative*, since design can not be done in one cycle; several iterations of discussing, evaluating, testing and improving are needed. The process is *adaptive* as it leads to solutions that are meaningful for users and adapted to context.

Local key-users   The core team involves key-users who are representative for a larger community of future users. Some users give information, others brainstorm and help design solutions; some users set priorities, evaluate, test and validate results. Text-literacy, computer-literacy or other knowledge is not required for participation in the team. Key-users (men and women) are good communicators with a sense of responsibility for the results of the project. There is a need for mutual understanding and partnership between developers and users. Diversity in the team is important.

Partner organizations   Partner organizations act as intermediaries between the developers team and the community of users. They are engaged with communities and

their problems. They have expertise in their specific issues. They maintain contacts, organize venues and visits, sometimes translate between languages, and give introductions. As partnerships matter, it is important to build longterm relationships. The organizations we have as our partners strongly support community-based social development, and are inspired by value-driven, collaborative, adaptive development approaches.

Local technology and business partners   Business partners and technical providers are often the future uptakers of innovative ICTs and should participate in the team and stay involved. How the framework caters for the concerns of less privileged contexts, is described in the following paragraphs.

- *Context analysis* is one of the key aspects of the framework shown in Figure 3.2. The need for a thorough context analysis is often overlooked, based on an (un-warranted) assumption that technology will work the same, irrespective of the context in which it is deployed. Context analysis is called for in our framework for two important reasons: (i) to bridge the big gap between technology and developers on the one hand and the world of the end-user on the other hand; (ii) because of the contextual nature of ICT and information systems themselves. Context analysis consists of field visits, road shows, focus group discussions, interviews and technology demos. It is based on field-based action research. Context analysis is not a one-off activity but a recurrent activity, in which the developer becomes familiar with the user's context. It is important to note that context analysis outcome might even be that no ICT solution is desirable, possible, or suitable.

- *Needs assessment* is a method for collaborative goal construction. Needs assessment, as a component of the above framework is a two-way, iterative process, which consists of several phases (i) jointly exploring the problem space (ii) jointly defining the solution space (iii) selecting the best key ideas, setting priorities, evaluating and jointly deciding which ICTs should be further elaborated. Needs assessment workshops make use of collaborative techniques for knowledge elicitation (living labs, ba, participatory technology development etc.).

- *Use case and requirements analysis.* The process of iterative use case and requirements analysis & elaboration is another important aspect of the proposed framework. As this is often overlooked in mainstream digital development projects, we propose a method to structure the collected data from the field research/workshops, presenting this in different views: (i) in formal technical specifications, that allow the ICT developer to design the architecture and build the system (ii) in a narrative and informal way to make sure the end-user can validate requirements and understand and discuss the technical idea/design. The method we propose is a "structured narrative method" [4].

- *Engineering, deploying, evaluating in a collaborative approach.* In Chapters 4 through 7 the engineering aspects are described and illustrated for four student

projects carried out in the city of Amsterdam. The cases illustrate how a project for digital development can be carried out. The adaptive, iterative approach is required when coping with innovation and complexity in the given context of the users. The cases show that many questions are still open. More and longer (interdisciplinary) field research is needed to improve sustainability of the results.

- *Sustainability analysis.* A useful method to perform sustainability analysis in a structured and formal way uses field research data to build scenarios and calculate business models for all actors in a value network. This sustainability analysis, which uses a method for networked eco-system analysis, is called *e3-value* [6, 7]. This method makes it possible to evaluate sustainability of an ICT service from the start of the project, i.e. before deployment. It allows to anticipate and adjust the project during the project implementation period. The collaborative aspect of this sustainability assessment method is that it evaluates sustainability and profitability for all actors in the value network. In this it differs from other business modeling tools that commonly evaluate profitability from one single business perspective. It is a participatory method to assess business aspects of a proposed digital service. This method has not been applied in cases in this book, but it is a component of the framework that needs further elaboration, in future studies, in the urban context.

3.3   Methods and techniques for needs assessment

Talking with users: To avoid communication gaps, it is important that developers talk with envisaged end-users themselves, not just with intermediaries. Whereas these intermediaries may be sources of (contextual) information, they do not replace the dialogue with the real end-users. ICT developers may be tempted (for various reasons, e.g. to save costs or time) to talk with intermediaries only. However, this will not reveal the full picture of needs and requirements, and will not lead to a good (socio-technical) solution.

Role of the moderator: The workshop moderator/requirement engineer mediates between users and developers and poses *what if* and *how is this done* questions: What if the actual constraints can be solved using innovative technologies? How do the users themselves perceive the problem(s)? Are problems related to lack of information and/or difficulties in communication? For which reason would potential users value a certain (technological) solution. Are there alternatives? How do things work currently? Who are the stakeholders/responsible persons in the given process? What will be improved by building a new ICT solution? What should or could be improved? What could possibly go wrong?

Local environment: Visits to the users own living environment are useful for the ICT developers, to observe and experience how things are done in practice. Users

may not be used to describe how they perform tasks or work, so it is useful to observe them while performing. Talks during site visits trigger discussions between developers and users and lead to new questions and answers.

Testimonials of other users: Local users who have previously participated in a similar project of digital development, are invited to share their experiences. The explanation is better understood by the new users when explained to them by their peers.

Expert interviews: Interviewing a (local) domain expert is a method for elicitation of specific domain knowledge and understand how local work flows are organized. In a complex new context, the interviewer must take an open attitude, and realize that she does not know what she does not know. She asks many "what if" and "how" questions. Interviews are semi-structured and preferably done with more than one interviewer, to capture as much information as possible. Sometimes a translator is needed, if the interviewee speaks a foreign language. Interviews are recorded and filmed and written out in field notebooks. Photographs are made, (with explicit consent from the users). Conceptual models or mind maps are often used to visualize the structure of the interview.

Business ideas and stakeholders: Taking into account the future sustainability of possible ICT solutions, business ideas are assessed, which relate to the users' operational goals: their work or business. Participation of local (potential) business partners is an essential aspect of the needs assessment, to understand the local ecosystems in which digital services are to be deployed.

Prototypes and technology demos: ICT demonstrations such as mockups, prototypes, story boards and films show users what ICTs have to offer. In contrast to deploying an application at once, this method ensures that solutions are meaningful for local goals and context. These demos encourage group brainstorming about constraints and ideas for possible solutions.

Rapid protoyping, i.e. building a demo system according to users' ideas during the workshop, is a quick method to increase understanding of the users about digital services and its development process and encourage brainstorming and evaluate usefulness of an idea. Users can evaluate the prototype immediately and give feedback. This requires the presence during the workshops of skilled technical developers who can do rapid prototyping on the spot.

3.4 Principles to guide the work of the reflective practitioner

Action research, as described in the following chapters of this book, has a practical, real world problem solving character. Central to the work is the design and deployment of a technological artefact, or prototype – a working solution to improve some real situation of a user or user group. This type of research is called *trans-*

disciplinary: academics (in casu master students Information Science and their supervisors) collaborate with users, often non-academics. The latter are considered domain experts of the context and work practices.

In real-world oriented research, the technology developer must continuously reflect and be aware of his or her role and responsibilities, as a professional and citizen. While the focus often goes to the delivery of the most effective result, it is equally important to reflect and consider the ethical implications of the technical work. To ensure that this is taken into account, principles for guidance and reflection [8] are proposed. The principles are helpful for discussion and reflection in the team, before, during and after the project.

Principles of Action Research:

1. Principle of Critical Investigation of Concrete Situations (field, professional practice).

2. Principle of Value: Developing/Taking a Value Position (democracy, emancipation, autonomy, social and economic betterment).

3. Principle of stakeholder Collaboration (involving Co-Investigation, Co-Design, Co- Creation, whereby goals and interests as seen by stakeholders themselves are central).

4. Principle of Dialogue (between multiple actors and stakeholders (to be) involved).

5. Principle of Action: Discovery and subsequent Realizing Change for the Better.

6. Principle of Reflection and continuous Learning in Action.

3.5 Summary

The framework for digital development in combination with the Principles of Action Research are proposed as to guide an actionable and reflective methodology and appraoch for the development of digital solutions to meet the specific needs and context of various unconnected or less privileged people. In the following chapters case studies will be presented, carried out in Amsterdam in collaboration with users and other stakeholders.

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CHAPTER 4

LOW LITERATE PEOPLE AND DIGITAL SKILLS: BUILDING VIRTUAL AGENTS

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Abstract   The rapid pace of digitization is causing digital exclusion of several groups in society. Whereas the Dutch government is increasingly digitizing its current services, many citizens experience difficulties with online tasks. This holds especially for low literate people, digital illiterates, non-native Dutch speakers and elderly people. The focus of this study is on the simplification of the use of online forms by using a virtual agent. By means of an iterative, user-centered design approach, a virtual agent was designed, built and tested among three different user groups who experience difficulties with online tasks. The study revealed new user-requirements to improve the accessibility of online forms. Furthermore, it shows how a user-centered, collaborative, iterative, adaptive design approach can lead to improved digital service, and increasing digital inclusion of citizens who are currently not able to cope with the digitization.

4.1 Introduction

One of the most digitally excluded groups are low literate people. Research shows that 1.3 million Dutch citizens are classified as low literate, of which 300,000 with very poor reading-, writing- or digital skills. That is, respectively, 11.9 and 2.6 % of the entire Dutch population [1]. A high percentage of this group also experiences difficulties in other functional areas such as calculus, problem solving skills and Internet usage [1]. Since most information on the Internet is textual, one also requires informational skills to be able to judge various types of information on their relevance and reliability [1].

Due to the digitization of society, low literate people frequently experience difficulties with digitized forms, online banking, or finding an online route description. Lost Lemon, a research organization in the social domain that develops IT-tools for municipalities, conducted a research among low literate people regarding their perception towards digital forms. The research outlined several barriers that are experienced by low literates when operating in a digital environment; (i) anxiety in making errors that result in judicial or financial consequences, (ii) forms are experienced as not personal, (iii) webpages contain too much textual information on a dense area, (iv) user interfaces are complex and crowded with unclear symbols. In collaboration with TNO, The Netherlands Organisation for applied scientific research, a Dutch organization Lost Lemon[1] developed Toegankelijke Formulieren (accessible forms), in which a digitized form was improved to the needs of low literate citizens by using co-design and design guidelines created by TNO. Although the research and the guidelines are supportive in improving the lay-out of digitized forms, research in this domain is yet scarce. Furthermore, there is a knowledge-gap of other methods or best practices in improving digital forms that considers the needs of low literates. Therefore, this research focuses on bridging the gap in the Dutch digital divide. This was done by investigating the implementation of virtual agents in digitized forms.

4.2 Ongoing efforts to close the illiteracy gap

Digital exclusion has been a research topic as early as the rise of the Internet. Many factors have been investigated to explain the occurrence of digital exclusion in various geographical areas or under specific demographic circumstances. There is an overall consensus among researchers of the social problematics that are accompanied with the digital divide and the ongoing increase of Internet diffusion. The main challenge is that access to information technologies (IT) is not evenly spread throughout countries and regions. This generates a division between the group of people who are benefiting from the considerable benefits of IT, and the group of people being excluded, leaving them in a more disadvantaged position in society [2].

The early stages of the digital divide, 1990 to 2005, were mostly defined by an access-divide [2]. Having access to a computer directly influences the ability of using

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[1]See https://www.lostlemon.nl/

the internet and being able to use its benefits. Looking at mostly socio-economic demographics such as gender, age, income and education, Colby classified the digital exclusion in terms of accessibility [3]. As addressed by Rogers, the access-divide evolved into a learning- or content-divide when internet diffusion reached a high level of maturity in many countries by the late 2000s [2]. Especially in developed countries such as the Netherlands, digital exclusion is nowadays mainly caused by the lack of reading-, writing- or digital skills.

Literacy is one of the core skills defined by the 'Programme for the international Assessment of Adult Competencies' (PIAAC). This programme, initiated by the Organization for Economic Co-operation and Development (OECD), defines literacy as 'understanding and analyzing written language, and being able to use that information to act'. This definition is generally accepted in the Dutch public debate, and is used as benchmark in multiple reports from 'Stichting lezen en schrijven', a social organization that focusses on improving language proficiency in the Netherlands. Based on this definition, with a language level of "1F" or below, one is classified as low literate in the Netherlands. In other words, people who are capable in reading or writing, but do not possess an educational level of "eindniveau vmbo" or "mbo-2/3" are considered low literate[2], [1].

Much research of digital exclusion in relation to low literacy is mainly focused on health issues. Low literate people frequently encounter difficulties when handling online dossiers or health surveys. Digital literacy is considered increasingly important, due to the importance to citizens' health. Thus,"eHealth literacy" has been defined as the ability of people to use emerging information and communications technologies to improve or enable health and health care.

A study by Brainin and Neter (2012) showed that patients who are less digitally literate do significantly worse in self-managing their own health care [4]. To tackle the low eHealth literacy challenge, Bickmore et al. (2007) built a virtual agent to explain health questionnaires and perform statistical analysis by testing the questionnaires with random participants. Although the results were not statistically significant, it was informative that participants indicated a slight preference for the assistance with the virtual agent in comparison to human explanation [5].

Research with a different perspective, conducted by TNO, focused on the accessibility of forms by investigating the lay-out of webpages. In collaboration with the municipality of Haarlemmermeer, they developed a new design for an existing webpage on the municipalitys website, 'Melding Openbare Ruimte'. The design is based on four general design principles that aims to improve user experience on usefulness, usability, desirability and persuasiveness.

Furthermore, they incorporated cognitive abilities of users and specifically implemented guidelines for people with a low cognitive ability. Feedback by a test group consisting of low literate people resulted in adjustments of the municipalitys webpage regarding; the order of webpages, usage of understandable language, use of

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[2]See also e.g. https://www.lezenenschrijven.nl/over-laaggeletterdheid – accessed 11-11-2019.

visuals, avoidance of open questions and being transparent about privacy sensitive information[3].

A study conducted in 2017 by TNO in collaboration with the Applied University of Utrecht, was concentrated on health questionnaires in order to improve health surveys specifically to the needs of low literate people [6]. By using co-design they developed *Ontwerpen voor laaggeletterden* (designs for low literates), a guideline that aims to improve the user experience of low literates when using online forms. Large font sizes, minimal usage of buttons, illustration with pictures and visuals, were among the most important design recommendations for improved human-computer interaction [6]. These guidelines provided guidance in the development of the prototype, as discussed in the following paragraphs.

Most previous research strongly focused on the lay-out components to improve webpages for low literate people. However, new technologies, ironically as it may sound, could be helpful in developing more accessible digital forms. Virtual agents are mainly used in assisting people in completing digital tasks. They are used in a wide range of industries, from improving E-commerce to treatment for depression. Most well-known virtual agents nowadays are Siri and Google. Supported by voice-based technology they are able to guide people through basic digital tasks.

These tools mainly use natural language processing, social abilities and learning techniques to offer support in information gathering or other user experiences. Although voice-based technologies are supportive for low literates, research has shown that the visual presence of an agent is critical when looking at motivational and affective outcomes in particular.

Hence, a voice alone containing a message delivers less significant results when that same message is communicated by using a virtually present agent [7]. Moreover, a visually present agent in combination with human led voice, provides greater learner perceptions and increases the agents credibility in the context of a learning environment [8].

An initiative by the municipality of Utrecht resulted in a virtual agent to support digitally unskilled citizens with difficult online forms, social service applications or their online banking. By using an interactive and approachable website, Steffie.nl, citizens are guided through application forms by a virtual assistant named Steffie. The website provides extra explanation for difficult language, and provides audio assistance to deliver extensive support to their citizens[4].

Although Steffie.nl made an important first step in supporting low literates in the digital domain, it only provides support through their webpage. Therefore, users are forced to switch between two different webpages. From Steffie.nl to obtain helpful tips, to the webpage containing the digital form. This may cause stressful situations among low literate or digitally unskilled users.

Furthermore, there is a lack of documentation and design requirements that assist development of online forms to the specific needs of low literate people. Especially

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[3]Source: "Ontwerpformulier melding openbare ruimte", an internal technical report by TNO.
[4]See for example: https://www.steffie.nl/ – accessed 11-11-2019.

when these forms are augmented with virtual assistance and audio, there is little literature available that discusses guidelines or requirements.

Therefore, this study investigates the usage of a virtual agent to improve digital forms. Important to note, the content of digital forms are implemented in the virtual environment to prevent switching between webpages. Moreover, detailed process description and careful documentation of design requirements were key principles along which this study was conducted. This translates to the following design question of this chapter.

Design question: How can we design a practical solution (i.e. virtual agent) to facilitate information provisioning to low literate and digital illiterate users? To specify the leading research question, it is important to elicit the requirements for the design of virtual agents for these focus groups. Therefore, this research investigates the following sub-question.

Sub-question: What are the requirements of developing a virtual agent to the specific needs of low literate and digital illiterate users?

4.3 How this research is structured

Our research investigates the ability of virtual agents in guiding low literate people to complete digital forms. Based on the interviews during the context analysis and the literature review, we found it valuable to investigate the design question by developing and testing an actual prototype of a virtual agent. Consequently, we decided to perform a design science technical action research as proposed by Wieringa (2014) [9]. The purpose of our study is to improve a societal context through the use of an artefact (i.e. the prototype). Main focus points were on understanding the context and close collaboration with key stakeholders in order to deliver the most effective result. Since the solution in design science is the design itself, it is evaluated by its utility [9]. As this study is centered around low literate people, their user feedback was important to measure the prototypes utility. We developed the prototype by using an agile methodology, which was tested among different groups of low literate people.

The practical approach of this research is augmented by a qualitative part in order to extract results. Strauss and Corbin defined qualitative research as "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" [10]. Given that this research involved a target group that is difficult to reach, any kind of quantification of the data was not possible due to the limited amount of participants. Furthermore, qualitative research is more centered on a naturalistic approach and aims to incorporate context from real life settings [10]. Due to the practical approach used in this thesis, obtaining more in-depth information regarding the prototype provided better results than doing statistical analysis. Since user-experience feedback is invaluable in improving prototypes that use user-

centered design, we were convinced that a qualitative approach would benefit the results of this research the most.

Furthermore, we structured the research by using (an adapted version of) the ICT4D 3.0 approach and framework [11]. ICT4D 3.0 is a collaborative, iterative, adaptive approach and framework for designing and building information systems targeted at marginalized groups. It consists of five stages, of which we used the following four as a guideline along which we carried out: (i) context analysis, (ii) needs assessment, (iii) use case and requirements analysis, (iv) engineering and testing. The next paragraphs specifies each individual phase and provides detailed insights in how this research was conducted.

4.4   Context analysis and needs assessment of the target groups

As part of answering the research question, we found it valuable to gain a more general understanding of the digital divide in the Netherlands from various viewpoints. These different viewpoints were provided by meeting with:

- Digi Challenge Amsterdam 2018 hosted by PACT. They are striving for an inclusive digital world. They organize events to foster collaboration between municipalities, social organizations and citizens to tackle the digital divide in Amsterdam.

- Various research consultants from Lost Lemon, a research organization in the social domain that develops IT-tools for municipalities.

- An employee from the municipality of Amsterdam who is overseeing various projects involving low literates. Furthermore, he was an initiator of the research De bouwstenen voor digitale inclusie (Building blocks for digital inclusion).

- A social worker from the organization 'Stichting lezen en schrijven'. She is specialized in product development in the social domain with a focus on low literates.

- The creator and current administrator of Steffie.nl. A website that uses a virtual assistant that guides people in doing common digital tasks.

- Program coordinator urban practice at Hogeschool van Amsterdam. Project BOOT is a core project that specifies in language development in focus areas. Co-creation and Living Labs are key principles in their projects.

The various interviews provided interesting insights on several aspects. The challenge of dealing with digitized (government) forms is not limited to low literates, but is felt among a growing group of people such as elderly, digital illiterates or immigrants. Given the overlapping characteristics of the challenges among these various groups, we strongly believe that the findings of this study could, to a decent extent, be generalized and used in a broader context.
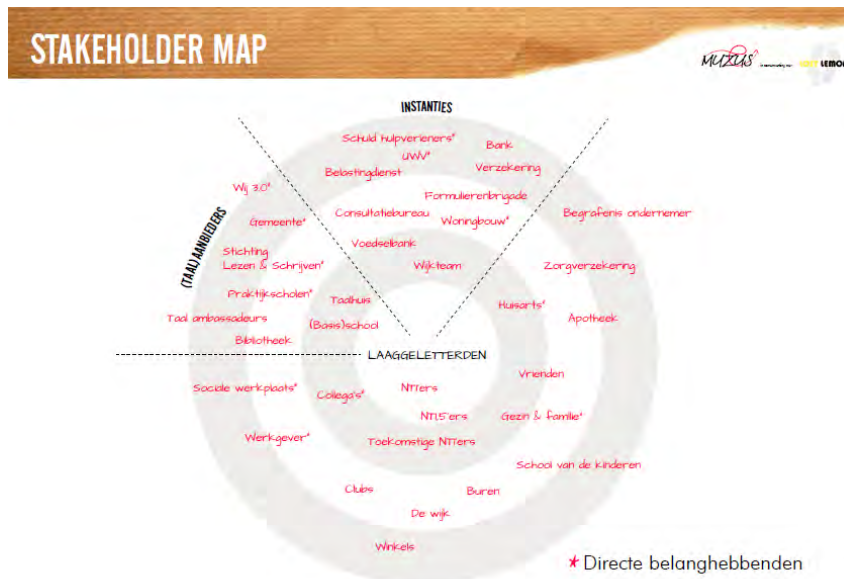
Figure 4.1 Stakeholder mapping showing low literates. Reprinted with permission from Lost Lemon.

Other recurring insights included the novelty and growing urge of this subject. Despite intensified attention by governments and researchers, we found a lack of generally accepted best practices and reusable methods in this domain. This causes the absence of a unified nationwide approach by the Dutch government to effectively tackle the problem. Although extra budget is given to various municipalities and organizations, new projects and initiatives are often decentralized and executed on a local level.

Another recurring theme we observed, was the experienced difficulty in reaching low literate people for researching purposes or product testing. Both Lost Lemon and the municipality of Amsterdam expressed certain barriers that keep the target group from being easily approached. Feelings of anger and the inability to find the right support are addressed as the main causes that low literate citizens are being distant and hard to contact. Although the group of low literate people in the Netherlands is significant, the *Toegankelijke Formulieren* test session conducted by Lost Lemon was only attended by four participants. Test sessions conducted by other social organizations have on average five to six participants. Their argument centers around the difficulty in motivating participants. Furthermore, test sessions are labor intensive due to the dependency on both participants and volunteers.

The obtained information from the interviews in combination with the literature review, provided me with enough perspective to identify the key stakeholders in this challenge. First, the government, and in particular municipalities, are a major stake-

holder due to their involvement on financial level, acting as sponsors to certain organizations, as well as being directly involved with the target group through various projects. Second, organizations such as Lost Lemon and 'Stichting lezen en schrijven', who are operating and doing research in this domain, are a major stakeholder due to their direct involvement and comprehensive knowledge about low literates through practical experience. Notably, their established trust with a small group of low literates gives them a central role in, for example, testing prototypes or practice with newly developed methods. At last, low literate, digital illiterate and non-native Dutch citizens are an important stakeholder due to their involvement as end-users of prototypes, methods or projects initiated by the first two stakeholders. Furthermore, they are at the heart of the digital exclusion giving them a strong influence due to their needs.

Lost Lemon developed a stakeholder map, in which the low literates are at the centre (See Figure 4.1). The map outlines all identified stakeholders and distinguishes between direct and indirect stakeholders.

4.5   Three-iterations requirements analysis

Requirements analysis took a central role in the design and evaluation of the prototype. Given the unknown requirements, we decided for a user-centered agile approach for the system's development, which was defined by iterative testing phases that were used to improve the prototype. This reduced the risk of spending time on development before testing against the demanded requirements [13]. The research consisted of the following iterating phases.

- We constructed version 1.0 of the prototype by using the obtained information during the context analysis as fundament. Use cases from Lost Lemon and the guidelines *Ontwerpen voor Laaggeletterden* were used for constructing the prototypes lay-out. We tested Version 1.0 among a test group consisting of non-native Dutch speaking participants. Results were obtained by observing the participants in completing the prototype, and by conducting a group interview for user-feedback.

- Re-engineering of version 1.0 based on the obtained user-feedback from the first test session. We converted the feedback into an initial requirements document, which was used to build version 2.0 of the prototype. Version 2.0 was tested, using a similar approach as the first test session, on a group of low literate people. We conducted a group interview to obtain user feedback on the second version of the prototype. This feedback was used to supplement the requirements document.

- The obtained feedback on version 2.0 formed the basis in constructing prototype version 3.0. We used Version 3.0 to validate the findings of the first two test sessions. Additionally, it was used to verify the constructed requirements in order to finalize the requirements document. At last, we compared the feedback

of the different test sessions regarding the different focus groups and converted it into findings.

Table 4.1   MoSCoW requirements table.

	Requirement
Must have	Audio assistance
	Replay-button for audio assistance
	Consistent, calm screen lay-out
	Virtually present agent
	Clear "continue to next screen" indication
Should have	Big font size
	Back-function
	Understandable sentences
	Help-function that includes username and password examples
	One question per screen
Could have	Variety of avatars and lay-out options

4.6   Prototype Design and Engineering

Given the practical approach of this research, a central role was taken by designing and constructing the virtual agent. Having sound design criteria is necessary to give structure in a path that has many unknowns. Furthermore, being able to argue why certain choices were made is imperative to explain specific features of the system. Moreover, it is helpful to refute uncertainties at a later stage, both for yourself as a researcher as well as to the public. When applying an iterative approach, it is important to carefully document the steps that were taken that led to the final result. Therefore, this paragraph discusses the argumentation that was used in making the design choices for the first prototype.

Design choices   The specific needs of the target group directly influenced the design choices that were made when designing version 1.0 of the prototype. Since version 1.0 was used as the fundament for prototypes version 2.0 and version 3.0, its design takes a central role in this research. The context analysis provided me with several important requirements that were used as vital elements of version 1.0. During the interviews with experts in this domain, two terms were repeatedly mentioned; (i) simplicity, and (ii) ease-of-use. This was also stressed by the co-inventor and current administrator of steffie.nl" "Any extra button or visual on the screen can be perceived as a distraction, keep it simple". Accordingly, to give structure to the

construction phase of the system, we divided simplicity and ease-of-use in terms of two aspects; (i) focus on appropriate lay-out for the target group, which is outlined in this paragraph, and (ii) focus on technical components in order to provide the right functionalities, as discussed in section 4.6.

As for the lay-out, we used several guidelines of 'Ontwerpen voor laaggeletterden', developed by TNO and Utrecht University of Applied Sciences, as design criteria. Their focus group was identical as the focus group in this study. Additionally, their research was conducted in a similar context. Consequently, many of the guidelines, in terms of lay-out, could be directly applied in version 1.0. The following guidelines were used that formed the basis for the design criteria of version 1.0:

- Simple language; use plain language and short sentences

- Minimize number of functions

- Consistent screen layout

- Show only relevant items

- Limited number of items to choose from

- One question per screen

- No progress indication

- No back-function

- Relaxed atmosphere

Avatar   The primary goal of the system is to guide low literate people in completing digitized forms. An important aspect to create empowerment among the user group is to develop an environment that generates comfort and trust. According to Albert Bandura (2010) the visual and social presence of an anthropomorphic interface agent must be established first; then the second important factor in the design of the social model is its appearance, which is key to influencing the user's motivation, attitude and behavior through directly impacting message acceptance [12].

In short, the avatar takes a central role due to its active engagement within the system, in which appearance is crucial. Its main function is to simulate human tendencies to create trust among its users and stimulate motivation. Since many low literate people experience stress when handling online forms, building a safe and comfortable environment is crucial in empowering them and boosting their confidence. The following measures were taken to create an empowering environment.

At first, we decided on a female avatar. This was mostly intuitively motivated due to the more open and relatable appearance of females in comparison to men.

Secondly, we found it important to simulate human movement to create a more natural appearance. The natural tendencies were simulated by letting the avatar blink, and by folding its left arm towards its middle. These movements were assumed to

Figure 4.2   Three versions of the avatar called Eva.

give the agent sufficient natural appearance while limiting possible distraction among users. The three different avatar appearances are displayed in Figure 4.2.

A critical aspect in human appearance is clothing. The program coordinator 'Urban Practice' at 'Hogeschool van Amsterdam' strongly suggested to use neutral colors, and clothing that is all-covering to make the avatar as 'general' as possible. This to include users from many different backgrounds and beliefs. As a result, we designed the avatar with a light brown turtleneck on top of a pair of blue jeans. Furthermore, the agent was given a yellow fillet as accessory to create a slight color contrast with the avatars brown hair.

The positioning of the avatar on the screen was chosen by imitating Steffie.nl in combination with intuition. Placing the avatar on the far right of the screen gives a more natural appearance. Furthermore, we perceived it as less distracting in comparison to having the avatar in the middle or on the left side of the screen. At last, it gives room to implement in-screen answering options that appear above the text window in the middle of the screen.

Name   To further enhance the agents natural appearance, we decided to give the agent a name, Eva. It was assumed that this would enhance the approachability of the agent and that it would improve user experience. Furthermore, my intention was to add a personal tendency to the agent to generate more trust among users. Given the focus on Dutch governments forms, a typical Dutch name like Eva was found suitable. Moreover, the commonality of the name 'Eva' in the Netherlands, was used as an advantage to address a wide range of users, both Dutch and non-Dutch people.

Background   The background has a central role in providing the appropriate environment for users. In this, comfort and trust were taken as key components in deciding for the appropriate background. Therefore, we chose an image of a grass-pitch covering the entire screen for various reasons. Studies in Environmental Psychology by Lee et al, show that the color green has a stimulating effect on human's span of attention, and show a decrease in omission errors when participants were confronted

Figure 4.3   Full initial screen lay-out of the virtual agent.

with a green color [14]. We considered both effects helpful in creating a comfortable and stimulating environment for users. Moreover, the color green is associated with calmness and it promotes restfulness since its light consist of low wavelengths[5].

We considered these attributes important factors to create a relaxed atmosphere for the user. The color blue has many similar attributes as the color green and was also taken into consideration to use as format for the background. However, the grass-pitch image better accentuates the text window as well as the avatar. This creates more restfulness while also making the environment more user-friendly.

Finally, to cover the consistent screen lay-out from the *Ontwerpen voor laaggeletterden* guideline, we chose to make this image the default background throughout the entire form. Figure 4.3 displays the full screen lay-out to visualize the afore mentioned design choices.

Form content   Since the focus of this study is on testing a virtual agent, the form content that was used in the prototype was merely seen as a means to create a functioning system. However, given the focus on Dutch governments forms and the desire to simulate a real-life online application, we chose to implement the content of a DigiD application. A DigiD is a Dutch digital identity. It allows citizens to safely log into Dutch government- and personal healthcare websites. Furthermore, DigiD allows citizens to use various government services such as healthcare- or child allowance.

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[5]Source of this information: https://edition.cnn.com/2017/06/05/health/colorscope-green-environment-calm/index.html – accessed 11-11-2019.

4.7 Technical framework

Converting the design criteria into actual system output is an important phase in which both limitations and opportunities were encountered. Especially for further research purposes or applications of this system, it is interesting to understand these limitations and opportunities. Therefore, this paragraph discusses the technical aspects of the different tools that were used in constructing the prototype.

RenPy: RenPy is a visual novel engine that allows for digitized storytelling. RenPy runs on the programming language Python, allowing it for advanced animations. The tool comes with an extensive package of default settings that is automatically provided when starting a new RenPy project. These settings are easily adjustable since it allows users to make changes in the three different default scripts; gui.rpy, options.rpy and screens.rpy. These options offer a wide variety of customization possibilities ranging from font size to placement of the in-screen text window. In addition to these default scripts, users are provided with an 'open' script, script.rpy, that is specifically used for writing code. This script allows for implementation of conversation, images or icons, sound and animations through its built-in functions like 'show' or 'play sound'.

RenPy's extensive and easy adjustable default package was a decisive factor in choosing this tool for building the prototype. Furthermore, its accessible built-in functions delivered great benefits during the construction of all versions of the prototype. Furthermore, there is a link to the source code that is publicly available on github.

Avachara: The avatar was created by using an online character maker, Avachara[6]. This tool allows for a wide range of animated avatar illustrations by providing numerous customization options. Furthermore, it offers a large set of default features to choose from when building an avatar. To give an impression about the amount of possibilities the tool provides; it includes 8 options for different head types, 64 options for different types of eyes, 48 options for different types of mouths, 60 options for eyebrows, 48 options for different types of noses, and 120 options for different hair styles. On top of this, it provides numerous options for both clothing and accessories. Although Avachara does not allow users to self-construct or customize any of the features it contains, the design criteria did not require for that level of detail. Therefore, the extensive package of default options convinced me in choosing Avachara as the avatar creator tool.

Paint 3D: After downloading the avatar from Avachara, it needed several finalizations in order to qualify for in-screen usage. We used Paint 3D to delete the avatars background canvas. Moreover, it was used to minimize the differences between the three versions of Eva on a pixel level. Due to the self-construction limitations of

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[6]For this framework see http://avachara.com – accessed 11-11-2019

Avachara, Paint 3D was used to generate the arm-fold position of Eva. Its 'magic select' function allowed for specifically selecting and shifting Eva's forearm. Afterwards, we smoothed out any inaccuracies on pixel level.

Voice record pro: RenPy supports three different audio formats among which mp3. Therefore, a free recording application, Voice Record Pro, was downloaded to record audio files in mp3 format. A set of earplugs was used to minimize background noise and to ensure consistent decibel levels. At last, a female voice was used to align with Eva's gender.

4.8   Iteratively testing and redesigning

First cycle testing and redesigning: SEZO, a social organization that offers citizens of Amsterdam Nieuw-West language- and computer courses, helped in organizing the test session. They offered to conduct the test session on a group they actively support on various aspects, including language- and computer skills. The test session consisted of three parts: (i) a group assignment, in which participants were asked to solve language exercises (ii) individually testing the application on a computer or laptop (iii) feedback session in group context.

The participants started the application, simultaneously, in a classroom environment. Me and two volunteers were present to guide participants in case of uncertainties. During testing, the participants were observed in their progress. We made notes regarding participants' behavior, and regarding their questions. Once finished, participants held a coffee break. This time was taken to obtain feedback by informally talking to the participants. After the break, we initiated a semi-structured group interview which lasted approximately twenty minutes. The feedback in group context was chosen due to a strong group cohesion in which certain members felt more encouraged to speak up. The following questions were aimed to obtain information about the different components of the system;

- How did you experience the application?

- Was the language understandable?

- What is your opinion on Eva?

- Did Eva give you confidence in completing the application?

- What is your opinion on the green background?

- What is your opinion about the font size?

- What would you improve about the application?

- Would you use this system rather than current online forms?

Test group: The group consisted of nine male participants. All participants were part of a program named 'Gouden mannen'. This program focusses on reintegrating socially isolated middle-aged men in Amsterdam Nieuw-West. All of the participants have a migration background and are non-native Dutch speakers. The language exercise exposed a significant difference between the language levels among participants. Although every participant was able to understand the Dutch language, four participants possessed limited speaking- and vocabulary skills. Three participants had a decent understanding of the Dutch language. Most of the participants applied for a DigiD before. However, there was confusion about the functions of DigiD among the group.

Observations and user feedback: The start of the application exposed a large difference in computer skills among the participants. While five participants autonomously found their way through the application, four participants were confused about the assignment and needed guidance in starting the application. Two of them ended up in other screens or webpages. They were redirected to the 'start'-screen of the application by guidance of the volunteers.

Four participants finished the application within five minutes. The other five participants finished between six and nine minutes. The participants who finished earlier, were the same participants who showed significant better language skills during the language exercise. The reactions from the feedback session were generally very positive. Each participant enthusiastically reacted to the included audio. It supported them in concentrating on the content of the application. Furthermore, they felt more confident in finishing the application. However, participants noticed the lack of a replay-button in the system. Some participants expressed a need to rehear certain questions.

Each participant gave enthusiastic reactions about the presence of Eva. While Eva provided some participants with a sense of restfulness and empowerment, it provided other participants a game-like experience "Het leek wel op een spelletje". Interestingly, none of the participants commented on Eva's appearance and were unable to remember distinctive characteristics. This gave reason to believe that Eva's appearance was perceived neutrally, and did not distract participants in focusing on the questions.

Participants positively reacted to the 'one question per screen'. It felt less intimidating than a screen filled with questions. Furthermore, the font size was perceived pleasantly and easy to read according to all participants. The background color was enjoyed by most participants. For some it created a calming effect, others found it comforting since they like green as a color *"Ik vind groen een mooie kleur"* .

Although participants completed the application faster than anticipated, many participants were confused about the lack of a continue-button. Only certain screens mention to press 'enter' to continue. Participants indicated it would be helpful if every screen explicitly indicates how to continue. All participants indicated a preference of this system towards current online forms. Moreover, they found the system accessible and easy to use. They indicated it would be an improvement if this would be offered on a broader scale in the digital environment.

Prototype version 2.0:   Although the overall received feedback was positive, participants provided two improvements towards the initial prototype. The first improvement involved the implementation of a replay-button that enables users to re-hear questions. Unfortunately, Renpys technical capabilities does not allow for such a functionality. Therefore, this was only included into the requirements document. Second, a clear "enter to continue" indication should be present on every screen. This was augmented to version 1.0 by both text and audio to every screen. In the absence of other improvements, this was the only extension that was implemented to construct version 2.0 of the prototype.

4.9   Second cycle testing and redesigning

Test setup: This test session was supported by 'Stichting Lezen en Schrijven', a social organization that focusses on improving language proficiency in the Netherlands. A group of language ambassadors, who are frequently involved in similar test sessions, volunteered to test the prototype. The test session consisted of three parts; (i) an interview to obtain information about participants internet behavior (ii) individually testing the application on a computer or laptop (iii) feedback session in group context.

To obtain background information about the participants' Internet behavior, we started the session with a small group interview. Participants were asked about their frequency of internet usage, their DigiD application and their experienced difficulties when using the Internet. Afterwards, participants were asked to test the application using version 2.0 of the prototype. Similar to the first test session, this was done individually in a classroom environment. We observed participants during testing, and made notes regarding their behavior and their questions. After each participant finished the application, a feedback session was initiated. The group context was chosen due to time constraints, but also due to the positive experience of the group interview from the first test session. Participants feel more encouraged to speak up when providing feedback in group context. The questions to obtain information about the different components of the system were similar to the previous session.

Test group: The test group consisted of four participants. Many of the participants had previous experience in similar test sessions or researches. This was noticeable during the feedback session, in which the participants provided constructive feedback in a structured manner.

The group was a mixture of both native Dutch and non-Dutch participants. All participants possessed an advanced, or fluent, spoken level of the Dutch language. However, two participants indicated a certain lack of Dutch reading and writing skills. Although all participants regularly use the Web, three participants did not apply for a DigiD personally. Two participants were supported by their family to apply for a DigiD, and one participant does not have a Digid-account. All participants had decent to advanced computer skills. However, two participants frequently

encountered difficulties by logging in on certain websites such as the ABP website, a pension insurance company, or the governments' s DigiD webiste.

Observations and user feedback: All participants were able to start the application without difficulties. During testing, there were few questions regarding the use of the prototype and participants completed the application at their own pace. One participant finished the application within four minutes, two participants finished the application in approximately five minutes, and the last participant took eight minutes to finish. The fastest participant was also the participant who applied for her own DigiD previously. The participant that took eight minutes to finish was the participant that has the most difficulty with reading and writing the Dutch language.

Since the participants were eager to provide feedback, the feedback session started directly after the last participant finished the application. The overall feedback was very positive and participants indicated that the prototype was *"Geweldig"* (Great) and "Echt een makkelijk systeem" (System is really easy to use). Participants were enthusiastic about the pace by which they were able to go through the questions Het ging zo snel (It went really quick). The combination of audio and text was perceived as pleasant, while also providing the participants with more trust. One participant mainly focused on audio, and indicated it would be helpful to implement a replay-button. It would comfort him to be able to rehear certain questions.

Eva's appearance was hardly noticed by the participants and they indicated that it was not disturbing. Participants were not able to recall specific details of Eva since they were more focused on the questions. Eva was perceived as "Cool, niet vervelend" (Cool, not disturbing) and "Rustig en duidelijk" (calm and clear). This also applied to the background. Participants found it restful and it provided them with a sense of calmness. It helped them in focusing on the questions.

Participants positively reacted to the 'one question per screen'. It supported them from getting distracted from other questions or in-screen appearances. However, they indicated a help-function at certain questions would be helpful. Especially for the username and password questions, one participant said it would have supported him if an example was present. At last, one participant mentioned the lack of a back-function. It would comfort him to go back through the application to overlook previous answers.

There was consensus on the preference of the prototype towards current online forms. Participants were enthusiastic about its ease of use, and indicated that such a system should be the standard for online forms.

Prototype version 3.0:   The feedback session provided three improvements for version 2.0 of the prototype. First, similarly to feedback from the first test session, participants asked for a replay-button. Second, participants desired a help-function that offers explanation or examples at questions such as the username or password. As technical limitations of Renpy do not allow for such in-screen functionalities, this was only documented into the requirements document. At last, one participant asked for a back-function. However, we specifically excluded a "back" function, according to the *Ontwerpen voor laaggeletterden* guidelines. Since only one participant stated

a preference for this function, we decided not to implement it in version 3.0. Due to the limitations of Renpy and since it was specifically chosen to not implement the "back" function, version 2.0 of the prototype remained unchanged.

4.10   Third cycle testing and re-designing

Test set-up: The test session was organized with support of 'Academie van de Stad', an organization that tackles challenges in the social domain by connecting students to social projects. They have students who act as digicoaches to support elderly and digital illiterates in improving their digital skills. This session's set-up was similar as the previous test session; (i) an interview to obtain information about participants internet behavior (ii) individually testing the application on a computer or laptop (iii) feedback session in group context. The questions to obtain information about the different components of the system were similar to the previous sessions.

Test group: The test group consisted of four female participants, of which three were aged 65+. All participants were native Dutch speakers and were fluent in all aspects of the Dutch language. All participants regularly join the computer lessons to practice their digital skills. Three participants had not applied for a DigiD before and indicated that they never use it. One participant applied for a DigiD herself, but rarely uses it. All participants occasionally use the Internet, but frequently encounter difficulties with online forms or registering for an account such as Facebook.

Observations and user feedback: Although all participants possessed limited computer skills, one participant in particular struggled in completing the application. While the other three participants completed the application in approximately seven minutes, it took her eleven minutes to finish the questions. In particular, the participant misunderstood the '6-32 characters' requirement of the username-question. This led her to insert a username of 32 characters. After explanation from a volunteer, the participant misinterpreted the password requirement of '8-32 characters' as well. With support from a digicoach, she was able to complete the remainder of the application. The participant indicated it would be helpful to have a help-function that shows examples of possible usernames and passwords. Other observations were regarding participants' computer handling. Some participants were not confident with typing on the keyboard. They were afraid to press "wrong" keys and cautiously handled the computer.

Three participants provided positive reactions about the prototype and said: *"Dat ging goed"* (It went well). It was clear and the lay-out was pleasantly. Participants experienced it as less serious as if it were a game. One participant found it really difficult *"Heel moeilijk"*, and indicated she just started with computer lessons and had never experienced an online application before. All participants were enthusiastic about the font size *"Echt van die bejaardenletters"* (Font size for elderly people), and found it easier to read than normal websites. Participants were not disturbed by the presence of Eva, and it felt if she guided the participants through the questions

"Alsof ik aan de hand werd genomen". Two participants did not noticed Eva and focused on the questions. They did understand Eva 's function and could imagine that people would appreciate its presence. No participant was able to recall any details of Eva 's appearance. They confirmed they liked the agent as it was presented.

Although most participants focused on the text, the audio was not perceived as disturbing. One participant indicated that the audio made the questions more accessible, it *"Vergemakkelijkt het antwoorden"* (Made it easier to answer). The green background was preferred over a white background. It was calming on the participants' eyes. One participant experienced it as a soccer game due to the grass pitch background. Although most participants rarely fill in online forms, they were enthusiastic about the prototype. Having online forms as the prototype would empower them to try online applications more often individually.

Prototype adjustments: The participants in this test session provided similar feedback as participants from the second test session. They provided two improvements to the prototype; a back-function and a help-function. While 'Ontwerpen voor laaggeletterden' specifically mentioned to exclude a back-function, multiple participants found it comforting in having the option to go back to previous answers. Therefore, it was decided to include the back-function into the requirements document. The help-function was already incorporated in the requirements document due to the last session. No other adjustments were made regarding version 2.0 of the prototype.

4.11 Findings

The three test sessions provided an extensive and varied overview on the prototype through the perspective of the focus groups. While the initial focus of this study was on low literate people, the context analysis exposed more focus groups that encounter similar difficulties when handling online forms. We found it important to include their perspective in the research. For this reason, one test session was conducted with digital illiterate people. When comparing feedback between low literate and digital illiterate participants, many similarities were observed. Both groups indicated a desire for a help-function that supports users by providing examples or extra explanation. Additionally, participants from both groups expressed a demand for a back-function. While we intentionally excluded it due to the *Ontwerpen voor laaggeletterden* guideline, the various requests in different test sessions were found convincing to incorporate the back-function into the requirements document. Moreover, the overlap in feedback was perceived as a strong indication that the challenges in handling online forms is a problem that is present among different groups in the Dutch society, such as low literates, digital illiterates and non-native Dutch speakers. While the challenge of low literates and digital illiterates are different in nature, they both benefit by the same solution; a more accessible, user-friendly system that guides them in overcoming the challenge in a structured and step-by-step approach.

Next to overlapping feedback, low literate and non-native Dutch participants expressed a higher demand for a replay-button. The implemented audio was a vital functionality that supported them in concentrating on the content of the form. It improved their understanding of the form by reading along with the audio.

The feedback from all three different test sessions was generally very positive. Most participants found the prototype intuitive and straightforward to use. Furthermore, participants felt empowered by the presence of the virtual agent. It provided them with a sense of calmness that enabled them in focusing on the content of the form. Additionally, the agent produced a game-like experience that contributed to a less formal digital experience. Interestingly, no participant, from all test session, was able to recall any specific features of the agent's appearance. This corresponds with their feedback of not being distracted by the agents presence. Therefore, we concluded that the 'neutral' design of the agent was sufficient. While it is important to include basic features in order to resemble human presence, we advise to limit the amount of time spent on the agents level of detail.

Participants were positive on the prototypes accessible lay-out. They perceived it as relaxing while limiting the risk of distractions. Low literate and elderly participants were especially positive about the big font size. It enabled them to carefully read the sentences. All participants indicated a preference toward this type of lay-out over current online forms. Some participants were surprised by the pace in which they were able to complete the form. The enthusiasm we observed from that felt like empowerment, as if it provided them trust to take on other digital challenges as well.

While the most important results were obtained during the test sessions, there are other outcomes of this study that were found worth sharing. The engagements with the experts and volunteers revealed interesting insights. While we expected to encounter difficulties in finding participants, all organizations were very open in co-operating, and even supporting, in hosting the test sessions. They were enthusiastic by the idea that this challenge is being researched and were hopeful that it could make an impact. This indicated the level of urgency of the problem. While digital education for the focus groups is an important component, this challenge requires not active, but a proactive mindset of the government. The Dutch digitization strategy is ambitious and inspiring. However, creating a digital society that excludes a large portion of people, is not sustainable. Therefore, they should be more actively involved and develop a strategy specifically designed to bridge the Dutch digital divide. Currently, experts in this domain that are collaborating with the government on projects, indicate that bureaucracy is the biggest challenge that restricts effective change within the Dutch government and municipalities.

Requirements document: The user feedback and findings of this study were converted into a requirements document by using the MoSCow method. This is a technique that is commonly used to prioritize functionalities in software development projects[7]. When developing online forms that are to be used by low literates, digital

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[7]See: https://www.rijksoverheid.nl/onderwerpen/digitale-overheid/vraag-en-antwoord/wat-is-digid – accessed 11-11-2019

illiterates or people who are non-native Dutch speakers, we strongly advise to use table 1 as a guideline. These requirements support in creating increased engagement from these focus groups. Moreover, it helps in distressing a large group of people in handling online forms. Additionally, it empowers them in tackling other digital challenges.

4.12 Discussion and Future work

This research contributes in understanding the requirements of designing online forms for low literates, digital illiterates and non-native Dutch speakers by using a virtual agent. It is the first time that an actual prototype of a virtual agent was tested on these specific focus groups. Additionally, it builds upon previous studies that focused on developing accessible online lay-out designs for low literate people. Most of the *"Ontwerpen voor laaggeletterden'* guidelines were validated by this research. However, the direct user feedback from participants provided new insights on the digital desires of these target groups by testing with a physically present agent in combination with audio support. Moreover, it was the first time that test sessions were conducted in this particular setting, with participants from three different focus groups. This enabled the opportunity to compare feedback between the different groups. Interestingly, it was observed that most of the feedback was similar in nature and that the different focus groups encountered similar challenges when handling online forms.

Furthermore, it is the first time that requirements for designing online forms using virtual agents are described by using a structured and methodological method. While there are organizations that focus on the practical aspect of supporting low literates and digital illiterates, like Steffie.nl, there is a lack in publicly available guidelines that are able to assist the government in creating accessible online forms. This study provides an elaborative description in design choices for the lay-out components as well as functional requirements that fills a gap in the knowledge domain of this particular challenge.

The technical limitations of RenPy constrained me in testing and validating functionalities that were desired by participants. Implementing these functionalities would provide the opportunity to test and refine the prototype by using participants feedback. Now, it is only included in the requirements document. This leaves room for interpretation on the design of such a functionality. Available user feedback on the design of these functionalities would have increased the quality of the requirements document.

The variety of user feedback has been valuable in this study and its results. At the same time, we experienced it as the biggest challenges of this research. While the second test session included a test panel with participants who were able to provide constructive and structured feedback, the other two test session consisted of participants that were not used to provide feedback constructively. This made it challenging in equally evaluating the feedback of participants from the different groups. However, research in this domain will always be due to circumstances as experienced in

this study. Closely observing participants' behavior during testing and during interviewing, allows for obtaining important pieces of information.

Over the course of this research many challenges surfaced that come along with the Dutch digital divide, both on organizational and technical aspect. The biggest organizational challenge is caused by the lack of a centralized approach by the government. The size of this challenge is too large to be solved by decentralized projects and without unity. Organizations would benefit from increased cooperation and a shared strategy that supports them in delivering more effective results. Furthermore, additional research on new methods or implementing new technologies could support these organizations in becoming more efficient. Supporting low literates and digital illiterates is a labor intensive process due to the many volunteers needed. New tools would be helpful in increasing their efficiency to enable them in bridging the current gap.

As participants indicated a preference of the prototype used in this research, having a specifically UI-toolkit or git-kit, including default designs and lay-outs, would be an interesting follow-up. This tool can be used to easily create accessible and customized online forms without needing technical expertise. Users are able to personalize forms by choosing from the variety of backgrounds, avatars, fonts and other functionalities the tool provides.

Looking even further into the future, these systems could incorporate intelligent agents that are solely voice based. Low literates and digital illiterates will become empowered due to the abundance of using a keyboard. These systems could be connected to known technologies such as Alexa and the Google Home that enables users to fill in online forms without seeing user interfaces and by only using voice based commands.

4.13   Validation

The digitization of Dutch government forms is putting pressure on low literates, digital illiterates and non-native Dutch speakers in the Netherlands. As more government forms shift to a digital format, these people increasingly encounter stressful situations when applying for social services, tax returns or using DigiD. They experience anxiety in making errors that result in judicial or financial consequences, forms are experienced as not personal, webpages contain too much textual information on a dense area, and user interfaces are complex and crowded with unclear symbols. Changing the design of these forms by taking into account the specific needs of these focus groups can lead to a positive impact on their digital engagement. This leads back to the leading design question; *How can we design a practical solution (i.e. virtual agent) to facilitate information provisioning to low literate users?*

Working in iterative phases and using user-centered design were found effective in developing the prototype. The different phases allowed to discover unknown requirements directly from a user perspective. These perspectives were used to develop a prototype of a virtual agent. The test sessions were important to gain user feedback. This feedback was converted to establish a requirements document that can

be used as a guideline to make online forms more accessible. Testing the prototype over three sessions allowed the validation of user feedback and resulted in stronger findings of this research. Moreover, it allowed me to compare feedback between the different focus groups. Given the overlap in feedback, it was concluded that most findings can be generalized to other groups that encounter similar difficulties with online forms.

The second design question was specifically targeted at finding the requirements of the practical solution; *What are the requirements of developing a virtual agent to the specific needs of low literate users?*

The most important requirements are listed in table 4.1 under the headings 'must have' and 'should have'. As indicated by participants, following these requirements increases the sense of calmness, increases users ability to focus on the content of the form, and it decreases their level of stress when handling online forms. Additionally, it not only relieves stress and anxiety among the focus group, it could empower them in becoming more digitally engaged. Encouraged by their ability to handle online forms, other digital tasks become less stressful.

4.14 Conclusion

This study has investigated the use of a virtual agent to improve online government forms for low literate, digital illiterate and non-native Dutch citizens. It has shown new insights regarding the development of online forms in terms of simplicity and ease of use. Their user perspective and feedback are valuable in designing a requirements document that provides guidance for creating online forms that are accessible for these groups of people. The user-centered design in combination with iterative phases (agile method) were key in obtaining the necessary requirements. Despite a thorough context analysis, testing the prototype gave valuable insights in the actual needs of the focus groups. It showed me that certain functionalities or lay-out decisions can easily be overlooked due to the different perspective you have as a designer.

With this study, we are convinced that active engagement with the target group is an important condition in designing practical solutions. It not only provides the opportunity to deliver a better solution, it also saves time, since it is easier to incorporate changes at an earlier stage of the process. While an agile user-centered approach is time consuming and labour intensive, it significantly improves the result of the outcome. Given the intention of the Dutch government to be inclusive to all citizens, we are obliged to take into account the demands of these groups in the digitization strategy. A solution such as the toolkit we suggested in the "future work" paragraph, could significantly improve digital engagement among these groups. Given that we all benefit as a society that is digitally inclusive, there is yet a great deal of work to be done in order to bridge the digital divide. The continuous efforts of organizations and volunteers are indispensable in this challenge. Together with a proactive government and an applicable strategy, we as society can make important steps towards an inclusive digital society.

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MOBILE APPS FOR HOMELESS PEOPLE: CO-CREATION OF INFORMATION SOLUTIONS FOR DIGITAL INCLUSION

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Figure 5.1   Bandro Edoga and Marc Hegeman at the weekly homeless dinner evening, Huis Sant'Egidio in Amsterdam, January 2019.

5.1   Digital exclusion in Amsterdam

Digital exclusion is often experienced by very poor, homeless and disadvantaged people [1, 2, 3, 4]. *"Where can I get a meal tomorrow? How often can I come here to eat? Where can I get free coffee or gloves?"* are frequently asked questions, passed by word of mouth. If the homeless could dispose of a digital, central place with up-to-date and user-friendly information, many would benefit from it. Since this group has often less digital skills than an average user [5] this has to be taken into account in the design of a digital solution.

Our research was carried out with homeless people. A number of interesting insights was thus obtained. A frequently heard complaint was that they have the opportunity to access the Internet, but had no idea where to start, as the complexity of the Internet is experienced as too high a threshold. Volunteers working with homeless people told us which information is requested: important addresses, telephone numbers and information about assistance offered, e.g. on food, health, legal or municipal issues. Especially since access to the Internet is often not the problem, a simple application could be a useful solution. The emphasis should be on mobile access and reliable, user-friendly and high-quality information.

5.2   An action research approach

To build a usefull application for the poor and homeless we first need to find out: (i) how the target group could be best served with information? (ii) are the current

information providers? (iii) who are the information seekers? (iv) which information is needed? (v) which channel of information is effective? (vi) which barriers currently exist to access information?

To answer these questions we used an action research approach. Action research is a methodology with an iterative approach, combining theory and practice [6]. Action research often consists of two steps: (i) collaborative analysis by the participants, leading to the formulation of theory; (ii) collaborative change with studying of results [6]. Action research is strongly focused on action and change. It operates over reasonably short time spans, and involves substantial collaboration and participation [6, 7].

It is not entirely clear how research from other countries on digital development for homeless people is applicable to the situation in Amsterdam. We did not find much research on specific usability methods aimed at interfaces for homeless people who have different digital skills than those who the average user interface designer considers as basic skills. We looked into usability methods in user-centered design [8], mobile-first design [9] and human-computer interaction [10] which have been tested with this target group. To put our action research into a framework, the ICT4D 3.0 framework was used [11]. This framework consists of five distinctive, iterative phases:

- Context Analysis

- Needs Assessment

- Requirement Engineering

- Engineering

- Sustainability Assessment

This framework makes it possible to design and build an application for homeless people that aimes to overcome some of the problems they encounter in daily live. To start, data are collected from interviews with representatives from this target group to find the needs and requirements for the design of the application. Testing the prototype is done by organizing "thinking aloud" sessions that yield insights and results with which the cycle can be re-iterated to improve the application [12]. The different steps of this framework are briefly explained in the next sections.

5.2.1   Context Analysis

During the first phase, the research domain is explored and information is collected, from literature and in the field, through site visits, interviews and focus group discussions with representatives from the target groups, and expert interviews.

For our research the start of the context analysis was the event Digi Challenge, organized by the municipality of Amsterdam[1]. It was for us the introduction to the domain of digital development and digital inclusion in the urban context of Amsterdam.

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[1]https://www.pact-amsterdam.nl/digichallenge-2-2/ – accessed 11-11-2019.
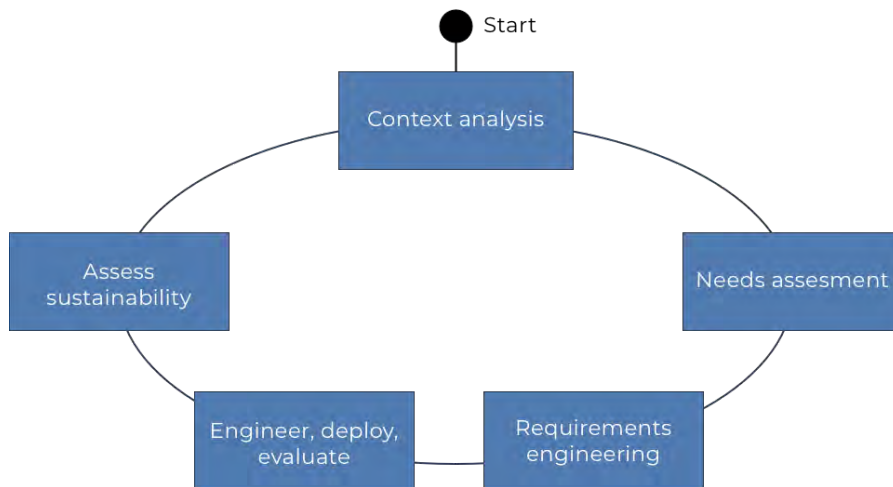
Figure 5.2   A view of the ICT4D 3.0 Framework.

In weeks and months following this event, various domain experts were interviewed by us: employees from a private organization called LostLemon, experts from the Dutch institute for applied science TNO, advisors from the Municipality of Amsterdam. In addition, many discussions were held with volunteers in the homeless care sector, for example at the institution *Sant'Egidio*[2]. These volunteers have made it possible for us to get in touch with homeless people on a regular basis, during this research.

5.2.2   Needs assessment

When it is possible to get into contact the homeless, one can start to get to know them and map their wishes and needs. Questions are: What kind of people are the target group? What do they need? This could be answered by means of interviews. We went deeply into what is really important for this group, in order for them to survive as well as possible. Do they have a smartphone at all, and what do they use it for at the moment? It immediately became a collaboration between developers and the target group, as explicitly described in the ICT4D 3.0 framework [11].

5.2.3   Requirements engineering

Based on the needs identified with the target group, a list of functional requirements was made, which the end product has to meet. This list consists of a list of "must have" and "nice to have" requirements. In addition to this functionalities list, a list

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[2]https://www.santegidio.nl/ – accessed 11-11-2019.

of qualitative requirements is also drawn up. This should guarantee the quality of the end product in several ways, as will be explained later in this paper.

5.2.4   Engineering

The list of functionalities has been applied to a number of sketches, which were later incorporated into a wireframe and finally into a prototype. With this prototype we went back to the target group several times to check if it met the needs that had been determined earlier. With the resulting feedback, the product has been improved a number of times, with the mentioned ICT4D 3.0 cycle being repeated.

5.2.5   Sustainability assessment

Throughout the project, the sustainability of the final product is taken into account in several ways. In this way we try to maximize the viability of the product. In order to guarantee this aspect, contact was made with parties such as the municipality of Amsterdam, and organizations as TNO and LostLemon, who could possibly play a role in the further development and viability of the application. The different ways in which sustainability plays a role will be discussed later in the use case and the discussion of this paper.

5.3   What has been done previous to this study

Various studies, in the Netherlands and other countries, show that there is still much to be gained in the field of digital development and information facilities, in support of disadvantaged groups and homeless people [1, 2, 7].

Various studies in the Netherlands show that a large part of the population is still digitally unskilled. In 2017 researchers from the Vrije Universiteit in cooperation with local research agency OostWest, carried out a preliminary study on the digital divide in Amsterdam, from which an advisory report has been published [7]. This report states that many minima (people living from a minimum income) are only digitally skilled to a limited extent, but they often cannot cope with the complexity of today's society. This is also a conclusion of the report "De sociale staat van Nederland 2017" of the Dutch national social and cultural planning office: *Sociaal en Cultureel Planbureau* [13]. The latter report focuses on a group of Amsterdam children, adults and parents living in poverty, precisely because developments affect them in particular and their learning ability is limited.

Other studies, by on the relationship between poverty and technology, have investigated how mobile phones can improve the quality of life for people living in relative poverty or homelessness [14, 15]. It was found that technology plays an important role in how homeless people connect with family and friends. According to a research by Roberson and Nardi (2010), technology plays an important role in creating social ties needed for cooperation between the poor in urban environments [2]. As stated by Roberson and Nardi (2010), the needs of homeless for survival

and involvement in social worlds, even beyond their immediate communities, motivates them to use of digital technologies. This makes technology a powerful, yet underexplored part of homeless culture.

Recent research carried out in the United States shows that almost every adult homeless person has access to a mobile phone [4]. From this they conclude that mobile applications can be very promising to support target groups such as the homeless and the very poor in, for example, health care. Research on homelessness in Scotland shows that it is possible for homeless people to be digitally included, for example by using a mobile phone. This study indicates that this does not immediately mean that they are no longer socially excluded. The study has shown that access and use of ICT can lead to everyday practices and facilitate contact with homeless subcultures [1].

Access to digital technologies alone is not enough to become included, because the road to social and digital inclusion is a complex one. For example, certain skills will be needed and the will to learn them is necessary, as Claire (2006) stated [1].

What the municipality of Amsterdam has done   In its 2018 coalition report, the municipality of Amsterdam included a section on "Democratie en de Digitale Stad". This section states, among other things, that attention will continue to be paid to people who have difficulty with digitisation, in the form of digital services and participation. In addition, access to data is considered important, which means that all residents have access to important information. The manifesto *"Tada, duidelijk over data"*[3] will also be implemented. Among other things, the manifesto forms a manual to deal with the possibilities of digital technologies and fair access to these technologies to reduce the existing knowledge gap.

Contact was made with the municipality of Amsterdam, where a conversation has taken place with an employee of the department responsible for the digitisation of the municipality of Amsterdam. They currently have several projects in progress as a result of research from the Vrije Universiteit [3]. Examples of these projects are community centres with computers, computer lessons for adults at primary schools and digital buddies for the elderly.

It became clear that there are currently no projects that are aimed at providing information to homeless people and that this problem could not currently be given the highest priority out of the municipality, partly due to a lack of personnel. Not much research has been done on specific usability methods aimed at interfaces for homeless people who have different digital skills than those that the average user-interface designer considers as basic skills.

Similar initiatives   There are currently no information systems that are equivalent to the outlined image of an application aimed at the homeless. There is an application called "givemeshelter", where people can donate money so that homeless people can eat and sleep[4], the so-called "bed, bad, brood app voor daklozen".

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[3]See: https://tada.city/ – accessed 11-11-2019.
[4]See: https://www.givemeshelter.nl/ – accessed 11-11-2019.
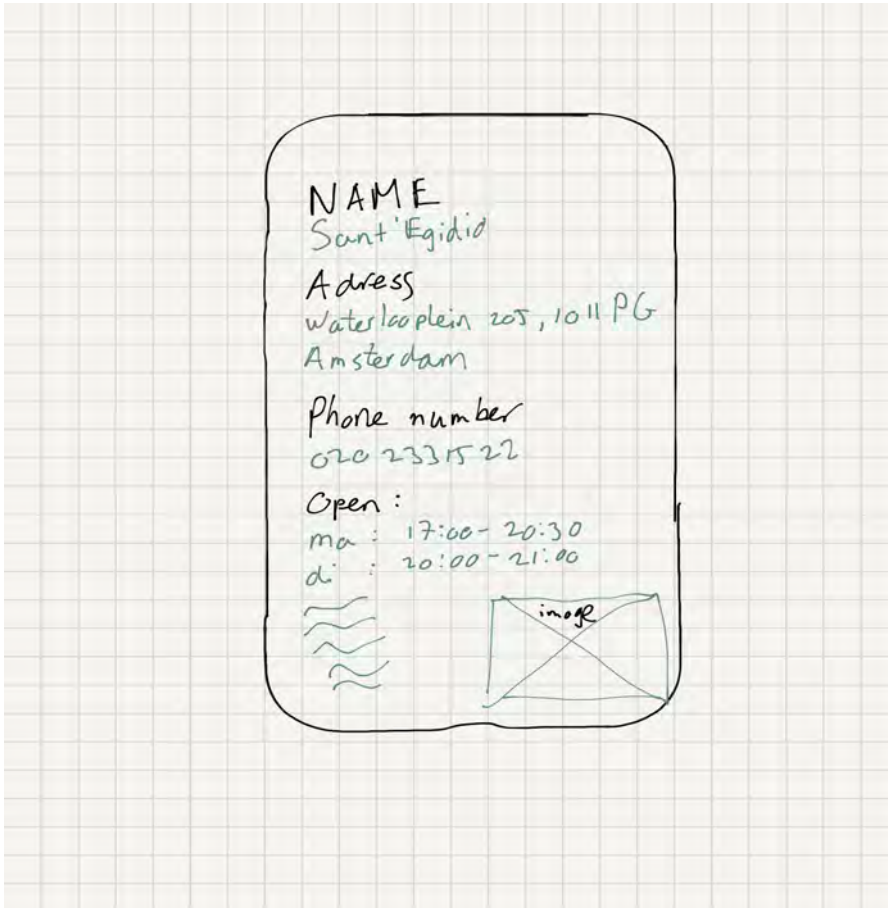
Figure 5.3   First sketch of the envisaged information page.

There is also the *Street Messenger*[5] messaging service, which sends a message to the homeless when it freezes about a shelter or location where extra beds are available, so this is especially for emergencies. In addition, there are several pages with information about shelter on the websites of different municipalities. At the time of writing, these are the only existing options in the field of information provision specifically aimed at the homeless.

Development frameworks and methods   Because it concerns a very specific target group, it is important to choose a design approach in which the user is central. This is the case with Inclusive Design. Because this is a very specific target group as well as a diverse target group, it is important to include a more specialised method during the development. In addition to Inclusive Design, there are numerous design approaches in which the user is central.

A number of approaches focus on involving users in the design process (such as human-centered design, user-centered design, participatory design and co-design). Other approaches focus mainly on principles and guidelines that the design (product or service) must meet (such as usability, user experience, persuasive design and value-driven design). Inclusive Design deals with both the process and the design, but focuses specifically on the diversity of users.

Inclusive Design   A very suitable design method to consider is *Inclusive Design*[6]. This method is similar to other design approaches where the user is central. An example of this is user-centered design. With inclusive design, special attention is paid to the diversity of the user group. It is about designing for the needs of people with permanent, temporary, situational, or changing disabilities. Inclusive Design focuses on seven principles:

- Provide comparable experience;

- Consider situation;

- Be consistent;

- Give control;

- Offer choice;

- Prioritise content;

- Add value.

The Inclusive Design Principles are shared under a Creative Commons licence[7] that allows copying, sharing and redistribution, in addition to remixing, transforming and building upon the material, even for commercial purposes.

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[5]https://www.ad.nl/utrecht/contact-met-dakloze-via-de-app-street-messenger a0f3576d/ – accessed 11-11-2019.
[6]https://inclusivedesignprinciples.org/ – accessed 11-11-2019.
[7]https://creativecommons.org/licenses/by-sa/3.0/ – accessed 11-11-2019.

5.3.1 "Toolkit Inclusie"

Two of the organizations with which we were in contact during this research were TNO and Lost Lemon. They contributed to the development of the "Toolkit Inclusie", which was developed to provide guidelines for the design of systems for, among others, the following target groups: (i) people with mental disability; (ii) people with autism; (iii) homeless people; (iv) Immigrants; (v) elderly people. The toolkit is made available within the community 'Gebruiker Centraal'[8]. The design for inclusion takes into account various possible limitations of users, both in terms of skills and in the circumstances in which the user may find himself. This may include stressful situations or situations in which, for example, sound is not desirable in the interaction. The five design principles that have been proposed are as follows:

- Putting the user first:

  - Design from the needs and context of people, not from the technology or your organization. sion: Gather a diversite group of users in terms of skills and living circumstances;

- Don't be satisfied until your user is;

  - Design, test, measure and improve. And continue to do so. Involve a diversity of users;

- Make it easy for the user:

  - Design simple processes, make user-friendly systems and write easy to understand. Take into account the physical, cognitive and psychosocial limitations of your users, and limitations due to circumstances, in your design. Use design guidelines and examples

- Proceed on the basis of facts, not assumptions:

  - Design based on facts and user research, and don't assume that your user is like you. Get to know the characteristics of your users and involve a diversity of users;

- Be transparent and share your knowledge:

  - Work together and share your knowledge and experience. Be open to feedback; Create awareness about inclusion among all parties involved in the design process. Record your insights and share them with others.

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[8]https://inclusie.gebruikercentraal.nl/ – accessed 11-11-2019

5.3.2 Powertoolkit

Another project TNO has worked on is the Powertoolkit. This design principle kit is intended for:

- Designers of technology who want to gain more insight into the user group of people with a cognitive disability (a light mental disability and/or autism) and their care providers;

- Healthcare providers who want to gain more insight into participation in participatory design processes;

- Care innovators who want to gain more insight into the possibilities of technology for clients with a cognitive disability;

- Knowledge institutions that want to carry out projects in education and research at the interface of care, design and technology.

This Powertoolkit consists of design guidelines that indicate what you have to take into account in the design when designing for people with cognitive disabilities. It is a comprehensive set of practical guidelines. These guidelines include navigation, layout, use of colour, information presentation, error messages, feedback and personalisation[9].

5.4 A case study with homeless people in Amsterdam

In this section a case study is presented, on how an information system for homeless people was developed. The development and design of the system follows the steps as discussed for the ICT4D 3.0 framework. It also takes into account the set of guidelines for inclusive design, the powertoolkit and the *Toolkit Inclusie*. Three iterative phases have taken place during the project.

5.4.1 Context Analysis

An estimated 30,000 to 70,000 people are currently homeless in the Netherlands[10]. Figures vary, depending on the definition and method of counting, but in general people are considered homeless if they have no fixed home of residence. Homelessness often goes with a lack of money for primary goods and food[11].

The place and context in which our main use case is developed and tested is the foundation Sant 'Egidio. Here homeless people can get a free meal every week. This is served by a group of volunteers. Here it was for us possible to come into contact with a group of homeless people in Amsterdam, to carry out tests, to map wishes and to collect their reactions.

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[9]http://www.powertoolkit.nl/richtlijnen/ – accessed 11-11-2019.
[10]Source: https://inclusie.gebruikercentraal.nl/doelgroep/dak-en-thuislozen// – accessed 11-11-2019.
[11]Ibidem.

At Sant'Egidio about 100 people are coming for dinner every week. Not everyone is open to communicate with us, but in the end, during the iterations, there were about 15 to 30 people who participated at least once in a user test. When the intention of the investigation was explained and the possibility of helping in a product from which they could actually benefit themselves was explained, it appeared that there was a certain willingness to share an opinion.

It turned out that a personal and cautious approach together with a good explanation is very important with this group of people. This, because of some of the distrust mentioned, could probably have to do with the fact that many people within the target group said that they had already been affected by negative experiences in life, many times.

The volunteers of Sant 'Egidio told us that they frequently received the same type of practical questions from the homeless people. Questions like: Where can I get a meal tomorrow? How often can I come here to eat? Where can I get free coffee or gloves? were some of the main questions. Questions that often had a clear answer. This information that is still often passed on orally. It is believed that this type of information could reach a much larger target group if it does not depend solely on foundations such as Sant 'Egidio to be distributed. Especially since it has become clear that access to the Internet is for many not the actual problem, we decided to make this type of information available in an easy to use mobile or web application, that can be reached via the Internet.

The context analysis has shown us that the target group is a very diverse group. Homeless people often deal with multiple problems: psychological problems, drug and alcohol addiction, debts or physical problems. In the (easily accessible) social care, it is reported that the number of homeless people with mental disorders is increasing. New groups are emerging within social care. Although there are no precise figures, there are signs that more people are becoming homeless without any addiction problems and/or psychiatric problems. There are usually several problems at the same time.

It was interesting to see that about 40 percent of the people who come to the dinner have access to a smartphone. This percentage will only increase because the percentage of people who have become homeless in recent years and have access to a smartphone is even higher[12].

The homeless people we interviewed told us they were often hanging out with fellow homeless people and that they were often living together in groups. As a result, there is a good chance that at least one person will have access to a mobile phone in such a group. This makes it very interesting to make information accessible via this device, because a very large part of the homeless could be reached in this way. In order to get a good feeling for the needs of people, a questionnaire has been drawn up that can be found in Figure 5.11. This is mainly used to get an open conversation going. The results of this questionnaire, together with the information

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[12]See NRC news article https://www.nrc.nl/nieuws/2017/06/20/pechmannen-zijn-de-nieuwe-daklozen-11038039-a1563695 – accessed 11-11-2019.

Requirement	Definition
Caching	Since users do not have access to the Internet at all times, it should be possible to hold the information on the device so that it is also available without Internet access.
Multilanguage	Because the target group speaks many different languages, it is nice if they can use the application in different languages.
Text-to-speech	In order to make the application accessible to people who are struggling with low literacy, a function that allows text to be spoken is a useful tool. This could be done using a service such as Readspeaker See: https://www.readspeaker.com/

Table 5.1 Functional requirements for the envisaged app, collected during the field research.

from meetings with the municipality of Amsterdam and experts from Lost Lemon and TNO, have been compiled in order to draw up a needs assessment.

5.4.2 Needs Assessment

Based on the context analysis, a list of needs and wishes that the application must meet can be drawn up. These have been mapped out by talking to the target group. In the conversations that were held, it became clear that the greatest need was for information, especially about shelter. Information about this should therefore be prominently present. Information about food was then most frequently mentioned, followed by medical information, information about education and help, free items such as blankets and gloves and public WiFi spots in the city. On the basis of this list drawn up by the target group, it was decided that the prototype should be based on this information categories.

The list is prioritized on the basis of most named category to least named category. The information should also be easy to access, as many people within the target group indicated during conversations that they had limited digital skills. The target group also consists of people from different countries who speak different languages, so multilingualism can also be defined as a need. At least 40 percent of the people who were interviewed at Sant'Egidio had a smartphone, and an even larger group had access to the Internet by using for example computers in the public library.

There is a need to make the information available on as many digital devices as possible. This is also one of the recommendations in the article "Bouwstenen voor Digitale Inclusie":

> "The smartphone is by far the most widely used device. Invest in good digital interaction with citizens with low digital skills. By making more offers (websites,
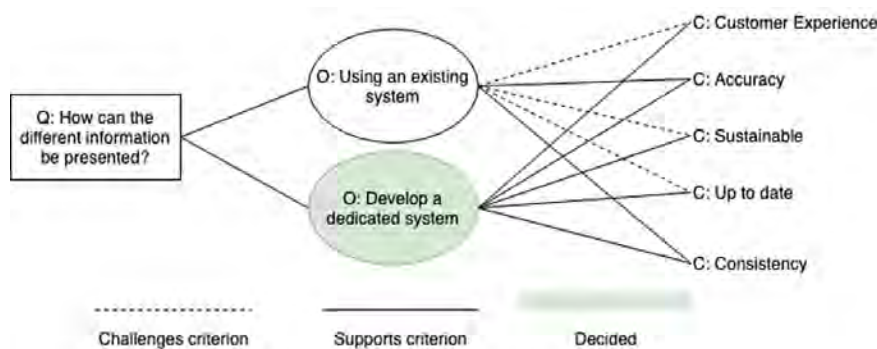
Figure 5.4   QOC 1: Criteria supporting the decision to build a dedicated system.

systems, etc.) suitable for smartphones and making it easier to use. With the help of decision trees and visualizations, the possibilities of using smartphones can be increased and the target group gains confidence to use digital applications. Experiences gained by the municipality can be shared and made available to partners. For example, the municipality can commission a startup to further develop existing offerings into attractive and accessible offerings that can be used on the smartphone. In this way, existing knowledge can be safeguarded, but also knowledge from outside can be used. The Commission has also been able to achieve a high level of commitment to the development of new technologies, so that innovative steps can be taken" [7].

However, low literacy, which affects many people within the target group, must be taken into account [16]. In addition, with the public Wi-Fi hotspots in the city of Amsterdam, homeless can connect to the Internet. During the conversations, many people indicated that access to the Internet is possible in certain places, but certainly not everywhere. It should therefore not be expected that they will be able to obtain a constant update of information during the day.

There are many different parties that provide the information that needs to be provided. One assumption was that the municipality would be an important provider of valuable information for them, but this does not appear to be the case in the discussions held. If we want to focus on primary information provision for the homeless, then the institutions that offer this information will be the most important information providers. The information collection will take place on the basis of information available from different organizations. This include providers of food, shelter, medical information, public Internet providers, providers of free equipment and providers of education, for example in the field of reintegration.

5.4.3 Requirements Engineering

A requirements analysis is used to determine the requirements to be met by the end product. This analysis initially consists of a list of functional requirements, which

can be guaranteed on the basis of a list of qualitative requirements, both of which will be discussed and explained in the following sections.

5.4.4   Functional Requirements

The list of functional requirements is a result of the need analysis in the previous section. Because the flow for the application was very clear quite quickly, functional requirements were established easily. They can be found in table 5.1.

5.4.5   Quality Requirements

A list of qualitative requirements has been drawn up which has been pursued during the development of the application. These will be defined with the corresponding rationale included in table 5.2. It is important to establish qualitative requirements in order to implement the idea as a real product. In this way, the story with its characters, the use case and functional requirements are shaped into a form that can actually be developed technically.

5.4.6   Supporting development choices with QOC

To explain a number of design decisions and considerations made during the design process, QOCs (Questions, Options, Criteria) are recorded. This method helps to keep track of the argumentation and reasoning behind a software design process, and to learn from it (see [13]).

5.4.7   QOC 1

To meet the users' needs, either an existing system can be proposed to make the information available, or a tailor-made application can be developed. The reasons for choosing the second option are explained in Figure 5.4 on the next page. The absence of a specialized application or dedicated platform, leads to the decision to develop an application for the homeless. This also takes sustainability into account. It would be unnecessary to develop a system or service that already exists.

5.4.8   QOC 2

The information can be entered manually in a content management system (CMS) or can be crawled automatically . This second option was chosen, because it was possible to realize this by means of another research project, and this offers a very sustainable solution. It has also been shown that the required information can be crawled very easily. How exactly this script works can be read in Chapter 6, by Carlbandro Edoga who developed the algorithm for the mobile app, and describes it in detail in his chapter. The advantages of this method can be seen in figure 5.5.

Requirement	Definition
Customer Experience	This requirement deals with the user experience. This aspect is crucial for the success of our solution. The application must be easy to use. Otherwise users, who often are not technically skilled, will soon stop using it. The design principles presented in the Power Toolkit, Inclusive Design and the Toolkit Inclusie are used as guideline.
Accuracy	To become a reliable tool, the application must present accurate and reliable information. Context analysis has shown that many people within the target group have difficulty trusting something unknown. Therefore, the application will have to present very accurate information and the possibility to continue to guarantee this.
Up to date	It is very important that up to date information is shown, so that people are not sent to places where they can no longer actually go. This also promotes user confidence in the application.
Sustainable	Efforts should be made to keep the information up to date in an efficient manner. Field research has shown that it is difficult for all the different services from which information is collected to keep the supply up to date. Therefore, the possibilities for automated information collection will be explored. In addition, it will be examined how as few different platforms as possible need to be developed in order to maintain the whole system in a durable manner.
Consistency	In order to maintain the user-friendliness and confidence in the application, the information about the different categories must be offered in the most consistent way possible, this will improve usability and is in line with the previously mentioned design principles.

Table 5.2   Quality requirements.

5.4.9 Engineering the system

During the actual development, the ICT4D 3.0 framework was used, as usual, in an iterative way. With this method we have tried to test quickly with a MVP, a minimum
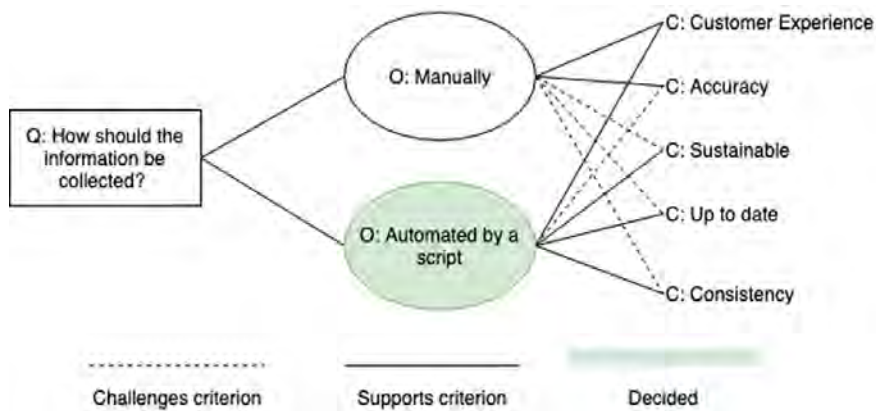
Figure 5.5   QOC 2: Criteria to decide between manual or automated information collection.

viable product[13] with the target group. To get a feel for the use of colour, text presentation and layout direction, three possible, different homepages were designed and directly showed in a thinking aloud session with the target group. Based on available work such as the way in which Sant'Egidio offers an information flyer for homeless by Sant'Egidio Rome, in Italy[14] and the discussed inclusive design principles, these different options were developed. These first presented designs can be seen in figure 5.6.

5.4.10 First test session

We showed all three designs to 10 different people on a smartphone. At first we only asked to look at the phone. We showed all three designs without any assignment. Then we explained that all three designs showed the same categories for the same information. The next question was which design they would prefer if they used this app themselves. Interesting was the unanimous result of the first design. Some of the feedback given:

> "I'm not very good at language and here I immediately understood what it was all about without the text distracting me like those other pictures."
> "If you keep those colors the same I know them after a while and I don't even have to look at the icons anymore."
> "My Polish friends also understand this with the icons, handy"

[13]https://rubygarage.org/blog/what-is-a-minimum-viable-product – accessed 11-11-2019.
[14]https://www.santegidio.org/documenti/doc_1062/comunita-di-santegidio-guida-dove-roma-2014pocket.pdf – accessed 11-11-2019.
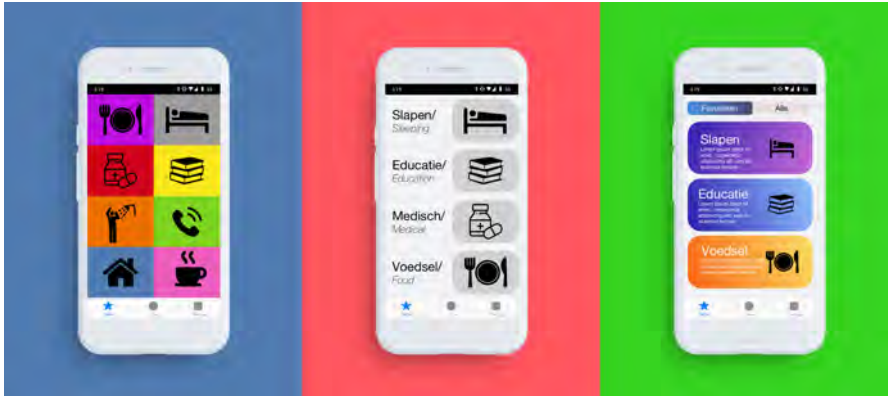
Figure 5.6   The first three proposed designs.

Datafield to show	Motivation
Name of the instance	To identify the place
Adress	To know where to go
Phone number	To be able to call them
Opening hours	To know when they are open
Image	To enrich the application and identify the place

Table 5.3   First list of data fields shown to the users.

5.4.11   Iterate on the first product

It was clear after this session that we had to continue with the design presented in figure 5.7 for the rest of the application. Other things that were often seen as user-friendly were simplicity, use of colour, icons and as few texts as possible. With this feedback, which fitted in well with the methods discussed earlier, the rest of the application was developed, first working out the category of food.

We noticed that a lot of people didn't speak Dutch during our test sessions, so multilingualism would be a very important priority for the next test session. Because we will try to use as few sentences as possible to keep it easy to read, we will use as much information as possible from Google. We were able to get a picture of the data that needed to be indexed and its design, which will be shown in table 5.3 and Figure 5.3 on the next page.

We developed this design. Then we noticed that the data were generic enough to be translated by Google translate, there are almost only keywords and loose words presented so that this translation could be effective enough. In this way it was possible to quickly build in support for many different languages that are well represented

within the target group. Examples of supported languages are: Arabic, English, German, French, Spanish, Russian and Polish.

5.4.12   Next test session

Now that we had finished the start page, a number of different archive pages with all results for the relevant categories, we were able to test the entire flow of the application for the first time. Again there were a lot of people who wanted to help us. The news that we are developing an application for them has been circulating and clearly promotes cooperation with this group of people.

This time we can receive feedback from more different people with very valuable input. This proves to be a high priority requirement: presenting information in different ways (because many people seem to have reading difficulties). Also, it is sometimes difficult to determine the location of an organization in the city on the basis of an address alone, especially for the people within the target group who have not been homeless for very long or have only just arrived in the Netherlands. People who have been homeless for a long time say they can manage well in terms of food because they have been in this situation for a long time. Incidentally required information such as medical information, current news and places for education are more interesting for these people.

Being able to translate the text seems to work very effectivel. This has been tested with Polish and Moroccan people who indicated that the translation is accurate enough to understand what it is all about. We also notice that it is valuable to show more information, which will be listed below. In the next iteration we want to focus on the improvements presented in table 5.4.

5.4.13   Last test session

With an application that has been successfully improved with all the above mentioned points, the possibility came up to go to Sant'Egidio for another test session. This was again well received. Frequently asked by the test group was where they could find the application. This indicates that there is a real demand for it to be developed, even people who indicated that they were quite capable in the field of information found it a nice idea to be able to use this application, both as a backup should their situation be getting worse, but also to expand their knowledge. A good tip was to give the information according to priority, taking into account the map.

In our test, this standard covered the lower part of the screen, which meant that not everyone knew that it was possible to scroll to the opening times, which was very important information for this group. Based on this feedback, the map has been moved to a lower part of the detail page so that some of the opening times are immediately visible, and when people see half a week of opening times, they are more likely to scroll down. The translation function and the text-to-speech function were again very well received, and have therefore become indispensable functionality within the application.

Improvement	Motivation
Add location on a map.	A small map makes it clear how far a location is.
Add the Google Maps description of a place.	Google Maps shows a small description of places, making it very fast clear what kind of instance it is.
Button for direct navigation.	A lot of the people are using a Android phone, having Google Maps pre-installed makes it easy to present a direct navigation route to the place.
Images of a instance in the archive instead of the detail page.	The image does not add much to the page with details about an instance, but it makes navigating the archives easier.
A way to generate feedback.	To keep the information up to date, it must be possible to give feedback, when the presented information is not accurate.
Text to speech.	To help low literate people using the app, it will be configured with text-to-speech functionality.

Table 5.4   List of improvements of the system and what the motivations are.

Figure 5.7   The unanimously chosen design for the app, by the users.

Again we understood that there are occasional giveaway actions in the form of for example gloves in winter, free coffee or other free stuff. These exceptions are often difficult to find, and could therefore be offered in the form of a newsfeed within the application. The already existing category of items would consist partly of this information. This was not immediately clear to the target group from conversations, after which the name of this category was changed to news, which can cover a broader scope and is easier to understand for these people. This category will contain news that is difficult to crawl from Google Maps, and will have to be provided by the appropriate organizations that offer something.

5.4.14   The final product

At the end of the iterations there is a very complete prototype of which several screens will now be shown. First the homepage of the application is shown in figure 5.8. It is an easy page to use according to the users, where you can quickly make the choice of what you want to search for. This can be done in various ways that comply with the mentioned design guidelines for inclusion.

After clicking on 'food' in the screen above, the user will be taken to the page with all places for food. This page is shown in figure 5.9 on the next page. This page is prioritized based on the Google indexation that preceded the crawl process. Each place is presented here as its own card. This so-called card contains a picture of the location, the name of the location and a 'read more' button. In addition, a label is attached to the card with the category in which the user is located. This combination of information was seen by the tests with users as the most pleasant and useful, without it becoming cluttered for them.

When the user clicks on the first result, in this case Sant'Egidio, he will see all the details about this place, as shown in figure 5.10. This figure is presented here as

Figure 5.8   The frontpage design of the mobile application.
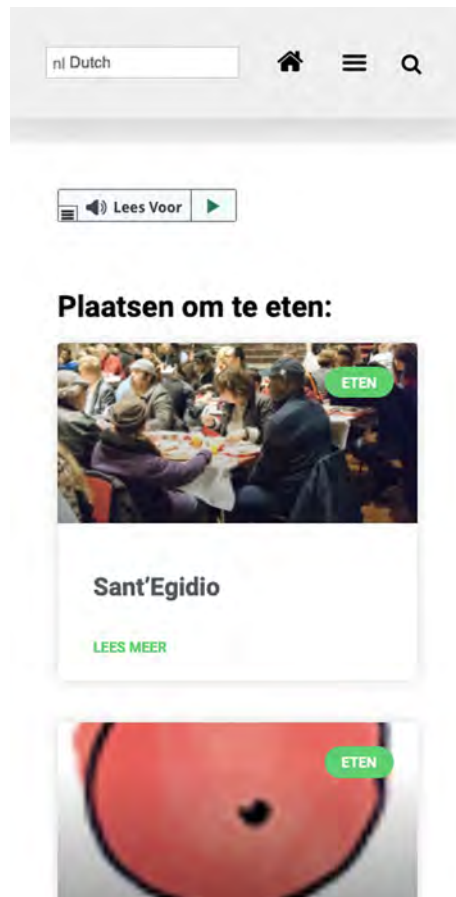
Figure 5.9   The archive page "where to eat".
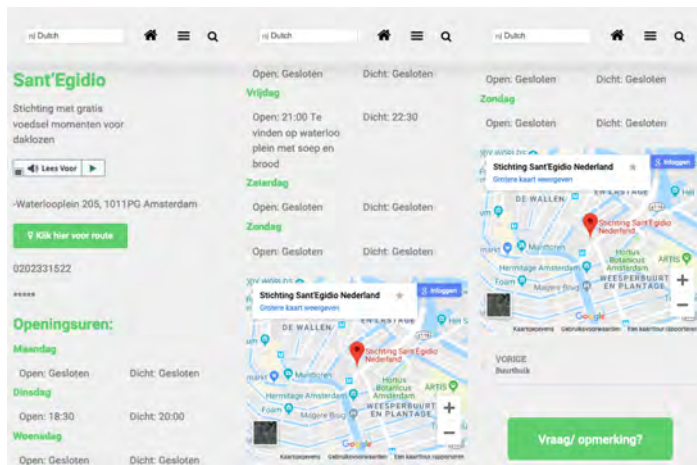
Figure 5.10   The detailed page of the homeless app.

three separate pages to keep it readable in this document, in the application this will be a long page with all the information among each other.

5.5   Sustainability Assessment

How to achieve sustainability of the system has been a concern during the entire project. The wish of the VU University Amsterdam research group has been to deliver something tangible and effective from the very beginning. Attention has therefore been paid from the start to developing the current product as sustainable as possible, but also to being able to offer a sustainable existence. In this context, a number of important choices have been made, which will now be discussed.

5.5.1   The application form: a progressive web app

In order to keep both the development and the maintenance sustainable from a budget point of view, it was decided to develop the application as a progressive web app. This means that the application is not a native application for mobile phones. Instead, there is only one application that can be presented as a hybrid to iOS users, Android users as well as computer users. This way only one application needs to be developed and maintained, which makes this modern hybrid form very efficient and interesting from a sustainability perspective [17].

The application can be accessed via an url and automatically adapts responsive to the size of the user's screen. The application can be added to the user's home screen on a phone to include some of the benefits of a native app as opposed to using a website. For example, a progressive web app can store data on the user's device. This way, the application can also be used without an Internet connection. When the

Figure 5.11   The list of questions asked to the homeless.

Carlbandro Edoga
Marc Hegeman

Questionnaire App Usage

As part of two master thesis projects under the supervision of Anna Bon at the Vrije Universiteit Amsterdam this questionnaire aims at assessing the usage of mobile applications. No personal data will be retrieved. All data will be solely used for academic purposes. You can leave out questions that you cannot or do not want to answer.

1. Do you own a smartphone? If not, please go to question 4.

   ❏ Yes
   ❏ No

2. How often do you use your smartphone per day?

   ❏ < 1 hour
   ❏ 1 hour
   ❏ 2 hours
   ❏ 3-5 hours
   ❏ > 5 hours

3. Which applications would you consider the most useful?

   • _____

   • _____

   • _____

4. Which information do you get offline because you do not find it online

   • _____

   • _____

   • _____

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user is reconnected to the Internet, the latest version is retrieved, just like a native application. This promotes the sustainability of the application because the chance of using the application is so much greater for the target group. It is also possible for users to receive notifications from a progressive web app, a feature that is not currently used by the described application but that will be discussed in a moment.

5.5.2   Automated data crawling

Because a large part of the data displayed by the application is automatically retrieved by an algorithm, the application will require little maintenance in terms of content. At the moment, only the news section requires manual input from organizations, furthermore, providing up-to-date data on Google Maps is sufficient to keep the information within the application up to date. This makes the application very durable in maintenance. The chance that the information is still correct in five years' time is much greater than if we were completely dependent on manual input from updates. There is a cronjob that can run every night that activates an algorithm that checks if there are any new instances on Google that meet the requirements of the algorithm. The exact functioning of this algorithm is further explained in the research project of Carlbandro Edoga.

5.5.3   Keeping the information up to date using crowd sourcing

At the bottom of every page within the application you can quickly go to a contact form. Through this way of crowd sourcing feedback can be collected. For example, about incorrect information. In this way, the accuracy of the given information can be further improved, based on feedback from the actual users of the services that are shown in the application. This review system will only further improve the quality of the data in a way that is proven by Tong et. al. [18]: the more active a user community, the higher the quality of the content.

5.5.4   Scalability of the application

During the investigation, we came into contact with several parties. Specialized parties in the field of development for minorities such as Lost Lemon, TNO and the municipality of Amsterdam have already indicated that they are interested in the idea of this application. The automated method of data collection mentioned above is an important part of this.

   Another important part for this interest appears to be the generic aspect of the application, they told us. The algorithm combines a number of search queries that consist of generic keywords with location keywords. At the moment, 'Amsterdam' has been used as the location keyword. In this way, the output consists of places that are located within Amsterdam. The same keywords also apply to the same kind of places for homeless people in other cities. For example, Amsterdam could very well be replaced by 'Utrecht' or 'Rotterdam' in combination with the same generic query to collect results within these municipalities. What this means is that the application

Figure 5.12   The final app being used.

could easily be launched in other municipalities, and is therefore not restricted by the city borders of Amsterdam or even by the national borders of the Netherlands. When a correct combination of appropriate keywords in combination with a location keyword is combined, the application can be of service anywhere.

5.6   Discussion

In the discussion section, the methodology used will be reflected next to the results obtained. Also, future research and the possibilities offered by the development of the current application will be discussed in more detail. In addition, there is room to give recommendations.

5.6.1   Validation of the used framework, ICT4D 3.0

The ICT4D 3.0 framework was used throughout the study, but particularly during the case study carried out. This was also the most interesting practical part to test the development framework for what it is actually intended. ICT4D 3.0 has proven to be a useful framework for the developed application, for several reasons.

Firstly, because it was not at all clear in advance in what form the application would finally have to work out next to a number of assumptions. In order not to start on the basis of unchecked assumptions and to throw away valuable time, it has been a very pleasant experience to use the framework and to start with a very extensive context analysis. This has resulted in many insights at an early stage that have remained intact throughout the project, something that is very difficult to achieve when starting on the basis of assumptions.

Next, the needs and requirements were drawn up in consultation with the actual target group. This shows how the framework lends itself to inclusive design, in which

co-creation and co-design in consultation with the target group are an important part of te work[15].

5.6.2 Collaborative

To get to know the needs and wishes, there was a close cooperation with the volunteers and visitors of the weekly organized dinner at Sant'Egidio in Amsterdam. This gave us the unique opportunity to visit as many times for testing or knowledge gathering as we deem necessary. Also, the various volunteers who help here weekly have a lot of knowledge about the needs of the homeless visitors. To collect this information from this perspective has been very valuable during the development.

In addition, we have been invited several times by the organization Lost Lemon to exchange thoughts. This party with a lot of knowledge about developing for different less fortunate target groups was able to contribute a lot, especially in the orientation phase of the project, and put us on the track that was eventually followed. They indicated that they were always open to a session to discuss the prototype and to see if there could be a future in which the application is further developed.

The introduction to TNO has also proved to be very interesting. Both to exchange knowledge about the subject and for possible future steps for the application. They indicated that they saw potential in the application and could put us in touch with a number of people who might be able to ensure that the application could also be launched in Utrecht. At this moment no concrete plans have been made for this together, but the invitation to discuss this later is there. This indicates that there is potential in the prototype and that there are possible partners with whom we could collaborate so that more people could make use of the application.

Also the cooperation with my colleague Carlbandro Edoga went very smoothly. Every week we organized a meeting in which a backlog was kept and a todo list for the week in question. Because on this regular basis we discussed the possible improvements together, I believe that the final product has been received so positively.

5.6.3 Iterative

Both the framework and the possibility to organize regular user sessions ensured that iterative work could be done. In this way we were able to test a minimum viable product on a regular basis while little valuable time was lost. Because a lot of needs were collected from the target group during the project, the iterative working method was a very effective way to achieve an optimal result. If all the feedback after the first orientation phase had not been gathered, it would not have been possible to deliver a product that would meet the same number of wishes of the target group.

It turned out that the target group had some difficulty to see the added value of the intended application and to indicate what in their opinion the application should fulfill without being able to see anything visual. When we came back with a visual example and design and layout choices they were allowed to make, it became a lot

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[15]Co-design explained: http://www.powertoolkit.nl/wat-is-co-design/– accessed 11-11-2019.

easier to get feedback, because they got a much better idea of our intentions and the awareness that they could benefit from it was also created.

5.6.4   Adaptive

From the iterations that have just been mentioned, many new needs and requirements were found during the execution of the project. The implementation of these new requirements has resulted in an adaptive character to the project. Also the development of a single application for all common devices with associated changing screen sizes has made the application an adaptive, responsive application. Open Source software was also used for the development of the application, as this is required for further and future adaptation.

5.6.5   Future work

The application is ready to be shared with the target group within Amsterdam. It is also equipped with anonymous tracking and data collection functionality. This is done so that the use of the application by real users can be monitored. The expectation is that on the basis of this data, new improvements will come to light. Also, the mentioned possible roll-out of the application to other cities could result in an interesting use case. In this way it could be investigated whether there are significant differences in the use of the application in different cities. Here, too, the collected anonymous data can play a very interesting role. When the application is well known among the homeless, the number of users is likely to increase.

If the number of users increases seriously, it is expected that more municipalities and other organizations will be open more quickly to enter into a collaboration. Therefore, the application will first have to prove itself on the basis of data. This could also promote the offerings in the news and stuff section, making it more interesting for users to keep an eye on them. One idea to make this easy for users could be to implement notifications for new news. Also implementing a community in which people can have contact with each other and with organizations is one of the ideas on the backlog at the moment.

The past year has taught us that there is no comparable application available at the moment, and that the need for such an application is clearly present among the potential user groups. In an interview with an employee of the municipality of Amsterdam it appeared that this idea was considered interesting. Unfortunately no resources were made available to start such a project itself. More results are needed to convince the municipality of the usefulness.

5.7   Limitations

Despite the promising nature of the application, there are certain risks and limitations in the current set-up. The greatest limitation has to do with the way in which data is currently being collected.

5.7.1 Dependency on the algorithm

The output is as good as the search algorithm, instances with valuable information that cannot be found by the system will not appear in the application in first instance. There is a possibility to enter input manually that could tackle this limitation. This manual input and feedback from users could be collected via the contact form, and then added to the database by someone. This is workable but not as efficient as the described automatic way of collecting data.

5.7.2 Dependency on Google Maps

The application for the automatic data generation depends on information available on Google Maps. It is crucial that the information on Google Maps about an institution is up to date and complete. A possible limitation we have encountered is the opening times. There are institutions that undertake multiple activities, not all focused on homeless care. These organizations have often mentioned very wide opening times on Google, which are included in the application by the algorithm, but are not fully applicable to homeless people. At the moment these would have to be changed manually afterwards to make them accurate.

5.7.3 Dependency on manual news supply

The news section will have to be filled with input provided by organizations. The power and degree of up-to-dateness of this section therefore depends on the cooperation of all the different related organisations. At the moment it is not yet clear how this will work in practice. It will have to be decided in the future.

5.8 Conclusion

This chapter illustrates how a mobile application, designed and built with inclusive principles, using an iterative, adaptive and user-centered process based on the ICT4D 3.0 framework, can provide primary information needs, as outlined in several use case and requirement gathering session with homeless people in Amsterdam.

The proposed mobile service – with many tools to make its human-computer interface as easy as possible for the various people of the target group – has been developed with long-term sustainability in mind. Since our research has shown that mobile phone is owned by large part of the target group, this medium has been chosen.

Several organizations have shown interest in continuing its development in the future. With scalability and data maintenance in mind we were able to automate a large part of the data collection. With this research we have validated the proposed mobile application together with real end-users in multiple sessions. With this research we have also validated the approach and framework ICT4D 3.0, which proved suitable for this type of research problem.

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CHAPTER 6

EXPLORING INFORMATION NEEDS OF HOMELESS PEOPLE IN AMSTERDAM

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Abstract   This chapter proposes a web application that offers homeless people in Amsterdam information on where to find food, shelter, medical aid, education, useful goods and WiFi. After ascertaining the particular needs of the target group a Natural Language Processing (NPL) approach was chosen to find all the required information. The focal point of this master project is on the algorithmic retrieval and processing of the necessary data. In conjunction with another master research project (see Chapter 5) a user-friendly, sustainable and effective service was realised.

6.1   Homelessness in the Netherlands

Homelessness in the Netherlands is dangerously rising. While in 2009 18,000 people were without a permanent stay, 31,000 people were considered homeless in 2015 constituting an increase of 74% over 6 years[1]. Interestingly, especially among young

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[1] CBS: The Dutch Central Bureau of Statistics.

people (18-30 years) homelessness has increased about 55% from 8,000 to 12,400. These numbers illustrate the significance of homelessness even in first world. In order to further examine this issue one should first try to find a definition of the term homelessness, which naturally varies from country to country or even city to city.

A generally accepted definition of homelessness, which essentially also applies to the Netherlands, was made as part of the Stewart B. McKinney Homeless Assistance Act in 1987 aiming for inclusion of people, who lack a fixed, regular, and adequate nighttime residence, and people with a primary nighttime residence that is (i) a supervised publicly or privately operated shelter designed to provide temporary living accommodations; (ii) an institution that provides temporary residence for individuals intending to be institutionalised; or (iii) a public or private place not designed for or ordinarily used as a regular sleeping accommodation [1].

A huge problem that homeless people face is finding affordable or ideally free food, adequate sleeping places or medical aid. Paradoxically, especially in bigger cities such as Amsterdam there are plenty of institutions and charities providing all kinds of help. The arrival of the technological era in the early 2000s brought us web enabled phones which allow us to be reachable at any given moment and to retrieve information of any kind. As a consequence one would assume that this issue is a thing of the past. Indeed smart phones became more and more popular until they seem indispensable in the world of today. Yet, the correct use of smartphones still highly depends on one's acquaintance with technology itself and its design.

On the one hand, this includes knowing where and how to look for information online (e.g. Google or homepage of the municipality of Amsterdam) and on the other hand properly evaluating the acquired information. In addition, not everyone in this group owns a smartphone, let alone, has permanent access to the Internet which has to be considered, too. Altogether, finding useful information can present an almost insurmountable obstacle for some people in our world. In the worst case this could lead to a two-tier society. Since the correct use of (mobile) technology often correlates with one's social status, especially marginal groups are affected.

However, even for people adept at using the Internet, it may be difficult at times to find the desired information online. This is due to growing complexity of the software and also to the abundance of data to choose from[2]. Thus, a software is proposed that is capable of providing homeless people with information on places that were determined by an algorithmically improved Google search which will then be displayed in an application. This research both intends to delineate the content-related requirements homeless people have regarding digital information and also to design a software that locates places in Amsterdam. Together with Marc Hegeman and his master thesis project *'Mobile apps for homeless people: Co-creation of Information Solutions for Digital Inclusion"*, which mostly addresses design and usability, this endeavour resulted in this application[3]. Henceforth *we* stands for Marc Hegeman and Carlbandro Edoga as we worked closely together in the course of this project.

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[2]Roughly 10^9 GB are produced every day (see domo report at https://www.domo.com/learn/data-never-sleeps-5?aid=ogsm072517_1&sf100871281=1

[3]This can be found at: http://app.digitize.amsterdam/ – accessed 11-11-2019

The implications for homeless people using this application could be huge such as mitigating their social exclusion, familiarising them with (mobile) technology and empowering them to independently acquiring information; all of which could potentially enhance their (re-)socialisation.

The group of homeless people in Amsterdam was selected because we were initially liaised with a charity institution in Amsterdam, *Huis Sant'Egidio*[4], that focuses on aiding homeless people and served as one of our main contact points. Most certainly after some adaptation the findings of this project just as the application itself can be used for other (constrained) groups such as low-literate or elderly people too. In order to satisfyingly implement this plan, we identified the following questions:

- Which is the most crucial information that homeless people need to have?

- Should this data be automatically retrieved?

- If so, how can entirety and accuracy of the information be technically realised? and how can this process be repeatedly improved to make it more accurate and more sustainable?

6.2 Identifying and understanding the target group

The overall significance of this project and the demand for our application is supported by a systematic research that was done in the US. It suggests that there is a potential to fundamentally improve the lives of homeless people by the use of ICT. Though they discerned the mobile phone as the most essential factor serving as a platform to contact friends or family members for example to ask for support and also as a figurative link to our modern society, they failed to show an independent use of the smart phone by the target group [2].

In a study conducted with 301 homeless people in New York, United States, needs like safety, education, transportation, medical/dental treatment, and job training/placement were identified as at least as necessary as affordable housing. In addition, these needs were also described as difficult to satisfy by the participants. On the contrary, needs such as formal mental health and substance abuse appeared to be less relevant [3].

Furthermore, Roberson and Nardi distinguished two types of use of technology, *technology for survival* and *technology for social inclusion*. The latter hypothesis was confirmed in the study, but is not decisive for this project. Technology for survival though was characterised by "study participants [who] developed ways to use digital technologies to find food and shelter, to secure their safety, and to make money". Seemingly also less technologically inclined people can both adopt technological skills and also invent new strategies to use technology in a way that suits them surprisingly fast (length of study: 14 weeks) [4].

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[4]See: https://www.santegidio.nl/amsterdam/ – accessed 11-11-2019.

Likewise, Miller et al. (2005) showed that men who lived in a homeless shelter and had no or strictly limited access to the Internet gained self-efficacy by the use of web enabled computers. Within eight weeks the participants managed to acquire new technological skills and deemed the computer a new component in their lives that could help them re-socialise [5].

Hersberger raised the blatant question *"Are the Economically Poor Information Poor?"* respectively *"Does the Digital Divide affect the Homeless and Access to Information?"* He concluded that the precarious financial situation of homeless people reduces their ability to find the information needed online. Interestingly, she also ascertained that the people saw themselves socially disadvantaged due to limited access to the Internet. She identified transportation difficulties, technological inabilities and privacy concerns as reasons why the existing service for example free WiFi in public libraries is not exploited sufficiently by homeless people [6].

A very important insight for our project was gained when it was shown that almost half of the homeless youth indeed owns a smart phone. However, it was also described that these homeless adolescents tend to use social networks merely to communicate, whereas sheltered college students spend recreational time on social platforms and use them as source of information [7].

This outcome is also supported by another descriptive study from the US where 421 homeless people participated. The scientists even found that more than half of the sample group owned a smartphone and accessed the Internet daily. Also noteworthy is that most of them (85%) use Android as their operating system. On the other hand, an alarming one-third stated to have not have used the Internet in the past 3 months whatsoever [9].

6.3   How this project was carried out

This project consists of two different – but logically connected – activities. In order to understand the actual problem of the homeless in Amsterdam an exploratory case study in form of a questionnaire and informal 1-on-1 interviews were carried out in five phases from the initial idea until the finalisation of the project. The phases are tightly interconnected and frequently overlap and re-iterate. In a chronological order the elements of the framework are *Context Analysis, Needs Assessment, Requirement Engineering, Engineering and Sustainability Analysis* (see Figure 6.1). The engineering phase and the sustainability evaluation constitute the focal part of this work and will be examined more thoroughly, whereas the remaining phases of the ICT4D framework [8] are also partially covered by Marc Hegeman in chapter 5.

6.4   Natural Language Processing

Natural Language Processing is engaged with the interaction between computers and the human language. It mainly deals with deciphering speech, text mining and the generation of natural language. Its application is virtually limitless and ranges from
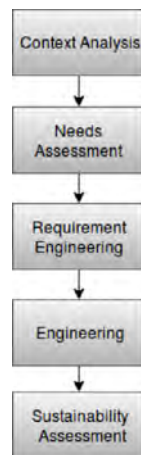
Figure 6.1   A view of the ICT4D 3.0 Framework for digital development [10].

improvement of voice-assisted systems like Alexa[5] over the systematic analysis of large text documents to the automatic creation of taxonomic word trees.

For decades many companies and research institutions have been looking for a way to automatically finding synonyms. As per today one has to state that a universal solution to this problem has not been found but every problem has to be tackled individually. One reason for that is the complexity of the human language. If a machine reads the word *right* without any further information, it does not understand if the direction (right/left) or the judgement is meant (right/wrong). Likewise, words can and in most cases do have different meanings depending on their context. Homonyms and ambiguous meaning among others contribute to the sophistication of our language which makes it hard to automatically process and understand it.

Nevertheless, research and software emerging from it have improved substantially. In the following the most significant methods will be presented.

One remarkable breakthrough was achieved by Tomas Mikolov. First he proposed *word vectors* [11] and later introduced the corresponding *Word2Vec* model [12]. This is a Neural Network with two layers[6] which uses a large text corpus, mostly Wikipedia, to produce a multidimensional vector space in which every word is assigned a unique real-valued vector. This whole vector space is called *Word Embedding*. This word embedding can now be used to trace back the linguistic context of single words, analyse them automatically and eventually get insight into the semantic similarities between words. This method takes a distributional approach meaning that the surrounding words of target word w_1 and w_2 are examined. The

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[5]*Amazon's* intelligent speech-controlled personal assistant.

[6]Layer here describes layers of artificial neurons that are implemented between input and output data; they are responsible for the calculations being made. The number of layer determines the complexity of the neural network.

so-called *distributional hypothesis* then states that two words with a similar meaning have a similar distribution, hence occur in similar contexts [13].

Context Analysis   The Context Analysis tries to find all factors that potentially affect the realisation of the project and/or have an interest in its deployment. It is often described as an elevator pitch, a 30 second brief explanation of the project to a person that is unfamiliar with the topic. The main goal of this thesis is to create a mobile application that supplies homeless people with up-to-date information on where to find useful places such as food banks, shelter for the night or hospitals. In the following the factors involved will be delineated and their contribution to the success of the project scrutinised.

Target Group   Certainly the most important stakeholder of this project are the end-users, namely the homeless people in Amsterdam, more precisely, the homeless people in Amsterdam that own a web-enabled phone. Finding these people turned out to be a formidable challenge. Thankfully, we were supported by several organisations along our way, which not only gave valuable insight into the current situation but what is more they liaised us with our target group.

Social   The social factors of the project are evident. As mentioned in Section 6.1 the product of this master project can play a part in contributing to bridge the digital gap homeless people face. This, in turn, may lead to a better integration of these people into the rest of society. Ideally, our product is generic enough to also use it in other countries where the situation for homeless people may even be more delicate. Altogether, the main purpose of this project is to level the digital disparity between homeless people and the rest of society.

Political   The municipality of Amsterdam is an important stakeholder of this entire project. If the situation of homeless people regarding information acquisition wants to be changed fundamentally, awareness should be raised in politics. This would require an all encompassing assessment of the status quo and draft proposals on how to approach problems. Maybe this project can release the required pulse for a subsequent larger project. In any case, the insights we gained will be valuable and the product immediately usable.

Technology and Methods   State-of-the-art technology plays an important role in this project. The expectations people across all social classes have towards technology are increasing. Ab initio we were aware that our software has to include cutting-edge technology to satisfy the target group's needs. Only by doing that it can be avoided to widen the existing digital gap between homeless people and other members of society. The same is true for our approach to the topic. Since we abided by the ICT4D 3.0 framework we could be certain at any given moment that our project is well-structured and has a firm goal.

Economic   Although we deployed state of the art technology and methodology, one still has to consider the economic constraints of an academic project like this one. Except for travel expenses for interviews no money was spent. Clearly this had effects on the development of our software. For instance, we knew that we would need to find a free web host which we managed to do. Fortunately, Marc had access to server and database due to his part-time job. We also created a Google Platform account which grants access to the Google API but is limited in the number of requests. Also, the scripts to retrieve the data from Google are currently run locally on our machine which can cause performance problems at some point. To summarise the project is viable for its geographic scope but would certainly need to be supported financially in case of an expansion.

Competing software   Based on the conversations we had with all stakeholders there is currently no software in the Netherlands serving the same purpose as ours. Although many plans especially by research institutions and the municipality of Amsterdam were devised, as per today, no ready product is available. On a global scale the application *OurCalling*[7] from the US just like our application lists services such as addiction recovery, food resources and shelter. *Strappd*[8] and *HelpFinderNYC*[9] operate similarly. For all of them it holds that they only work in a very limited area and that the services are added manually hence undynamically.

Ethics   As mentioned in Section 6.1 homeless people are a very sensitive group of people in our society. Any contact with them has to be well-considered to not make a wrong impression on them. Particularly members of less represented groups often get the feeling that scientists only want to instrumentalise them for their research. A sincere interest in their situation is indispensable. Considering this we always approached a person with a mediator who acquainted us with him/her. Let alone, we never approached someone without his/her consent. Additionally, all the answers we received from people (see Section 6.5) regardless of their content were candidly taken into account and included in our assessment.

Organisations   Very kindly the *Huis van Sant'Egidio* which is located in the centre of Amsterdam agreed on helping us with our project. Sant'Egidio is a Christian community that is concerned with charity work all over the world. On Tuesdays and Fridays they hand out food in the city centre of Amsterdam to people in need. In total we attended three meetings during which we assisted the volunteers in distributing the food and got in contact with the homeless people.

A further stakeholder of the project Digital Divide is the Municipality of Amsterdam. The municipality was one of the hosts of the Digi Challenge[10], a kick-off event about the digital divide in Amsterdam in December 2018. We arranged one meeting

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[7]https://www.ourcalling.org/app/ – accessed 11-11-2019.
[8]https://strappd.org/– accessed – 11-11-2019.
[9]https://apps.apple.com/us/app/helpfinder-nyc/id1083284201 – accessed 11-11-2019.
[10]https://www.pact-amsterdam.nl/digichallenge-2-2/ – accessed 11-11-2019.

Figure 6.2   Overview SWOT Analysis, see https://www.muddygecko.com/2018/04/09/swot-analysis/ – accessed 11-11-2019.

with a representative of the department for homeless people who provided us with information on the current situation within the municipality. By its very nature municipalities design projects on a much larger scale and have to satisfy many other stakeholders. Therefore, the allocation of appropriate staff and the mobilisation of necessary funds can be arduous and slow. This assumption was reconfirmed by the representative of the municipality in Amsterdam when he stated that there indeed was a project to address digital needs of homeless people in Amsterdam but it had to be discontinued due to the aforementioned reasons.

   Considering other topics at the Vrije Universiteit Amsterdam in the department of Computer Science the ICT4D research group under the supervision of Anna Bon clearly stands out through social projects in countries worldwide. This may have caused the internal newspaper of the Vrije Universiteit Amsterdam, *AdValvas*, to become aware of our project. As a consequence one of their journalists invited us to give a short speech about the project. The corresponding article can be found at http://advalvas.vu.nl/nieuws/studenten-maken-app-voor-daklozen. (See also the flyer at the end of this book).

   A SWOT analysis was conducted to get further insight into how the factors that emerged from the context analysis are intertwined and how they affect the project. This is a strategic technique to identify **s**trengths, **w**eaknesses, **o**pportunities and **t**hreats, normally of a business. Long since, though, this strategy has found its way into academic projects too. It is deemed as a gold standard that helps to not disregard negative influences (weaknesses and threats) and equally to fully exhaust positive ones (strengths and opportunities). The former have an internal character meaning they arise from the project itself whereas the latter spring from external parties (see Figure 6.2). The results of this SWOT analysis are captured in Figure 6.3.

6.5   Needs assessment

During this phase the customer's needs for the application, in this case the homeless people, are determined. In order to do so, this vulnerable target group required a
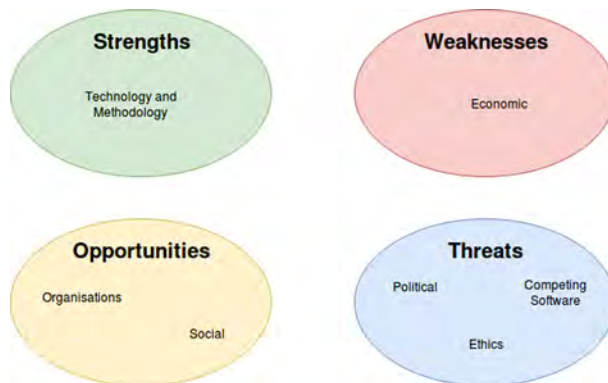
Figure 6.3 Results of SWOT analysis on factors of the context analysis.

considered and cautious approach. Hence, it was desisted from conducting structured interviews. We rather tried to informally elicit their needs and expectations which is in line with Section 6.4. On that account four questions were elaborated which were either asked in informal 1-on-1 interviews or handed out via a questionnaire (see Figure 5.11). Naturally, depending on the interviewee the questions sometimes had to be slightly modified in order to get more extensive or more precise answers; this especially holds for the open questions 3 and 4. Because some people were sometimes only willing to answer questions partially, we here refrain from giving an exact number of participants. We roughly interviewed 30 participants in this first test session which constitutes an approximate one third of the total number of people who on average visit Sant'Egidio.

1. **Do you own a smart phone?** (*Yes / No*)

2. **How often do you use your smart phone per day?**
   (*<1h / 1h / 2h / 3-5h / >5h*)

3. **Which applications are installed on your smart phone and which of them would you consider the most useful?** (*open question*)

4. **What is the most crucial information you get in your everyday life?** (*open question*)

The reasoning behind this selection is as follows:

Question 1 aims at getting an overview over how many people actually could use the application. [7, 9] have shown that an approximate 50% of homeless people

own a smart phone. Due to political, technological and socioeconomic similarities between the United States and the Netherlands we presumed a similar number.

Question 2   gives insight into how the person currently uses his/her smart phone. We expect people who spend more time on and with their phone to have a better understanding of where to find useful information than people who barely use it.

Question 3   rather focuses on the scope of the information. Is the information we supply something that the target group is really interested in? Also, are we right in assuming that this group of people wants to use their smart phone as a source of information or do they rather use it for example for leisure pursuit or communication? For instance, our application heavily relies on the use of *Google* and its various services. Users who are already familiar with Google and its usability and functionality will understand and be able to use our application without any problems.

Question 4   makes the globe expand from mere digital information to information in general. We strived to ascertain which type of information the target group deems relevant.

A selection of answers:

"Except for this place [Sant'Egidio] I don't know where to get free food."

"I ask my friends and they show me where to find clothes."

"WiFi is really important for me."

After evaluating the answers and speaking to all stakeholders involved six categories were identified as most vital. Those are:

- Food

- Shelter

- Medical Aid

- Education

- Useful good (such as clothes, chargers and bags)

- WiFi

6.6   Requirements Engineering

In systems and software engineering this step is characterised by finding an appropriate way to descriptively explain the requirements that the needs assessment yielded.

Thus, this phase serves as a connection between the requirements found and their technical implementation. It comprises the steps *Requirements Analysis*, where the needs are identified and *Requirements Design*, that aims at conceptualising a coherent software system that meets all the needs.

A distinction is made between *functional* and *non-functional* requirements. The former are defined as "functions of a system or its component, where a function is described as a specification of behaviour between outputs and inputs" [14]. This comprises any functionality that is necessary to satisfy the needs from Figure 6.5. Non-functional requirements on the other hand are "requirements that specify criteria that can be used to judge the operation of a system, rather than specific behaviours" [15]. These are requirements such as reliability and accuracy supporting the functional requirements.

As mentioned before this thesis focuses on the efficient and sustainable procurement and processing of the data. Thus, topics such as usability and design are only covered peripherally. Marc Hegeman's master project gives further insight. To get a feeling of the application though Figure 6.4 shows the home screen with the six categories, derived from the needs assessment.

The second test session was in contrast to the first one not only conducted with the target group but also with other stakeholders like the organisation team of Sant'Egidio and officials from the municipality of Amsterdam. By that we ensured that every party (see Figure 6.4) is actively involved in our purposes. These functional requirements were elaborated in the course of the requirements engineering with all stakeholders:

- Name of locality

- Address

- Telephone number

- Opening hours

- Homepage

We included two more requirements that were not mentioned by stakeholders:

- Photo

- Rating

The photo provides the page of a certain place with familiarity and kindness. The rating is used to give the end-user a feeling about the quality of the place.

We identified several non-functional requirements that will help serving high quality data:

Accuracy

The places that our system returns have to be existing places in Amsterdam.

Figure 6.4 Home screen of the application for the homeless.

Also, they have to be categorised correctly (e.g. food bank to the category *food*).

Precision

The results have to be repeatable, meaning one end user should be offered the same places when he uses the services in short time intervals. They also have to reproducible which requires that different end users with different devices should get the same information when selecting one of the categories.

Maintainability

From the beginning it was clear that the web host should be connectable to a database which shows the current data for each category in a comprehensible way. It should also be possible anytime for us as developers to intervene and modify data if needed.

Legal

In times of legal threats regarding licensing every use of a third part service has to be in accordance with applicable law. Many services at least require to appear somewhere on the application or to be named in the licensing section.

Usability

Ideally our software should be usable by a person who has never touched a smart phone before. Thus, also the data have to be as clear as possible. Here the data we retrieve should be understandable without further explanation.

Performance

> These days we are used to immediate handling of our requests. Despite our limited technical capacities we aspired after a highly performant service.

Integrity

> The data should be consistent over the whole life-cycle. This also includes data retention, which is the ability to restore data from the database.

Reliability

> Reliability is one of the pillars of high-quality systems engineering. From our perspective it would be a worst-case scenario if a person in need was unable to reach our service because the server is down or similar. Some problems are unforeseeable but it is wise to always have a backup just in case.

In addition to functional and non-functional requirements, we added *basic requirements* for each category that concern general aspects about existing law, regulations and ethics. This can also concern requirements that were not explicitly mentioned by interviewees but are in our opinion crucial and self-evident. We also included *specific requirements* which were mentioned during the second test session. These requirements will have to be implemented independently. However, not all of them could be incorporated into our system (see Figure 6.5).

6.7 Overview

Time-wise the actual engineering part overlapped with the requirement engineering part. This was necessary because of the limited time frame of the project. Since we were a team of two people,though, we managed to smoothly merge the phases.

Figure 6.6 shows a UML use case diagram of the software which we devised after the Requirement Engineering.

In a typical use case scenario the end user clicks on one of the six icons to know where he can find places providing that service. There are two ways how the database is filled with information. On the one hand we manually created a list containing the in our estimation most adequate places for each category in Amsterdam. On the other hand an algorithm (Figure 6.18) is being run periodically that fills the database with additional information. Together this information is displayed on our application and can be viewed by the end user.

6.8 The engineering idea

When we searched the web for suitable places in Amsterdam that should be included into our predefined list (see Figure 6.6), we quickly noticed that we needed many

	Basic requirements	**Specific requirements**
Food	Food banks or very affordable restaurants. Naturally only official organisations were considered that comply with the regulations of the Dutch Health authority and periodically undergo a health examination.	A surprisingly high number of the interviewees indicated that they are vegetarian or even vegan. Food banks also represent a social meeting point for many homeless people. Hence, a building that allows them to sit down and talk to each other is preferred. This will be even more important in the cold winter time.
Shelter	This category mainly includes homeless shelters that are fully roofed and heated. Beds with mattresses and a blanket or a bedroll constitute a minimum requirement.	Some interviewees liked to know in advance how many were already in the shelter, respectively how many people were expected to come.
Medical Aid	A practice or a hospital that treats in case of need without asking for identification or Dutch health insurance. The practising doctors should be specialised in health issues that prevail among homeless people.	Ideally, the health workers speak multiple languages to overcome possible language barriers. Many people reported to feel stigmatisation when seeking medical help, which can deter them from doing so. Health workers should be considerate of that.
Education	Places where the target group can find free books or attend training courses on various topics.	If personnel is available they could assist in finding what they are looking for or in giving some advice on a certain topic.
Useful Goods	Cleanness and proper functioning are necessities.	Clothes and electronic devices were frequently mentioned as most important goods.
WiFi	The WiFi has to be completely free of charge and nothing has to be purchased in order to use it.	Some people expressed concerns on data privacy. They should not be urged to enter personal information such as name or email address to use the WiFi.

Figure 6.5   Basic and specific requirements for the six categories.
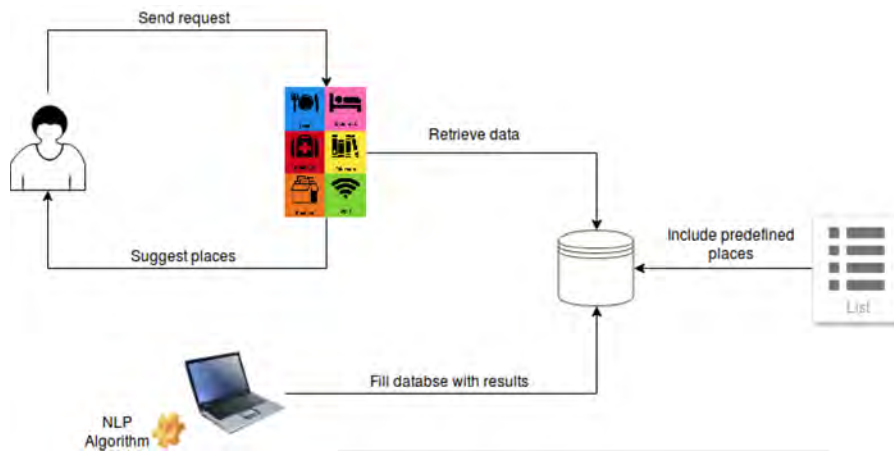
Figure 6.6   Use case scenario of the proposed application.

search queries to find them – yet still we assumed that we did not manage to find all of them. We came up with the idea to use two or three words that unambiguously describe what we wanted to find. We then wanted to use similar words to enrich the search query and combine all of the search results to our final outcome. This was realised with an NLP (Natural Language Processing) approach.

6.9 Essentials

Google   Since the application requires dynamic and live data, an adequate data source had to be found. Soon Google emerged as the best candidate due to its large amount of data and its completeness of content. The *PageRank* algorithm that was invented by Larry Page and Sergey Brin in 1997 laid the ground stone for the later success of Google. Google offers an API[11] for developers so they can have access to its services such as Google Maps[12]. This API corresponds with the results you get when you search for a venue. Integrated in Google Maps there is a service called *Google Places* which provides information such as opening hours, rating or telephone number of a certain place. As Figure 6.7 shows, Google Places offers all the information we defined as necessary for our application (see Figure 6.6). At the moment the free license we acquired from Google grants 150,000 requests per month, which is definitely enough for the current scope of the project.

Although Google is undoubtedly the most used search engine (77% of all search request are made on Google), search results depend on the quality and validity of the

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[11]Application Programming Interface: Set of clearly defined methods of communication among various component.
[12]https://cloud.google.com/maps-platform/ – accessed 11-11-2019.
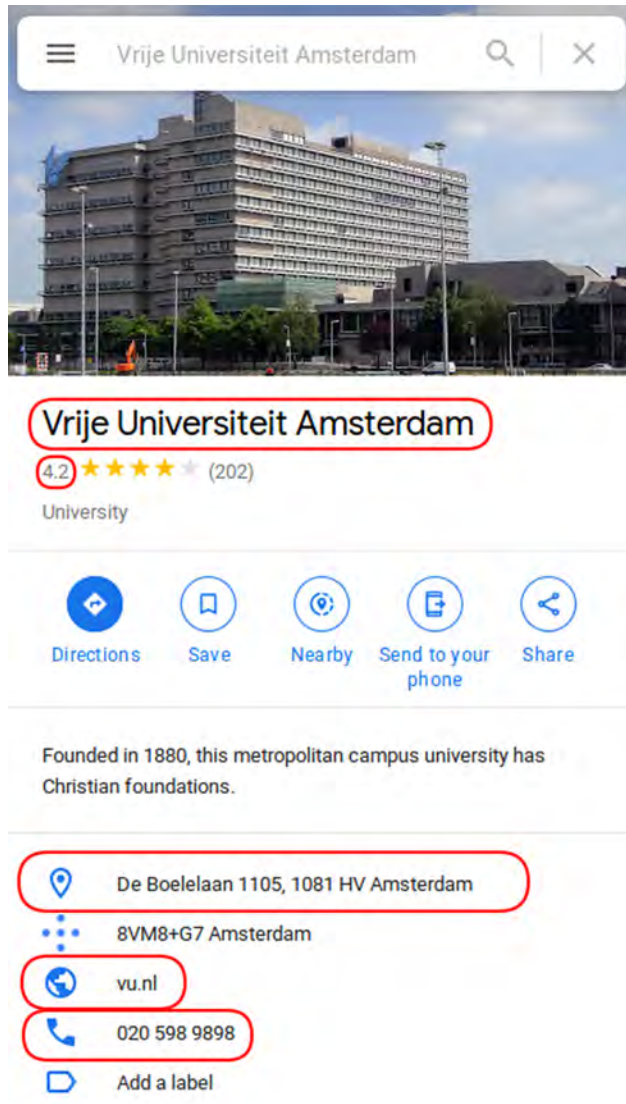
Figure 6.7   Contact info about VU Amsterdam extracted from Google Places.

words entered. As a consequence many potentially correct results are either omitted by Google's optimisation algorithm or do not even appear in the list of results.

Word Embedding   After word embeddings (see Figure 6.4) have been successful in almost any NLP task in the last few years, their number has increased alike. As

of this writing the algorithm had to be run on a local machine[13] which excluded the use of huge word embeddings. This may, but not necessarily does, have an effect on the result. After some testing the Word Embedding *GloVe.6B.300d*[14] was selected. This word embedding is based on the Wikipedia 2014 [15] and the *Gigaword*[16] corpus, which was created by the Linguistic Data Consortium (LDC). The *6B* stands for 6 billion tokens, how single words are called in this context. The *300* describes the number of dimensions. On Figure 6.8 one can see that – in compliance with the distributional hypothesis – words that usually appear in the same context like *bottle* and *alcohol* or *laundry* and *dryer* are semantically similar and thus relatively close together in the word embedding.

*Cosine Similarity*   If one now would want to quantify how similar two words actually are, a mathematical metric is needed. The cosine similarity has been proved to be successful in many NLP tasks where word embeddings were deployed. For two word embedding vectors v_1 and v_2 of two words w_1 and w_2 their cosine similarity is defined as

$$similarity(w_1, w_2) = cos(\theta) = \frac{v_1 \cdot v_2}{|v_1| \cdot |v_2|} \qquad \theta : v_1, v_2$$

The value of similarity has the interval [-1,1]. The closer it is to 1, the closer both words in the word embedding and the more similar they are. Two identical words have a similarity of 1, see Figure 6.9). For more information, see e.g. https://datascience-enthusiast.com/DL/Operations_on_word_vectors.html

Python   Everything was solely and exclusively programmed in the programming language *Python 3.7.3*. This was a clear choice since Python has a very active community and offers a wide range of libraries, especially in the realm of NLP. For the calculation of the cosine similarity this was the excellent NLP library *gensim*[17] *python-wordpress-xmlrpc*[18] was used. XML-RPC is a remote procedure call protocol which uses XML to encode its calls and HTTP as a transport mechanism, whereby it allowed us to automatically sign in to our Wordpress website. Still a lot of data formatting had to be made until the data retrieved from Google were suitable for the internal WordPress structure.

WordPress   WordPress is a free content-management system and used on roughly 30% of all web pages[19] by now. It captivates due to its straightforward usability and its adoptability of other services. So technically we did not create an application but

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[13]Latitude-E6320, 4GB RAM, Intel Core i5-2520M CPU @ 2.50GHz $\times$ 4

[14]https://nlp.stanford.edu/projects/glove/ – accessed 11-11-2019.

[15]https://dumps.wikimedia.org/backup-index.html – accessed 11-11-2019.

[16]https://catalog.ldc.upenn.edu/LDC2011T07 – accessed 11-11-2019.

[17]https://github.com/RaRe-Technologies/gensim – accessed 11-11-2019.

[18]https://github.com/maxcutler/python-wordpress-xmlrpc – accessed 11-11-2019.

[19]https://trends.builtwith.com/cms – accessed 11-11-2019.

Figure 6.8   Selection of food related words in the word embedding GloVe.6B.300d link

Figure 6.9   Illustration of different cosine values between two words.
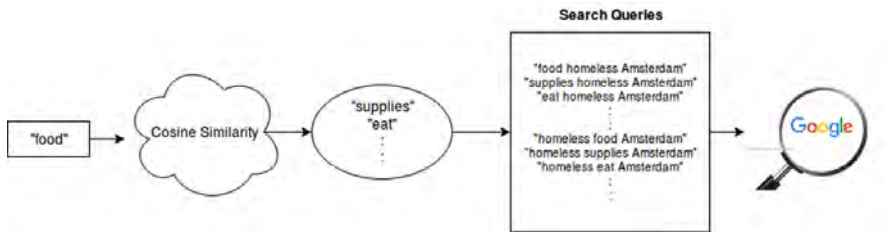
ALGORITHM   **103**

Figure 6.10   Schematic illustration of the used algorithm.

a website-application-hybrid, which is a website that you can save on your desktop. By that the services can be used just like an application without Internet connection once it is fully loaded.

6.10   Algorithm

The expanded Google query is composed of three words per category. The first word w is the name of the category e.g. *food*. The second word is always the word *homeless*. This has two reasons. First, the word *homeless* is a concise and meaningful words in many regards. Semantically it includes the fact that the offered service should preferably be for free since homeless people are probably unable to spend a lot of money. Secondly, the Google algorithm identifies certain places as suitable for this target group. The third word signifies the city respectively the location where to search. Currently this is set to *Amsterdam* but can be changed dynamically to the user's location. The location tells Google that a place is wanted as opposed to a website.

Now by the means of the cosine similarity the word embedding is searched for the most similar words to w, here *food*. Based on that the 30 most similar words of w were chosen. On a first sight 30 may seem fairly high, considering the postprocessing, though, which eliminated many places the number was reasonable. Since the Google algorithm also regards the order of the words, as a last step the first and the second word were turned around; the third word for the location, here Amsterdam, seemed to have no effect on the outcome when placed somewhere else. Figure 6.10 shows the procedure using the examplaric category *food*. On our application the places are displayed in decreasing order from most to least relevant. The relevance here is determined by the value of the similarity.

6.11   Preprocessing

One disadvantage word embeddings clearly have is that they only consider tokens i.e. single words. Hence, the algorithm is unable to intake the word *food bank* but would perceive it as a composition of the two independent words *food* and *bank*

Table 6.1   Comparing search results before and after optimisation algorithm.

Category	Query word	# Found places (basic)	# Found places (+ NLP)
Food	"food"	4	18
Shelter	"shelter"	1	9
Medical Aid	"hospital"	8	36
Education	"education"	-	39
Useful Goods	"goods"	4	14
WiFi	"wifi"	-	7

which evidently does not reflect the meaning of the word. Consequently, the terms *medical aid* and *useful goods* were shortened to *hospital* and *goods* respectively.

6.12   Postprocessing

Some postprocessing was necessary to get accurate results. Conveniently, the Google API also stores *tags* about places.

Since we were looking for places that were (almost) free of charge, we dismissed all results that contained the tag *restaurant*, *cafe* or *store*. Also, some places have a *pricetag*, insinuating that one will be charged. These places were also omitted.

6.13   Results

With the baseline search, we were able to find a number of places, by using the category word (e.g *"food homeless Amsterdam"*). With the optimisation search algorithm we managed to expand the list of places for each category, in some cases magnificently, as shown in Table 6.1.

6.14   Evaluation

In order to asses the algorithm and the results it yields, we take a look back on the (non-)functional requirements (see Figure 6.6). Unfortunately it was impossible to derive the basic and specific requirements from the Google results. Some of the information in these requirements is not even manually retrievable, let alone with a Google query. Also, a metric would have to be conceived to evaluate some of the requirements. The functional requirements could be met satisfyingly with the help of the information on Google. The non-functional requirements that only concern

the algorithm itself as opposed to the whole application and that are objectively examinable are:

Precision

> The algorithm does not depend on the operating system, the end user or other external factors. One click on the category suffices to get the results which will only change when new places are traceable on Google (a recently started business, place with better SEO[20], . . .) or old ones are not detected anymore (closed, different name,. . .)

Data integrity

> We only have one database where information is stored, which is a *MySQL* database used in combination with *phpadmin*[21] to connect to WordPress. Therefore, modification of data (inserting, altering, deleting) will always affect the whole system.

6.15   Testing

We used the third session as a test session to ascertain if the target group was satisfied with our application and what in their view still has to implemented or adapted. The critique was positive in every aspect. Some of them even asked us if they could use the application right away. To this point the front end of the application was in English and Dutch. The interviews elicited that there is a considerable number of people who speak neither of those languages sufficiently to properly use our service. Languages that were mentioned the most were Arabic, Polish, Spanish and Russian. We used a plugin in Wordpress to translate the data. A forth session is planned to conclusively verify the application.

6.16   Further improvements

After the requirements engineering repeatedly new ideas how we could improve design and/or functionality of the application came to our minds. We always meticulously minded that we did not change the fundamental concept of the software.

Bilateral Rating system   Alongside the current Google rating of a place (see Figure 6.6) which already contributes to quality assurance we also established an internal bilateral rating system. Although this rating system was not a requirement that initially was derived from the needs assessment, it is supposed to enhance the sustainability of the data. On each place we included a *thumbs up* and a *thumbs down* together

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[20]Search engine optimisation: process of increasing the quality and quantity of website traffic by increasing visibility of a website or a web page to users of a web search engine

[21]Free software tool written in PHP, intended to handle the administration of MySQL over the Web.

with the question "*Does this place offer what you expected*". This gives us first hand information on the quality of our Google results. In addition to that we wrote a script that composes an email saying that we are two master students writing their theses who would like to know if this place indeed is a food bank, shelter, etc and then send it to the owner/operator of the locality. Currently this script is not yet activated because we decided to first wait for the evaluation made by the users. We also had to adhere to the *GDPR*[22] which was enacted in the European Union in 2018.

Comment   To gain a more meaningful insight into the acceptance of our service, we also included a comment section under each place. In contrast to the rating system these entries have to be evaluated manually to understand what exactly user wanted to convey. The comment section could also expand the basic and specific requirements which were defined in Figure 6.6. Possibly our sample group disregarded aspects that other people in a similar position would deem mandatory.

6.17   Sustainability Analysis

Sustainability is becoming more and more a factor in system engineering, which is why it is dedicated a separate section. Anna Bon and her research group also direct their particular attention on the question how to build effective software systems that are resource saving at the same time. What makes sustainability so hard to grasp and to implement is one side the fact that everyone has a different idea of its meaning. On the other side people often associate sustainability with sacrifice or abstinence which makes it an unpopular issue in political discussions. We decided to scrutinise our entire application regarding its sustainability based on the framework devised by Lago et al. [16]. They proposed that sustainability as a software quality should be perceived in four dimensions: *social, economic, environmental and technical*. Especially the dimensions social and environmental should be regarded more highly in the future compared to economic and technical if one really aspires to create a sustainable software product. Naturally the dimensions affect each other and a trade off has to be made for the final software solution.

Social
>   By advertising places such as food banks or shelters our project can further communities within the group of the homeless people. In this group a person can benefit from mutual activities or can rely on someone else's advice or help. Another aspect of social sustainability is the quality of life which covers an appropriate supply of health, housing, education, employment and safety. Three out of these categories are directly approached by our service. This will eventually warrant that future generations ending up in such a situation can already build upon an existing stable structure.

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[22]Regulation in EU law on data protection and privacy for all individual citizens of the European Union (EU) and the European Economic Area (EEA).

Economic

At this stage the entire project is drastically inexpensive and depending on future plans at least has the potential to stay like that. Throughout it was our highest concern to create a software for every person that owns a web enabled device or knows such a person in his/her surrounding and has momentary access to the Internet, regardless of his/her financial situation.

Environmental

This dimension is hard to asses based on the information we have. Just recently after a long period of silence Google gave insight into their energy consumption. Among others they reported that one average Google query equals 0.0003 kWh or 0.2 of carbon dioxide. This should be considered when automatically firing Google requests. Apart from that our project seems too minuscule (no big servers, no facilities) to have an perceptible environmental impact.

Technical

One pillar of technical sustainability is long range planning. This certainly is the case for our project; we conceptualised a software that should deliver valid results even in many years from now. In this fast changing era, where countless new software is launched every day, technical sustainability is an invaluable asset.

One should bear in mind, however, that these assertions refer to the current scope, the city of Amsterdam. Extrapolating the software to other cities or even countries will surely require more resources, especially financial wise.

6.18   Limitations and Future Work

Google   Our software heavily relies on the information provided by Google. Over the past years Google has managed to build a vast data empire. Nevertheless, the information is not always flawless. For the future use a critical accuracy examination of the places should be conducted. Presumably though, this has to be done manually. We for our part included additional features (see Figure 6.16) to contain the impact of Google on our results. Still at the moment we do not see a different source of information which gets somewhere close to Google's abundance and quality of data.

Language   To this stage the algorithm solely focuses on words of the English language. We promised ourselves a higher quality of results when sending requests in English. Also, word embeddings for other languages for the greater part are less extensive and tested. This is why we decided to initially find the places by using English words and then afterwards to translate our findings to the desired language.

Word Embedding   For the future multiple Word Embeddings should be tested although *GloVe* constitutes a much-cited data basis. The problem of disregarded composite words like *food banks* was already covered in Figure 6.11.

Predefined List   Our predefined list of places for each category served as a baseline which we could compare our results to. This list too is not proven to be accurate though. Based on information on the respective homepage, reviews and conversation with responsibles we drew the conclusion that the places on the list are adequate for our purpose. This part of our solution slightly taints dynamic and sustainability as someone will have to update it at some point.

Algorithm   The algorithm has many parameters that decisively determine the result, such as which word is defined in the beginning to concisely and accurately describe the category or how many similar words are chosen. Again, in order to entirely evaluate the algorithm, qualitative information is necessary (*Does the place indeed belong to the category indicated?* or *Is this place suited for homeless people?*

Social effects   The social repercussions of our application which were partially covered in Figure 6.1 cannot be assessed in such a short time. This will require a whole new research approach. However, we are confident that the software will lead to immediate information empowerment among homeless people in Amsterdam.

6.19   Conclusion

This chapter has explained how an application can be conceptualised and developed to provide homeless people in Amsterdam with information on food, shelter, medical aid, education, useful goods and WiFi. Altogether, Marc and I managed to create an application that answers all expectations we had delineated before. Our thorough needs assessment not only answered *RQ1*, namely which information is crucial for homeless people (see Figure 6.1), but also set the ground stone for the whole purpose of our endeavour. The consistently positive feedback we received from homeless people in Sant'Egidio but also from people who were otherwise involved in the project was both motivating and assuring.

The core part of our application is the algorithm based on a Natural Language Processing approach that was presented in this paper; it confers the application dynamic and persistence. By that also *RQ2* with its two sub-research questions could be answered. In case of questions and remarks of all sorts, Marc and I will be on hand with help and advice.

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LANGUAGE PROFICIENCY AND ICTS FOR PEOPLE WITH A MIGRANT BACKGROUND

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Abstract In this chapter we explore ICT solutions for low literate people – especially people with a migration background with Dutch as their second language – to access and understand written information. We use an iterative, adaptive and collaborative method based on three principles (i) goals and objectives are set by the envisaged users, (ii) technological solutions are created together with the users (iii) technologies are fully adapted to the local context. Three cycles of user evaluations show that low literate people can be supported with ICT solutions, if they are closely involved in the design, adaptation and evaluation of digital solutions. We show how the adaptation of several existing tools into a smartphone app is tested and evaluated with envisaged users.

7.1   The digital divide in the Netherlands

In the 1990s, when computers and mobile phones first came to the market, they were not affordable for low-income families [1]. Almost two decades later these technologies are widely adopted, even by the poorest households of the Netherlands

Figure 7.1   The Dutch government's digitization policy, published on 16-08-2018. Reprinted from https://www.rijksoverheid.nl/actueel/nieuws/2018/06/16/kabinet-nederland-de-digitale-koploper-van-europa – accessed11-11-2019.

[2]. Still, inequality has remained between the wealthy and poor households. This shifted from "having access or not having access to technology", to "having or not having digital skills". Low literacy is one of the causes.

In this research project, we focus on the digital divide in the Netherlands. It is plausible that the study is representative for urban high-tech environments and that the principles and results may apply in similar situations, for example in other West European countries. Still, one must be aware of contextual diversity, when comparing different environments and countries.

The main goal of this research is to help people who have difficulty in connecting to society. In this research, information technology and digital equipment are used to involve people in today's society. With this project, we try to reduce the digital divide in Amsterdam. By listening to the needs of the people, we try to ensure that individuals and communities, including the most disadvantaged, have access to and can make use of ICT so that they get more involved in society.

7.2 Facts and figures

In the summer of 2018, the Dutch government announced the objective to be the digital leader in Europe[1]. The mission is ambitious but at the same time remarkable when we look at numbers of the general audit office (de Algemene Rekenkamer), stating that about 2.5 million people in the Netherlands have difficulty working with digital devices such as a smartphone, tablet, or computer [3]. The CBS (Centraal Bureau voor de Statistiek) reports that in 2016 about 1.2 million people in the Netherlands never used the Internet [4]. These numbers and other news items are worrying when we realize that more and more government services are digitized. The 16th of June 2017, the Dutch newspaper De Volkskrant writes that low literate people are the first to suffer from Society's increased complexity[2]. Low literate people will get lost in their way online and will not get the required information out of the information they receive digitally. According to the *Sociaal en Cultureel Planbureau*, a large group of digital illiterate people is lagging behind the rest of the Dutch people [5]. Not being able to read and write has significant disadvantages[3]:

Unemployment Half of the people who have difficulty in reading and writing are unemployed. They often find it challenging to write an application letter. The challenge makes it difficult for them to find a job. They have difficulty in retaining a job, especially when work becomes more complicated.

Health issues People who cannot read and write well have more often health problems. For example, because they cannot understand the package leaflets for medicines. As a result, there is a good chance that they will misuse medicines.

Children with language deficiency Parents who have difficulty with language cannot correctly read to their children. They are not able to help their children with homework. As a result, there is a good chance that their children will not learn to read and write correctly.

Communication problems Filling digital forms to apply for a benefit, allowances, and taxes can be challenging. It is also often difficult to use a computer, tablet, and telephone.

It is essential to ensure that people who have less digital and linguistic skills stay connected in society. The Dutch government states, in the news item of 16 June 2018, that public services and new technologies must be accessible for everyone. The transparency and accessibility of the digital government are important objectives, see Figure 7.1 for a complete overview of the Dutch government's digital policy objectives. Making the digital environment accessible for all citizens is the responsibility

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[1]https://www.rijksoverheid.nl/actueel/nieuws/2018/06/16/kabinet-nederland-de-digitale-koploper-van-europa – accessed 11-11-2019

[2]https://www.volkskrant.nl/columns-opinie/laaggeletterden-zijn-het-eerst-de-klos-in-verzorgingsstaat bb46953c/ – accessed 11-11-2019

[3]https://www.rijksoverheid.nl/onderwerpen/taal-rekenen-digitale-vaardigheden/aanpak-laaggeletterdheid – accessed 11-11-2019

of municipalities. In the Coalition Agreement of 2018 [6], the municipality of Amsterdam agreed to keep attention to people who have difficulty with the digitization.

7.3 Building blocks for digital inclusion

In Amsterdam, many people who live in poverty have limited digital skills and are unable to cope sufficiently in today's society [7]. This observation prompted the poverty director[4] of Amsterdam to further investigate this issue. The results of the research are included in the report *Bouwstenen voor Digitale Inclusie*. This report makes recommendations on how to close the digital gap. One of the recommendationsto the municipality is to invest in improved interaction with citizens that have low digital skills and to use the smartphone for this interaction. Research by Deloitte in 2018 showed that at least 93% of the Dutch people are in possession of a smartphone[5]. Following this recommendation, in this research we investigate how the smartphone can be a tool for digital inclusion.

7.4 Target group

In the report, a clear group experiencing problems with digitization is mentioned. The focus is mainly on 21% of the people in Amsterdam that live in poverty, including children, adults, and elderly. The target group can be divided into four subgroups:

- Migrants;

- Disabled people;

- People with a difficult social background;

- Low literate people.

The group of low literate people can be divided into two groups: people who have Dutch as their native language (NT1), and people who have Dutch as their second language (NT2). In the Netherlands approximately 65% of the low literate people is NT1 [8]. The initial focus in our study was on the NT1 group, but due to circumstances, we were compelled to shift our focus to the NT2 group. The reason for this is explained in more detail later in the report.

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[4]Armoederegisseur
[5]https://www.consultancy.nl/nieuws/15292/smartphonebezit-gegroeid-naar-93-van-nederlanders-veelvuldig-gebruik-storend

Figure 7.2 Example letter used in trainings to low literates. Reprinted with permission from: Stichting Lezen en Schrijven.

Voorbeeldbrief gemeente A2/1F

Gemeente **Leesdijk**

Ons kenmerk: 10.00100517
Project: afval
Datum: 18 maart 2017

Geachte meneer, mevrouw, beste buurtbewoner,

Deze brief gaat over afval. Het ophalen en verwerken van afval in de gemeente Leesdijk moet namelijk anders. Dat is nodig voor het milieu.

De gemeente werkt daarom aan een nieuw afval-beleid. U kunt ons helpen, door mee te denken. Dit kan tijdens een bijeenkomst op 8 april.

Wat heeft ons afval met het milieu te maken?
Bij het verbranden van ons afval komen er veel vuile stoffen in de lucht. Deze zijn slecht voor het milieu. Doordat er veel van die stoffen in de lucht komen, gaat de temperatuur op aarde omhoog. Hierdoor verandert ons klimaat. Daar gaan we last van krijgen.

Wat kan onze gemeente doen?
De gemeente wil zorgen voor een schonere lucht. Dat betekent dat we moeten nadenken over wat er beter kan. Kunnen we bijvoorbeeld meer afval scheiden en meer opnieuw gebruiken? Er hoeft dan minder verbrand te worden. Dan blijft de lucht dus schoner.

Wat vindt u?
De gemeente wil graag dat de inwoners meedenken. Wat vindt u bijvoorbeeld van:
- Hoe kan het afval het beste worden ingezameld?
- Zijn de rol-emmers handig?
- Is het inzamelen van het grofvuil op de gemeentewerf praktisch voor u?
- Kunt u het oud papier goed kwijt?
- Heeft u voorstellen voor de verbetering?

Komt u ook?
Naar wat   : Naar de bijeenkomst over een nieuw afval-beleid.
Voor wie   : Elke inwoner van de gemeente Leesdijk is van harte welkom.
Wanneer   : maandag 8 april
Waar   : de raadszaal van het stadhuis in Leesdijk
Hoe laat   : van 19:30 tot 21:30 uur

Inhoud   : De teamleider afval, mevrouw Vermeern houdt een korte inleiding.
              Daarna gaat de gemeente met de inwoners in gesprek.
              De wethouder, meneer Wouterson, is er ook.

Aanmelden: graag vóór maandag 1 april via communicatie@leesdijk.nl.
              U kunt ons ook bellen 045 – 234 54 88. Vraag dan naar mevrouw Jansen.

Met vriendelijke groet,
Janneke Vermeern

Teamleider Afval, Gemeente Leesdijk

Postbus 6543, 5402 AB Leesdijk | Poststraat 104, 5415 BC Leesdijk | **T** 045 234 54 88 | **W** www.leesdijk.nl/stadsontwikkeling

7.5 Costs of low literacy in the Netherlands

Research by PricewaterhouseCoopers (PwC) shows that the total social costs of low literacy amount to 1.13 billion EUR per year[6]. The research shows that low literate people miss out on 572 M EURO income each year. The inability to read, write and/or calculate correctly directly affects people's prosperity. This results in less income from work and higher healthcare costs for low literate people. Both for the prosperity of the low literate and the finances of the government, it is therefore essential that this problem is tackled[7].

7.6 Research questions

In line with the third recommendation of the *Bouwstenen voor Digitale Inclusie* report, we investigated if the smartphone can be used to strengthen the interaction between the municipality and citizens, and how the smartphone can be used in practice for this purpose. The municipality and other social organizations most often communicate through written letters. It is problematic that the information is not understood by people who cannot read. We investigate whether the smartphone can help to understanding letters. We do this by answering the question: How can a mobile application support low literate people in understanding letters?

To answer this main question, the following sub-questions are answered:

- Do low literate people currently have problems in understanding letters? And what are they currently doing in this situation?

- What could be improved on the current letters and what is being done?

- Are low literate people open for advice about the use of their smartphone for this purposes?

- What functionality is required to achieve our goal?

- Are there usable mobile applications or do we have to develop a new application ourselves based on the needs of the low literate people?

- How do we ensure that the methodology to understand letters is used in practice?

- How do we ensure a sustainable approach and completion of the project?

- Is a collaborative, iterative, adaptive approach a suitable way of tackling the problems of the Digital Divide in the Netherlands?

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[6]See https://www.lezenenschrijven.nl/over-laaggeletterdheid/feiten-cijfers/
jaarlijkse-kosten-laaggeletterdheid/ – accessed 11-11-2019
[7]See https://www.lezenenschrijven.nl/over-laaggeletterdheid
/feiten-cijfers/jaarlijkse-kosten-laaggeletterdheid/ – accessed 11-11-2019.

7.7 General approach

In this project, technical action research is executed. It means that we are not just obtaining knowledge and information but that we are aiming to find real-life solutions to the problem of the digital divide in Amsterdam. In interviews conducted during the so-called DigiChallenge 2.0[8], it emerged that the target group is difficult to reach. The chance of having enough participants in this study for quantitative research is unlikely, therefore we decided to conduct qualitative action research. Besides, qualitative action research is more appropriate in this case, as in-depth feedback from users is highly valuable for improving methods and prototypes.

Essential of our approach is the user's central position. The aim is to maintain close cooperation with the target group, the experts, and the stakeholders involved in the domain. Our method relies on three principles: (i) goals and objectives are set by local users, (ii) co-creation is done in partnerships, (iii) the technologies are fully adapted to the local context [9].

The methodology can be seen as a cyclic process of prototyping, testing, analyzing, and refining the solution where the needs and the objectives are central. In each iteration, the newest prototype is tested, evaluated, and redesigned based on the feedback from the target group. This iterative process eventually causes an evolved solution. In total, three iterations of prototyping, testing, analyzing, and refining are executed.

7.8 Understanding the local context of the users

In the initial phase, a context analysis is executed to obtain information about the problem in real life. The Digi Challenge 2.0 is an event for people working in the social domain of the municipality of Amsterdam. This event, hosted by the municipality of Amsterdam, is used as the kickoff of the project. By interviewing experts and people that are involved in the social domain, we extracted information about the real-life situation in Amsterdam and surroundings. Based on interviews with experts from the municipality of Amsterdam, a consultant of TaalDoetMeer[9] and researchers and consultants of LostLemon[10], we obtained a more detailed understanding of the digital divide in the Netherlands.

With the detailed information and the viewpoints of the experts in mind, a first idea was thought out. This was then worked out and explained to the experts working in the social domain. By brainstorming about potential improvements, the idea was revised with the feedback from the experts in mind. The idea was further processed, and potential solutions evaluated. As soon as it became concrete and the context was clear, the network of the experts was used to come into contact with the target group.

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[8]See https://www.pact-amsterdam.nl/digichallenge-2-2/ – accessed 11-11-2019.
[9]See https://www.taaldoetmeer.nl/ – accessed 11-11-2019.
[10]See https://www.lostlemon.nl – accessed 11-11-2019.

Figure 7.3   An example letter reprinted from the Municipality of Amsterdam, with permission.

7.9 What do the users want and need?

Once in contact with the target group, the needs assessment takes place. First, we need to identify if the target group appreciates any help and support in terms of digital inclusion. If help is appreciated, the current situation regarding understanding letters is analyzed. We investigate if there are problems in reading and understanding letters by the target group. What actions do they take when they receive an official letter they cannot understand? Do they ask others to help them, and how do they feel about that? Do they even open the letters? What do they think about using a smartphone to understand the letters? These are questions that need to be answered in a first session with the target group.

In interviews, the specific objectives of the low literate people are discovered. We ask if the people own a smartphone and discover for what purposes they use it. To check if the potential idea is a suitable solution, we extract information about the currently installed applications. We discover why they use these apps, what is best about the apps, and if they experience any problems. We also need to know if the group can download new applications and if they are familiar with QR-codes.

The initial idea is then evaluated, adjusted, and refined based on the needs and the objectives of the user. According to the first principle of the ICT4D 3.0 methodology [9], we ensure that the entire project is done in close collaboration with the target group. The requirement analysis can be conducted once the context and the needs are clear. In this phase, we determine the exact requirements the application should meet in order to fulfill its purpose.

7.10 New or existing application?

Based on the requirement analysis, we determine if a new application needs to be created or whether we could use or improve an existing one. The feasibility, scalability, and sustainability of a potential new application will be considered. The pros and cons of creating a new application are compared against the pros and cons of using an existing application. The evaluation is done by answering the following questions:

- Which existing applications can fulfill the requirements?

- What are the needs that existing applications cannot meet?

- How can an existing application be used in order to fulfill the needs?

- How feasible is the application?

- How sustainable is the application?

- How maintainable is the application?

- How understandable is the application?

7.11 Testing with letters

The potential application and method are tested with the target group. In an experimental design, the participants are asked to answer questions about a letter. Questions that will be asked to check if the information is clear:

1. What is the letter about?

2. When is the meeting scheduled?

3. What is the location of the meeting?

4. Before when do you need to register for the meeting?

All answers can be found in the letter, and the participants are forced to use the smartphone. We do this to check if using the smartphone increases the ability to understand the letter. The purpose of the letter is to inform citizens about a meeting about a new waste policy. The letter used in the experiment is an example letter provided by Stichting Lezen en Schrijven[11] www.lezenenschrijven.nl/voorbeeldbrief, see Figure 7.2. The language level of the example letter is A2 / 1F. This level is comparable to a student who has just finished primary school. We also keep an eye on whether any simple adjustment to the letter itself can be of added value in understanding it. If interviews and observations show that simple adjustments to the letter result in more clarity, we notice this in this paper.

7.12 Evaluating

The goal of the application is to increase the understandability of letters currently not understood by the low literate people. We can measure the success of the application by checking if the participants can answer the questions about the letter. Besides, the success of the application depends on whether the low literate people experience it user-friendly and on whether the participants would recommend the approach to others. Another main issue with low literate people is that they often feel ashamed because they can not read and write[12]. The success of the application depends on whether the users trust the application.

7.13 Towards a sustainable solution

To increase the probability of being continued, we will share and present the results of the project to the municipality of Amsterdam and LostLemon. In all phases of the project, sustainability aspects will be included when possible. We will consider

[11] https://www.lezenenschrijven.nl/uploads/doe-mee/201701_factsheet_SLS_Eenvoudige_Taal-voorbeeldbrief.pdf

[12] https://www.lezenenschrijven.nl/over-laaggeletterdheid/feiten-cijfers/laaggeletterdheid-herkennen/

sustainability in determining whether we will make a new app or use an existing app. Development is sustainable if it also takes into account economic, human, and social aspects: scarcity not only applies to natural resources[13].

7.14   Related efforts

In 2013, the PIAAC (Programme for the International Assessment of Adult Competencies) research showed that compared to other countries, there are relatively few low literate people among the Dutch labor force [10]. The same research shows that there has been an increase in the number of low literate people in the last seventeen years. Also, these low literate people relatively often have multiple disadvantages and are both low literate and low digit. In 2013, it concerned almost 1 million people with multiple disadvantages.

In Maatschappelijke Achterstanden van de Toekomst, the Education Council states that there are indications that the low and high educated people are increasingly segregated: social and political participation, for example, appears to be less related to the societal pillar or religion and increasingly to the level of education [11]. Significant differences in skills between the top and bottom is a socially unwanted situation. The Netherlands, therefore, strives for a well-educated labor force with a high average skill level.

Much work has been done to help low literate people learn to read and write and to increase the average skill level of the population. Each year, the Rijksoverheid gives 60 M EUR to the municipalities in the Netherlands to tackle low literacy[14]. With this money, municipalities can offer courses to their residents in the areas of language, maths, and digital skills. Examples of projects that have been subsidized by the government:

- https://www.taalvoorhetleven.nl/ Taal voor het Leven

- Taalakkoorden

- https://www.evaenik.nl/ Educatie voor Vrouwen met Ambitie (EVA)

- Kunst van lezen

The common thing about these projects is that the focus is on learning to read and write. What we do differently in this study is that we try to provide direct support for problems without the low literate people being forced to learn to read and write.

7.14.1   Stichting Lezen en Schrijven

Another organization in this domain is Stichting Lezen en Schrijven; it was founded in 2004 by Princess Laurentien. The foundation aims to prevent and reduce low

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[13]https://www.cbs.nl/en-gb/faq/specifiek/what-is-sustainability- accessed 11-11-2019.
[14]https://www.rijksoverheid.nl/onderwerpen/taal-rekenen-digitale-vaardigheden/aanpak-laaggeletterdheid – accessed 11-11-2019.

literacy in both the short and the long term. By working together with social organizations, schools, companies, and governments, the foundation wants to reduce illiteracy in the Netherlands. To ensure that low literate people can understand information, Stichting Lezen en Schrijven has developed a list of writing tips. In the development of the prototype, the writings tips are taken into account.

7.14.2   Steffie.nl

Steffie.nl[15] is a product of "Leer Zelf Online"[16] and was founded in 2002. Steffie is a virtual assistant designed for daily issues on the Internet. Steffie explains daily subjects in a simple way for anyone who likes a step-by-step explanation with many images. Steffie covers topics such as dating, health, personal finances, contact with the government, social networks, internet banking, claiming benefits, and traveling by public transport, for example. DigiD[17] is one of the topics explained by Steffie. In simplified animations, people can, for example, see how to use it, how to request it, and how to log in with the DigiD app. In addition to Dutch, the animations of Steffie are also available in English, French, Tigrinya, and Arabic.

In this research, the simplified way of how Steffie presents things is taken into account. In the design of the prototype, we look at how Steffie separates topics into understandable parts. Steffie covers fixed topics but does not take into account what people should do when they receive a letter about a new topic. In this research, we develop a method that can deal with such a new situation.

7.14.3   Snap de Brief

It is important to note that the municipality of Amsterdam commissioned a project like this before. The project is called "Snap de brief"[18]. The idea was to create a mobile application where the purpose of the application is to help people when they did not understand a received letter. People could take a picture of a letter and send it with the application. They were then called back by a professional counselor who explained the letter or, if necessary, refers them to a support organization. The problem with this application is that the needs of the user are not put central during the design. The application was initially created to extract knowledge about the poverty situations in Amsterdam, and the main goal was not to help the people. The municipality of Amsterdam stopped with this project since it was not successful. This research distinguishes from the project because the needs of the user are central, and the main goal is to help the low literate people.

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[15]http://steffie.nl – accessed 11-11-2019.

[16]https://leerzelfonline.nl/home/ – accessed 11-11-2019.

[17]DigiD stands for Digital Identity and is used in the Netherlands to login to official websites and makes use of public services.

[18]https://www.amsterdam.nl/bestuur-organisatie/organisatie/overige/datalab-amsterdam/werkplaats/fixxx/snap-brief/ – accessed 11-11-2019.

7.14.4 VraagApp

VraagApp[19] is an app specially developed for people who find society complicated. The app allows users to ask questions about things they do not understand. The idea is that volunteers give users a quick answer to the questions. In Figure 7.15, we see the UI (user interface) of the app. What can be seen is that the user can ask questions about letters. One of the bottlenecks of this approach is that volunteers who know the answer are required. Another issue is that low literate people often feel ashamed of their situation. The fact that another person is involved can prevent low literate people from asking a question. In addition to that, if low literate people do not understand a letter, they may not know what to ask. In this research, we differ from the VraagApp because another person (volunteer) is not required in our approach. In our approach, the low literate people can handle the letters themselves, at home, without feeling ashamed.

7.15 Case study

This section describes the case study of this research. In the first two subsections, the context analysis and the reason why we shifted from NT1 (low literate people with Dutch as their first language) to NT2 (low literate people with Dutch not as first language) are explained. The subsections after that describe the needs assessment, the requirements analysis, and the three iterations of the previously presented methodology.

7.15.1 Context analysis

The research started at the PACT DigiChallenge event[20], organized by the Municipality of Amsterdam, to gather all stakeholders concerned with digital inclusion in Amsterdam. During this event, we were able to listen to exciting guest speakers: futurologist Wim de Ridder, alderman Marjolein Moorman and Marleen Stikker, de facto "Mayor of the Digital City". The overarching theme of their presentations was that the digitization of society is going fast and that it is essential to pay extra attention to low literate people because the digital world can be a complex world for them. On this introduction day, it became clear that there are several urgent problems to be solved.

During the event, we attended a workshop hosted by LostLemon. The workshop was focused on the challenge of how to reach the target group (NT1) and about the different personas that make up the target group. During the workshop it became clear that recruiting low literate people for research is challenging. LostLemon has experience with testing with the NT1 group, and they mentioned that it could take much effort to arrange a meeting.

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[19]http://vraagapp.nl – accessed 11-11-2019.
[20]https://www.pact-amsterdam.nl/digichallenge-2-2/ – accessed 11-11-2019.

The workshop continued with a brainstorm session with employees of the UWV (Uitvoeringsinstituut Werknemersverzekeringen). They advised thinking about simple smartphone applications that could help the low literate people with their daily issues. Multiple people confirmed during this day that the people of the target group often own a smartphone. On this day, we made contact with various organizations and planned a few appointments for interviews during the following weeks.

In one of the meetings with employees of the municipality of Amsterdam, we were told that the letters would not be translated soon. For political reasons, the letters sent by the municipality will only be sent in Dutch for the time being.

7.15.2   The initial ideas

With the idea to help the NT1 group in mind, two primary methods were created. After talking to different people, the question of how to ensure that low literate people can better understand written letters arose. At this moment, we wanted to find out if reading out letters, helps low literate people in understanding them. Moreover, if this would help them, how can a smartphone application be used to fulfill this purpose?

7.15.3   Audio messages

The first idea was based on the way the municipality of Molenwaard deals with low literacy. Molenwaard is the first complete digital municipality[21] and it has shown that the service offered has been improved on all fronts. The municipality of Molenwaard uses ReadSpeaker on its website to increase the accessibility of digital content for all citizens. Readspeaker[22] is a software that can be used to transform the text into speech. The software can be used to give a voice to websites, mobile apps, digital books, e-learning materials, and documents.

In this phase of the research, we wanted to find out if giving a voice to a letter increases the comprehensibility of the letter for low literate people, and how a smartphone application could be used to enable the low literate people to have the letter read aloud.

7.15.4   Instruction videos

The second idea was based on Steffie and Digi-taal. Steffie, the virtual agent makes topics more transparent by explaining them through animations and spoken messages. Digi-taal[23] is a platform that helps low literate people with digital forms. Based on the difficulties of the low literates, the platform was created[24]. The platform makes use of instruction videos to help people with their forms. We wanted to

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[21] https://www.digitaleoverheid.nl/achtergrondartikelen/molenwaard-digitaal-en-dichtbij/ – accessed 11-11-2019.

[22] https://www.readspeaker.com/online-text-speech-solutions/ReadSpeaker – accessed 11-11-2019.

[23] http://www.platformdigi-taal.nl – accessed 11-11-2019.

[24] https://www.omroepzeeland.nl/nieuws/107959/Dankzij-deze-filmpjes-kunnen-laaggeletterden-veel-meer-dan-je-zou-denken – accessed 11-11-2019.

find out if a smartphone application could be used to enable the low literate people to watch instructions videos belonging to a received letter. The challenge was how the instructional videos could be connected to the physical letters.

7.15.5 Switching target groups: from NT1 to NT2

In this type of real world action research unexpected things can happen during the course of the project, for example that the target group changes. This happened in our research. In the weeks following the DigiChallenge event, initial ideas were developed to help the NT1 group. By using the network of people met at the DigiChallenge event, we tried to come into contact with the group. Multiple attempts resulted in nothing. Mails were barely answered, or it was reported that the group was preparing for an exam, leaving no time for testing. We could indeed confirm that the NT1 group is hard to reach. Due to the limited time available for the project, we decided to shift the focus to the NT2 target group. In this group some students understand spoken language much better than written language. This was the reason to continue developing a method that helps understanding letters. As NT2 is also a group that also has problems with digital inclusion, as stated in De Bouwstenen voor Digitale Inclusie report, the shift in target group did not negatively affect the research project [7].

Mariëlle van Rooij is language consultant of *Taal Doet Meer*[25] and NT2-teacher at the NVA [26] , a non-governmental organization for integration and participation of migrants in the Netherlands (Stichting NVA Centrum voor Duurzame Inburgering). She invited me to test the method with her language class. Taal Doet Meer is an organization with more than 900 volunteers that ensures, for more than 30 years, that non-native speakers can participate in today's society. By attending language classes, I could interview the people from the NT2 group and identify the needs and objectives of this group.

7.15.6 Needs assessment

In a language class about Koningsdag (King's day), given in Amersfoort, the needs and objectives of the NT2 group were determined. Twelve participants from all over the world attended the class. People from Syria, Iraq, Eritrea, Gambia, and Ethiopia who are learning Dutch attended the class. The age of the participants is between 25 and 55 years. The participants of the language class are exempt from the national integration course but are obliged to follow 600 hours of Dutch language lessons as compensation.

In the first part of the class, I had the opportunity to introduce myself and tell something about the reason why I was attending the class. After an introduction, the group continued with their weekly personal assignments. At the same time, I had the

[25]https://www.taaldoetmeer.nl – accessed 11-11-2019.
[26]https://www.nva-amersfoort.nl – accessed 11-11-2019.

Figure 7.4   Participants of the language class (dressed for King's day).

opportunity to individually ask the participants questions that were relevant for the research.

- Do you experience problems with reading letters?

- What is the most difficult thing about these letters?

- What do you do when you receive these letters?

- Who are you asking for help and how do you feel about that?

- Would you be happy if the letters were read out for you?

- Are you in possession of a smartphone and which one?

- What smartphone applications are you using right now?

In the first session, five participants were interviewed. Four of the five participants had Arabic as their native language, and one of them speaks Tigrinya. All of the five participants mentioned experiencing problems when they received a letter. None of them was able to comprehend the full content. They all indicated that the language level of the letters is too difficult for them. The letters are often too long and contain multiple difficult words. Four of the five participants reported that they usually bring the received letters to the NVA and ask their contact person for help. The other participant mentioned asking the neighbors for support with the letters. All mentioned that they sometimes feel ashamed of this situation, especially when the letters contain private or medical information. All participants confirmed that they understand

the letters better if they were read to them by someone else. All five participants owned a smartphone with Internet, and they were all able to download new applications. Examples of applications installed on their smartphones were: WhatsApp, Facebook, Viber, ING/Rabobank, and NS Reisplanner.

In the first interviews, it became clear that the NT2 group had problems with received letters and that they would appreciate help in understanding these letters. It also became clear that spoken language is better understood than written language and that all participants in the group owned a smartphone that is used in their daily life. The participants were all able to download new applications and know how to take photos and how to send them. At the end of the interviews, I showed a simplification of the initial ideas described in section 7.15.2. All of the participants mentioned being more interested in the application that enables the users to have the letter read aloud than an approach where they needed to watch instruction videos belonging to the letter.
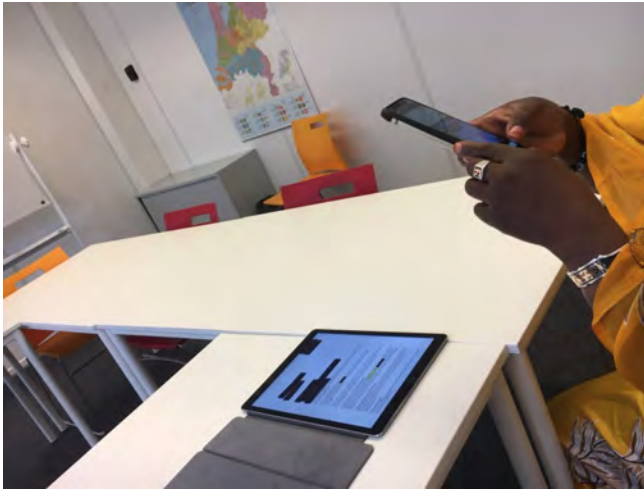
Figure 7.5   A participant testing the Google Translate app.

After the interviews, one of the participants showed a real letter that was not understood. It happens more often that students take letters to class to ask for help. Together we made a picture of the letter and used the Google Translate App to read it out loud. We first listened to the Dutch version of the spoken letter, followed by the English version. By using this method, the participant understood the content of the letter and now knew what to do. She told me that she was happy with this approach because she no longer needed to take letters to her contact person, an exciting finding.

At the end of the class, I took some pictures of the group in their orange clothes, which they wore because of Koningsdag. I was told that the group picture would be the new image of their WhatsApp group. All of the participants are part of the WhatsApp group, meaning that all twelve own a smartphone. Important to note is that the WhatsApp group is used to do weekly assignments at home. For that

Figure 7.6   Design view of the overall functionality of the app.

week, the participants were asked to make pictures of their experience of Koningsdag because the royal family came to Amersfoort.

7.15.7   Requirement analysis

Based on the interviews of the first session, the main requirements have been determined. It can be concluded that the solution to better understand letters should be delivered in the form of a smartphone application. The requirements are split into functional requirements and quality requirements.
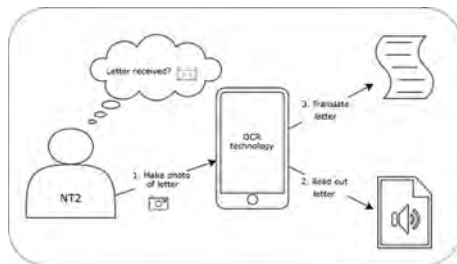
7.15.8   Functional requirements

In Figure 7.6, the overall functionality of the application is presented in a design view. The view shows how the low literate people can make use of the application to understand letters. The user should be able to make a picture of the letter (requirement 1). Once the user has made a picture of the letter, the written text needs to be transformed to spoken text (requirement 2). The written letters of the photo first need to be transformed to digital text. The technique used for this is called Optical Character Recognition (OCR) and is an important and widely used technology [12]. The digital text can then be processed and transformed to written text.

Since low literate people of the NT2 group have another language than Dutch as their native it is valuable to translate the text (requirement 3). The smartphone settings and the content of the currently installed applications could be in another language. Therefore, we need to ensure that the application supports multiple languages (requirement 4). An overview of the functional requirements is presented in Table 7.1.

There were two options for a potential smartphone application. The first option is to create a new application based on functional requirements. The second option is to use an existing application that already fulfills all functional requirements. I concluded that the Google Translate app is an existing app that fulfills all functional requirements. In section 7.15.9, we elaborate on why the option to use the Google Translate app has been chosen.

Item	Requirement
Camera	The user should be able to make a photo of a received letter.
OCR	The software then needs to recognize optical characters (OCR) and transform a photo of written text into spoken text.
Translation	Translate the content of the letter.
Language	The application needs to be able to support multiple languages in order to be used by users of the NT2 group.

Table 7.1   List of functional requirements

Name	Definition
Feasibility	This term is used to determine whether one has the technical expertise to handle completion of the project.
Sustainability	Sustainability is concerned with the well-being of future generations and in particular with irreplaceable natural resources.
Maintainability	Maintainable systems can easily be made to function if they are broken or not appropriate to the task at hand.
Understandability	The concept that information should be presented so that a user can easily comprehend it. In this case, the information presented in the application should be understandable for low literate people.
Usability	The extent to which a mobile application can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.

Table 7.2   Quality requirements, collected with the users.

7.15.9 Quality requirements

Based on the quality requirements, there has been decided whether a new application was created or an existing application was used. In order to make a grounded decision we used the QOC (Questions - Options - Criteria) modeling notation [13]. In Table 7.2, the considered quality requirements are presented. In the QOC-model (Figure 7.7), the decision to use an existing application is presented.
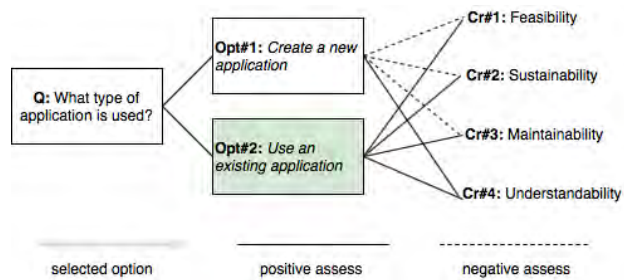
Figure 7.7   QOC model: Decision support for the selected application type.

Rationale for decided option #2   Based on the quality requirements, there has been decided to use an existing application that fulfills all functional requirements. In terms of feasibility, the time available for the project is approximately five months. Within this timeframe, it is a challenge to design and build a whole new application and test the application with the participants. Besides, the main goal is to help the participants with understanding letters. The objectives of the participants would have received less attention if the main goal was to create a new application in the available time. When choosing an existing application, we do not need to worry about the feasibility of the application.

In terms of sustainability, it is better to use an existing application. A new application must be hosted, which consumes additional energy. Also, a mobile application needs maintenance, and the chance that the new application is maintained after the project is finished is not that likely. If the new application would be broken after the project, it is less likely that it would be fixed. The benefits of creating a new application are that it can be designed entirely based on the needs and objectives of future users. Although this seems to be a significant advantage, the first tests in the first session with the NT2 group also indicated that the existing application was understandable for the low literate people. In addition to the fact that the quality requirements are to the advantage of an existing application, there are also hosting and maintenance costs if we would develop an app ourselves. In contrast, using the Google Translate app is free. We do not need to discuss any possible patent rights in this study because this is out of scope.

Our second concern was whether we should use the existing UI (User Interface) of the Google Translate App or whether we should create a new one. Moreover, if we use the existing UI, how can it be used to help low literate people in understanding letters? In the next section, we elaborate on the iterative methodology used to find answers to these questions.

7.16 Second test session

Two weeks after the first session, I participated in a second language class in Amersfoort. In the time between the two sessions, there has been decided to use the Google Translate app. The goal of the second session was to find out if the app indeed can contribute to understanding letters. Besides, we needed to find out if the existing UI could be used or whether a new UI would work better. In an experimental setup, five participants were individually asked if they could identify the subject of some test letters (Figures 7.2 and 7.3) without using their smartphones.

The municipality of Amsterdam provided the tests letters used for the second session. None of the five participants could mention the subject and the goal of the letters without the usage of their smartphone. This was expected since the participants are still in the first phase of learning Dutch. They reported that the words were too complicated and that they could not make a whole story out of it. The participants again confirmed that they would have asked someone for support when they would have received such a letter in practice. It was a pleasure to hear that none of the participants threw away the letters while leaving them unopened.

7.16.1 Testing with Google Translate app

Four of the five participants had the Google Translate app already installed on their smartphone and mentioned to use it to translate individual words. The participant that did not have the Google Translate app immediately downloaded and installed it. Unfortunately, we discovered that Google Translate is not supporting her native language, Tigrinya. She showed me that she currently used the 50 languages app[27] to translate individual words. Fortunately, this participant will soon be able to use Google Translate[28].

In the next phase of the test, the participants were asked if they could tell what was meant with the letters by making use of their smartphone. The functionality of how the app can be used to read out a letter was demonstrated [29].

The participants preferred to have the translated (Arabic/English) text readout instead of the Dutch text. Three of the participants translated the letters to Arabic, and one translated the letters to English. The participant who speaks Tigrinya used the app to have the Dutch text read out, see Figure 7.8.

By using the app, the participants could tell what was meant with the letters. They all knew the subjects of the letter, but the translation delivered by Google Translate was doubtful since the precise details were still a bit vague. One of the things discovered was that participants thought that the salutation (the address details and the date information) needed to be translated. This resulted in some confusion. A dis-

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[27] See https://www.50languages.com – accessed 11-11-2019.

[28] See https://www.trouw.nl/cultuur/binnenkort-in-google-translate-het-tigrinya
-met-dank-aan-rotterdamse-eritreeers af3c860c/ – accessed 11-11-2019.

[29] See the Instructions on https://support.google.com/translate/answer/6142483?co=GENIE.
Platform%3DiOS&hl=nl&oco=0 – accessed 11-11-2019.

Figure 7.8   Test session of the developer with one of the users.

advantage of the app is that it does not recognize that this information should not be taken into account when translating the critical parts of the letter. In the following weeks, it was a challenge to find a solution to this problem. Below the important things learned from the session are itemized.

- The OCR technology of the Google Translate app worked 100% secure on the example letters used for the second test session.

- Google Translate could not deal with the native language of Eritrea (Tigrinya).

- After a demonstration the participants understood how to use the Google Translate app. The current UI is understandable for the NT2 group.

- People do not always understand the structure of a letter and can possibly not determine important parts.

- The translation of the Google Translate is not always perfect.

7.16.2   User interface

In Figure 7.9 the QOC model of the User Interface is presented. Based on the quality requirements there has been decided to use the existing user interface of the Google Translate app.

Rationale for decided option #2   The most important criteria here to consider are understandability and usability. It is essential that the users can understand the application and efficiently use the required functionality. From the tests of the second session, there can be concluded that the current user interface is understandable and pleasant to use for the NT2 group. When considering the other quality requirements, there can be concluded that using the existing user interface is more sustainable. Using the functionality of an existing application with a new user interface means that
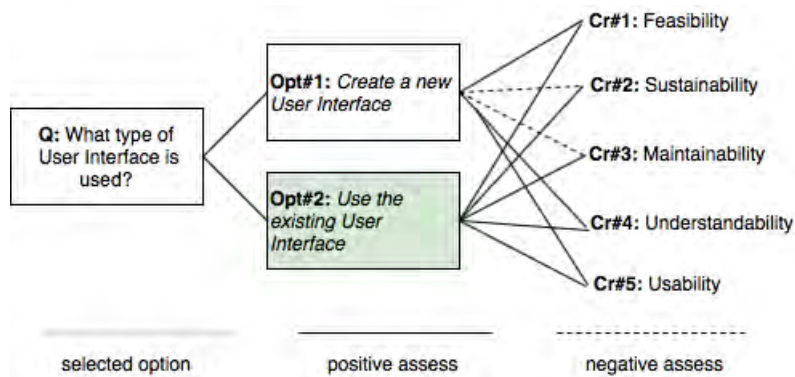
Figure 7.9   QOC model: Decision support criteria for the user interface type.

in the end, a new application needs to be hosted. This results in more energy consumption, which is not sustainable if a properly functioning user interface is already available. Regarding maintenance, it is also wiser to use an existing user interface. It would have been feasible to come up with a new user interface in the available time, but less attention would have been gone to finding a method to ensure that the application is used in practice.

In the weeks between the second and third session, consideration was given to how to deal with the shortcomings of the application and how to ensure that the application will be used in practice.

7.17   Third test session

After the second session, we knew that the Google Translate app with the existing user interface was suitable to read out the letters. Also, we concluded that the app is also suitable for translating the text, which contributes to comprehending the letters. Together with the teachers of the school, I looked at what would be a good way to ensure that the students of the school would use the app. We then came up with the idea of making an infographic of the steps involved in the process. The infographic can be hung as posters in the school, presented on our website and digitally broadcast on screens. In this way, the visitors of the school can continue to watch the approach and use the approach even after the project has been completed. In a later section, several methods to promote and stimulate the approach will be discussed.

7.17.1   Feedback for the infographic

The infographic shows a step-by-step approach of how the Google Translate app can be used. In Figure 7.10 the initial version of the infographic is presented. The infographic has been tested with three people who have full command of the Dutch

Figure 7.10   First version of infographic.

language. In addition, these three people use their smartphone daily and have the necessary digital skills. These tests were done to remove the fundamental errors from the infographic before it was tested with the real target group.

Before testing the infographic with the NT2 group, two teachers were asked to give their feedback. Because they are in daily contact with the target group, they know what the NT2 group can and cannot understand. Initially, an English version and a Dutch version of the infographic were made. However, it was not recommended to use English because this was generally not a language that the target group mastered and because it was in conflict with the purpose of why Dutch lessons were followed. Therefore, there has been decided to continue with the Dutch version of the infographic. Below we itemize the improvements done on the initial version based on the feedback of the teachers.

Figure 7.11   Example of a letter for user testing, with selected, red markings.

- *Brief ontvangen*: the font is unclear and contains hard to understand letters for the NT2 group. The font has been changed to a font similar to Verdana, as suggested in the factsheet.

- *ontvangen*: this word has been changed to gekregen. We used a website[30] suggested in the factsheet of Stichting Lezen en Schrijven to find an easier word.

- *Gebruik de Google Translate app*: this part contains difficult words and the goal is not clear. It is suggested to make a clearer description for what purpose the infographic can be used. In addition, change 'Google Translate app' to smartphone since this is a word that is known by the NT2 group.

- *Open de Google Translate app op uw smartphone of tablet*: this part has been changed to 'open de app op je smartphone'. The same is said with less long and less difficult words.

- Step 4 is a complex step and is probably not clear. The suggestion was to test this with the participants and split it eventually in multiple steps.

- *Luister en bekijk de vertaling*: has been changed to 'Luister en *lees* de vertaling' since it more describes the goal of what to do.

- A general suggestion was to use more symbols and increase the font size.

After the discussion with the teachers, there was time for testing the infographic. The initial version of the infographic was only tested with one participant. Unfortunately, there was not enough time to test it with more participants. For future research, it would be valuable to test the infographic with more participants. For the final test, the participant was given the official test letter presented in Figure 7.2. To make the essential parts more clear a marking has been added to the letter, see Figure 7.11. Important to mention is that the participant was not able to read and understand the letter and that the native language of the participant is Arabic. The infographic was printed out, and the Google Translate app was already installed on his smartphone. By using the app, the participant was asked to decipher the letter. After the letter was deciphered, the participant was asked to answer the questions presented in Section 7.11 and indicate if something was not bright. In Figure 7.14, a setup of the test is presented.

7.17.2 Final test

In the final test, the participant had some issues finding the Google Translate app on his smartphone. Therefore we decided to add a logo of the application to the first step of the infographic. In the second step, there was some confusion. In the Netherlands, we read and write from left to right. The second step of the infographic was designed based on this principle, but for the participant, who has Arabic as a

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[30]https://www.zoekeenvoudigewoorden.nl/index.php – accessed 11-11-2019.

Figure 7.12   Experimental setup for the user test.

native language, this was confusing. Since the Arabic script is from right to left, we decided to make the second step clearer by adding the Arabic option to the step. The third step could be carried out without problems. The fourth step was problematic; the participant indicated that the picture was too small and that he did not know what to do. As suggested by the teachers, there has been decided to split this step. By demonstrating what to do in this step, the participant could continue with the approach. The fifth step was again too small, and there has been decided to use a more zoomed picture. Below the improvements are itemized. In Figure 7.14, the final version of the infographic based on the feedback of both the teachers and the participant can be found.

- *Logo*: a logo of the Google Translate app is added to the first step. The participant was searching on his phone but it took a while before it was found. By adding a logo of the app we try to reduce the search.

- *Arabic differences*: in the Netherlands we read and write from left to right. The second step of the infographic was designed based on this principle. For the participant who has Arabic as native language this was confusing. By adding the Arabic option to the infographic we try to reduce the confusion.

- Step 4 was experienced as complex. It was not clear when the user was ready to go to the next step. This step has been split into two steps. In the fourth step the user is now asked to mark the words in the red text box and in the fifth step we check if all words are correctly marked. By splitting the task into two parts we try to reduce the complexity.

- The picture in the fifth step was experienced as small. Therefore there has been decided to increase the size of the picture.

Komt u ook?
Naar wat   : Naar de bijeenkomst over een nieuw afval-beleid.
Voor wie   : Elke inwoner van de gemeente Leesdijk is van harte welkom.
Wanneer   : maandag 8 april
Waar   : de raadszaal van het stadhuis in Leesdijk
Hoe laat   : van 19:30 tot 21:30 uur

Inhoud   : De teamleider afval, mevrouw Vermeern houdt een korte inleiding.
Daarna gaat de gemeente met de inwoners in gesprek.
De wethouder, meneer Wouterson, is er ook.

Aanmelden : graag vóór maandag 1 april via communicatie@leesdijk.nl.
U kunt ons ook bellen 045 – 234 54 88. Vraag dan naar mevrouw
Jansen.

Figure 7.13   Adjustments to the text box after collecting the user feedback.

Once the user was able to follow the steps of the infographic, we saw that the application functioned well on the first red marked text box. The participant could tell the subject of the letter and was able to mention the date of the meeting. The second red marked text box gave more problems. The answers to the third and fourth questions could be found in this box, but the participant was not able to answer the questions. The lowest text box does not contain smooth sentences. This resulted in the fact that the spoken and translated text messages did not make sense to the participant. When I showed the adjusted version of the letter (Figure 7.13), the participant could tell me before when he needed to register for the meeting. He mentioned that this part was more comfortable to comprehend since it contained less information. At the end of the final test, the participant told me that he would use this approach in practice and that he will demonstrate it to his wife.

After the experiment, we returned to class. During the lesson, the participant still had to do little reading and writing assignments. Remarkably, he used the Google Translate app for this in the same way as explained in the infographic. Of course, this is not the intention for reading and writing assignments, but it was good to see the method being used so quickly.

7.18   Evaluation

The main goal of the final test was to find out if the application contributes to understanding letters. By following the approach suggested in the infographic, the participant could answer the first two questions, see 7.15 correctly. Without help, the participant was not able to answer the third and fourth question correctly. What was observed was that the participant had trouble when the application processed too much information. When splitting the information, the comprehensibility increased. The fourth question could be answered correctly after the letter was slightly adjusted. Even though not all questions were initially answered correctly, we saw that the participant now had a better idea about the purpose of the letter. Without the application, the participant would have had no idea what to do and needed to bring the letter when visiting the NVA.
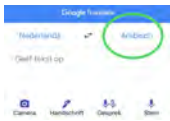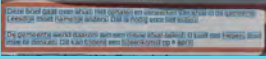
Figure 7.14   Final version of the infographic.

Figure 7.15   User Interface of the VraagApp.

It has been observed, and it can be concluded that the NT2 group can handle the Google Translate app well. Questions about the user-friendliness of the app were answered purely positively. In the first session, I showed someone of the group how to use the Google Translate and in the second session, she came back to me and told me that she had used it in the meantime. She said that she made an appointment based on a received letter and that she did not need to ask the NVA for help.

When asking the NT2 group whether they would recommend the Google Translate App to others, there were again purely positive answers. The participant of the final test even mentioned that he would demonstrate the approach to his wife.

To give a more grounded conclusion if the app works in practice, more people should be tested, and several test letters should be used. The feedback from these tests could be used to improve the infographic further.

The consideration to develop a new application was based in particular on the fact that it can then be developed according to the needs and objectives of the low literate people. However, during the sessions, we have seen that the existing Google Translate app functions well and is understandable for the target group. In addition to being a free and sustainable solution, the application is also continuously being improved. More than 100 billion words are being translated each day[31]. The Artificial Intelligence (AI) capability of Google Translate ensures that the system is self-learning. In addition to that, when Google Translate suggests a wrong translation, one can recommend an improvement. The service is currently supporting more than a hundred languages, and more languages are approaching. Besides all benefits, a recent news report also showed that the deep learning methods used by Google Translate still have a lot to improve in the area of discrimination, for example [32]. For the time available for this project, the existing application offered the most suitable solution.

7.19 Discussion

This section is used to discuss the methodology and the results of the case study. Elaboration of future research is done, and recommendations are given.

ICT4D 3.0 framework   For this research, the ICT4D 3.0 framework was used. This framework is based on three principles: (i) goals and objectives are set by local users, (ii) co-creation is done in partnerships, (iii) the technologies are fully adapted to the local context. In this research, the goals and objectives of the low literate people were discovered during a language class in Amersfoort.

By discovering the needs in the initial phase of this project, we could better look for a solution that was suitable for the target group. The approach to help the low literate people has been developed in co-creation with the group. In an iterative way

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[31]See: https://www.yuqo.nl/10-feiten-over-google-translate/ – accessed 11-11-2019.
[32]See: https://nos.nl/artikel/2286930-kan-kunstmatige-intelligentie-racistisch-of-seksistisch-zijn.html – accessed 11-11-2019.

Komt u ook?
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Voor wie   : Elke inwoner van de gemeente Leesdijk is van harte welkom.
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Inhoud   : De teamleider afval, mevrouw Vermeern houdt een korte inleiding.
              Daarna gaat de gemeente met de inwoners in gesprek.
              De wethouder, meneer Wouterson, is er ook.

Aanmelden : graag vóór maandag 1 april via communicatie@leesdijk.nl.
              U kunt ons ook bellen 045 – 234 54 88. Vraag dan naar mevrouw
              Jansen.

Figure 7.16   Text box with functional symbol to increase ease of use.

of designing, testing, and evaluating the application was chosen, and a corresponding infographic was created. The third principle was less relevant for this research than for research in low-resource contexts, for example. What we found out was that the low literate people of the NT2 group own a smartphone with access to the Internet. Therefore, it has been decided to develop a solution suitable for the smartphone.

7.19.1   Do not reinvent the wheel

In this project, we chose to work with an existing application. In cooperation with the target group, the needs and objectives were discovered, and the requirements for the applications were set. While considering to build a new application, we concluded that we did not need to reinvent the wheel. Using an existing application is more sustainable, and the current application was experienced user-friendly. In previous ICT4D projects, it is more common to design and redesign a new solution for a problem. Although no new solution was designed, we came up with an approach to help the low literate people with a daily problem. Why should we eventually reinvent the wheel if existing solutions are available?

7.19.2   Recommendations for the letters

We investigated wether a simple adjustment to a letter could be of added value in understanding it. What we discovered during the tests was that the low literate people could not distinguish between the salutation and the essential sentences in the letter. Using the Google Translate app became a lot easier after adding a red text box around the critical parts. In cooperation with the people who determine what is essential, the letters could be slightly adjusted so that the usage of the application is easier. It would, for example, be interesting to research if the approach presented in Figure 7.16 would increase the comprehensibility of the letter for the low literate people.

One of the advantages of Google Translate is that it is possible to make suggestions for a better translation. When in practice it appears that the approach described

in this study works, I recommend writing letters, that are known to be 'read' by many NT2 people, in a way so that the translated version is also understandable. In this way, we could increase the probability that the information is better received by this target group.

7.19.3 Sustainability

Sustainability is a critical success factor for projects for digital development of people in low resource contexts. In this project, this factor was decisive, especially when choosing between creating a new application or using an existing application. Because it merely costs more energy to host and maintain an additional application, it is a sustainable choice to use an existing application. To ensure that the research does not stop after my project has ended, we decided to share the outcomes with the municipality of Amsterdam and LostLemon. Also, posters are donated to the school, and we ensure that the infographic and the research are published on our website.

7.20 Roadmap

First, it would be good to test the infographic with multiple users. The feedback and experience can then be used to develop the infographic further. Also, it would be good to test the final version of the infographic and improve this again based on the feedback and observations. Besides, it would be interesting to test the approach with other letters.

The initial goal was to help the low literate people in the NT1 group. Because this group was difficult to reach, it was decided to switch target groups. It would still be interesting to investigate whether reading out letters to the NT1 group also helps to understand letters. Moreover, if it would help the NT1 group, could then the same application be used? Is the Google Translate app user-friendly for the NT1 group? Alternatively, would it be necessary to develop a new application based on the needs and objectives of this group? Interesting research will be to see if the NT1 group needs a different approach than the NT2 group.

For further research with the NT2 group, I would recommend working with a translator. Because the participants in this research did not speak English, and just a little Dutch, it was sometimes hard to communicate. Due to communication problems, the feedback given by the participants was not always clear.

7.21 Into practice

To ensure that low literate people more use the method, we made sure to donate posters of the infographic. The infographic is also available on our website and can be downloaded for free. It is interesting to investigate whether an instructional video contributes to the comprehensibility of the approach. Also, it is interesting to

investigate whether an instructional video in the same style that is used on Steffie.nl[33] helps to reach more people. To follow up on this, the research will also be sent to the organization behind Steffie.

7.22   Summary of research findings

In this section, the most important findings of the research are summarized. In addition, answers to the research questions are given.

The main research goal was to find out could low literate people could be supported. The selected use case was how to improve understanding of official letters with the use of a smartphone app. Based on a user-centered approach we concluded that low literate people, who have Dutch as a second language, can be best helped by an application that enables them to listen to the letter and to translate the letter. In a small experiment, we have seen that this increases the comprehensibility of the letter. Without the use of the application, the low literate people were not able to answer the most important question of the letter. With the use of the application, the low literate people could answer the questions correctly. We have concluded that the selected method meets the functional conditions. Based on feasibility, sustainability, maintainability, understandability, and usability, there has been decided to use the proposed method and also develop an infographic that describes a step-by-step approach of how the proposed smartphone app can be used.

We have seen that the low literate people experienced problems with the letters in practice and that they are open for advice and methodologies to be helped. We concluded that the smartphone is a perfectly suitable device to help the low literate people. As stated in the Bouwstenen voor Digitale Inclusie report, the smartphone is by far the most used device. We can confirm this, and also that the NT2 group possess the necessary skills. An extra barrier for the NT2 group is the Dutch language. This barrier can be reduced by using the Google Translate app. By stimulating and optimizing the use of the application, we can perhaps ensure that low literate people from the NT2 group become a bit more digitally included.

7.23   Conclusion

This research has shown that digital applications can be useful for low literate people with Dutch as second language in reducing their literacy gap. The digital solutions must be well adapted to the needs of the targeted user group. User evaluations of proposed solutions show that closely involvement of users in the design, adaptation and evaluation of digital solutions is very effective. This research has also shown that an iterative, adaptive, collaborative approach, embedded in a user-centered, sociotechnical approach is promising in finding solutions that can support low literacy in the context of migrants in the Netherlands and help bridge the Dutch Digital Divide.

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[33]https://www.steffie.nl – accessed 11-11-2019.

As long as we make sure that the needs and the objectives of the users are put central, developing and evaluation is done in co-creation with the end users, and the technology is fully adapted to the local context, the methodology can result in promising solutions from which the digital excluded people can benefit.

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CHAPTER 8

DIGITAL INCLUSION IN THE NETHERLANDS: POLICY AND PRACTICE

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Abstract   Modern society is intersected by a digital divide, also in the Netherlands. Many groups, especially the most vulnerable are at risk of social and economic exclusion. To mitigate digital exclusion, the Dutch government has designed new policies and made funds available. Local organizations are implementing programs and actions, accordingly. In this chapter we investigate how efforts to bridge the digital divide in the Netherlands are being carried out. We do this from the perspective of implementing organizations. To explore successes and pitfalls of current practices, we take the nine *Principles for Digital Development*[1] as a point of reference. The principles are: (i) design with the user (ii) understand the existing eco-system (iii) design for scale iv) build for sustainability (v) be data driven (vi) use Open Standards, Open Data, Open Source, and Open Innovation (vii) reuse and improve (viii) address piracy and security (ix) be collaborative. These principles have been formulated by a group of international development donors to guide the process of designing and building technologies for international development and cooperation. In this chapter we investigate the usefulness

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[1]See: https://digitalprinciples.org/ – accessed 11-11-2019.

of these principles in the Dutch context of digital development. And if so, are the principles applied in practice? Our research shows that most of the principles are useful and applicable in the Dutch context, to some extent and with some adaptations. Based on the outcomes of the assessment, we propose a tenth principle: (x) *'maintaining the user'*, to make the interventions more sustainable in the long run.

8.1   Introducing the digital divide in the Netherlands

Digital development[2] is the endeavor to provide digital technologies for social, economic, and political development, with a particular emphasis on helping poor people and disadvantaged communities in developing contexts of emerging and least developed countries [1, 2, 3]. Although the idea of being "unconnected" is often associated with poverty in developing regions, the "digital divide" [4] is also confronting wealthy regions and countries in the world [5].

This study focuses at the situation in the Netherlands, where various vulnerable groups are at risk of exclusion. A recent study by Van Deursen (2018) [6] shows that digital inequality reinforces pre-existing forms of inequality: the more resources a person has (e.g. income, property or a social network), the more benefits are obtained from being connected; conversely the fewer resources one has available, the smaller the contribution from the Internet to one's well-being.

For example illiterates, elderly people, people with a non-western migrant background, people with very low incomes and intellectually disabled people often have difficulties keeping up digitally [7, 8]. According to the national statistics institute (CBS), in 2018, 6 % of the Dutch population over the age of 12 confirmed never to have used the Internet, and another 6% experience difficulties in working with digital devices [9]. Among the people without an Internet connection at home, in 2017, 64 % of the respondents mentioned not to be interested in the Internet, many of whom mentioned lack of knowledge or digital skills (35 %) as the main reason. Among the elderly people (age over 75) are twice as many unconnected women than men[3].

A study by the Vrije Universiteit Amsterdam and the municipality of Amsterdam, titled "Bouwstenen voor Digitale Inclusie"[10] shows that "unconnected" people only take the initiative to become more digitally skilled, if this brings them an immediate advantage. For example they watch videos on YouTube, as this requires only basic language and literacy skills. In this way they develop so-called *digital splinter skills*: a limited number of well developed digital skills, while other skills such as arranging government affairs online or finding information, lag behind. To make these groups more digitally skilled, their needs and environment should be taken into account [7].

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[2]In 2018 the American development organization USAID launched "Digital Development" as a new term for what was previously referred to as"ICT4D". This is still under discussion see also: https://www.ictworks.org/ict4d-digital-development/#.Xcfx2ktCcvo – accessed 10-11-2019.

[3]Source: https://www.cbs.nl/nl-nl/nieuws/2019/01/zes-procent-nooit-op-internet – accessed 10-11-2019.

8.2   The state of digital development in the Netherlands

Digital development refers to the interventions and efforts, supported by governments and development agencies, to connect disadvantaged communities to the global Knowledge Society. In recent years the international development community has reassessed the effectiveness of interventions towards digital inclusion. One of the main conclusions of this assessment is that many problems can be attributed to a lack of collaboration between the service providers and developers and the envisaged beneficiaries [11, 12].

Yet, how does this work in the Dutch context? How are interventions to bridge the digital divide organized in the Netherlands? Who are the stakeholders? To explore the context of the Dutch digital divide, we visited to the Dutch Ministry of the Interior and Kingdom Relations (in Dutch *Ministerie van Binnenlandse Zaken en Koninkrijksrelaties* BKZ) and interviewed the Senior Policy Officer for Digital Inclusion of the Ministry about this subject. We explore actions towards digital development and digital inclusion from the perspective of implementing organizations. Each interview has brought new interesting insights in the subject which leads to interesting new questions for the next interview.

8.3   Dutch policy to promote digital inclusion

In this section the findings of an interview with the Senior Policy Officer for Digital Inclusion from the Ministry of the Interior and Kingdom Relations (BZK) are summarized[4]. Table 8.1 gives an outline of the points discussed.

The Ministry does not speak of a "digital divide" because of different understandings of what this concept actually entails. Hence, they prefer the term *digital inclusion*, which they view as supporting and promoting basic digital skills for all citizens in the Netherlands, so that anyone can participate in the digital society, even people who require extra help, such as some minority groups.

Policy goals: The Ministry of the Interior does not develop online learning tools or courses, but provides grants so that selected third parties can carry out the interventions towards digital development and inclusion. At the end of 2018, actions plans were made by the Dutch government, aiming to make everyone participate in the (digital) society[5]. Four main goals have been determined:

- Making digital services easier for everyone. It is important that as many people as possible can communicate with the government by themselves. This requires that everyone has access to the government and must be able to understand government information.

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[4]The names of the interviewees are not mentioned. All interviewees have spoken on behalf of their respectives organizations.

[5]https://www.digitaleoverheid.nl/overzicht-van-alle-onderwerpen/toegankelijkheid/digitale- inclusie/ – accessed 11-11-2019.

- Helping people deal with digitization. Although, the government is already doing a lot to help people with it, it is still not enough. The Ministry plans to collaborate with other governmental institutions, e.g. with the ministries of Social Affairs and Education. Also with municipalities collaboration is needed, as they are the ones in direct contact with the target groups in need of help.

- Digitization brings opportunities, but also risks. The government needs to inform citizens about digitization and explain the consequences. This allows citizens to reflect on the role of digitization in their lives.

- The Ministry of the Interior wants to collaborate with corporate businesses, knowledge institutes and all organizations that can bring their knowledge about digitization to tackle the issue of digital inclusion.

Challenges: In 2018, a network has been established, to discuss and act on digitization. This network is called the "Alliantie digivaardig Nederland". The aim is to share knowledge and experience, effectively. The main challenges with respect to digital inclusion, according to the Dutch government are:

- Identification of groups that are not digitally skilled is still difficult. The Ministry representative states that *"if you take a deeper look on how we are investigating whether someone is digitally skilled or not, standard questions are posed such as "can you log in with DigiD?" or "have you ever interacted with the digital government?". If the respondent's answer is yes, he/she is considered digitally skilled. Yet, if someone has not had any online interaction with the digital government, it cannot be concluded that the person is non-digitally skilled. How can we properly determine if someone is digitally skilled or not?"*;

- Serving the digitally unskilled is a financial challenge. The difference between the government and a private business is that when a product can be suitable for 80% of the population, the private business can choose not to serve the remaining percentage. The government must serve all citizens;

- The groups who are not digitally skilled are heterogeneous. For example, not all elderly or all low-literate people are digitally unskilled. In all levels of the population digital exclusion exists, which makes it difficult to reach these diverse groups and people with one communication message or motivation.

Fragmentation of efforts: In the Netherlands the government is by far the largest funder of actions towards digital inclusion. Some funds are made available by the national government and some through municipalities. Funding schemes are based on public tenders for which small initiatives as well as large organizations can apply.

According to the Ministry, there is a so-called *market failure* in bringing digital development to the market, because of lack of (business) opportunities. For implementation the government must rely on public and social not-for-profit-organizations. This brings the problem, as discussed during this interview with the representative

Theme	Findings
Main challenges	Determining who is and who is not digitally skilled. Reaching the group that is not digitally skilled.
Focus towards Digital Inclusion	Since the past year or two, the attention and sense of urgency of the Digital Inclusion is increasing.
Fragmentation	There are different organizations producing materials, however, it is not all collected on one platform.
Grants	The government grants subsidies, however, some parties want to remain self-organized which results in a dilemma as to whether they want the government to aid them financially.
Municipalities	Every municipality has its own agenda and has the power to prioritize what is important.
Leaving it to the Market	The government aims to form an alliance between public and private organizations to effectively deal with the issue of digital inclusion.
Bridging the digital divide	In order to bridge the digital divide the question of What is Digitally skilled should be better understood and everyone should work together more intelligently.
Actions	The government is actively looking how to reach target groups. A public campaign is planned. The government is forming alliances and discovering more targets.

Table 8.1   Summary of the interview with a Senior Policy Officer for Digital Inclusion, from the Dutch Ministry of the Interior and Kingdom Relations.

from the Ministry, of fragmentation of services of digital inclusion projects. Currently, there is not a central point of departure for digital services, or a single platform where to find all resources. Many different service providers are producing and delivering digital resources. It is difficult for the private sector to resolve the problem on their own, because of market competition. Implementing organizations try, where possible, to collaborate by complementing each other.

Yet, competition is not desirable in this case, if we aim to reach as many people as possible. The government has been inspired by the UK where there is more of a joint venture between public and private organizations (See: [13]).

According to the Ministry, the Association of Dutch Municipalities, the *Vereniging van Nederlandse Gemeenten* (VNG) is actively engaged in actions towards digital inclusion. However, not every municipality is represented in the VNG. A municipality can take a different perspective, based on political inclination. If one municipality considers something important, others may disagree. This is a field of political tension, hence, efforts towards digital inclusion depend on the political agenda at the level of municipalities.

Many digital resources are being developed. However, to achieve digital inclusion, it is necessary that all parties work together smartly and learn to understand the problems of different groups. What are the various living conditions? What can digitization mean to them?

Actions: The actions undertaken by the Dutch government towards digital inclusion are:

- The government is investigating how to reach the citizens, helping them to help themselves. Besides a large group of people not being digitally skilled, there is also a large group that does not want to be digitally skilled. They often do not realize how much is happening online nowadays. Despite efforts, experts and ongoing dialogues, no final conclusions can be drawn.

- The government does not intend to force anyone, only to inform citizens and show the possible impact of digital technologies on daily life.

- The government will launch a public campaign on digital inclusion in 2020. In recent years, the government gave local parties freedom to coordinate communication with the people they want to reach or what fits best in their particular environment.

- The government has run many pilots, to test out what works and what does not for the people they are trying to target. Although this initiative brings some small new insights, no big impacts in terms of numbers of people who have been "digitally included" has yet been achieved.

- The government aims at forming new alliances, discovering more targets and looking at the accessibility of websites and applications.

8.4 Frameworks and approaches for digital development

A high rate of unsuccessful digital development projects [14] has made clear that digital development targeting people in low resource environments is different and more challenging than "mainstream" ICT projects, rolled out for example in business and industry or in the public sector.

To understand how digital development in the Dutch context is being implemented, we investigated the perspective of implementing agencies and organizations. We contacted and interviewed a variety of them.

To guide our investigation, we first select an appropriate reference framework. In literature various frameworks and approaches have been proposed, for digital development in low resource contexts. According to Keijndener et al. (2018) most operational frameworks that guide an implementation start with an understanding phase to investigate the environment and identify stakeholders [15]. Next comes a requirement gathering phase. This is often followed by a phase of use case and requirements analysis. The fourth phase is a sustainability assessment and the final phase is the build (development), where the prototype is iteratively developed into the final product and implemented [15]. Frameworks for digital development often employ iterative methodologies. According to Joost Dijkers et al., iterative, agile development methods improve ICT4D projects, as they encourage user collaboration, team communication, organizational learning, and frequent software updates [16]. Examples of operational frameworks for digital development are:

- ICT4D 3.0: This framework, which is described in Chapter 2 of this book, uses a collaborative, adaptive, and iterative methodology [17];

- The Distributed Agile Methodology Addressing Technical ICTD in Commercial Settings (DRAMATICS): This is a repeatable software development methodology enabling the creation of sustainable, scalable and reusable ICTD solutions [18];

- Speedplay: This framework combines agile iterative development with principles drawn from action research and participatory design [19];

- The Nordic Model: This model incorporates agile design methods with elements such as demand driven approach, non-hierarchical management, inclusion of diverse target groups and formative evaluation [21];

- The Analytical Framework: This framework incorporates a project design approach using iterative development that could help practitioners in the field incorporate empowerment objectives for the marginalised participants to participate [20].

In 2012, a group of the most influential international development donors and multilateral organizations gathered to reconsider policies and practice and institutionalize lessons learned for digital development [12]. Mainstream practices in development

programs and projects were reassessed [12]. Based on the outcomes of this reassessment nine principles were formulated, to help make digital development more user-centered, scalable and sustainable[12]. The nine *Principles for Digital Development* are a continuation of the 2009 UNICEF Innovation Principles and the Greentree Principles, that were created by 40 mHealth practitioners in 2010 [12].

Despite the good intentions, various barriers have been identified, to putting these principles into practice. In 2015 and 2016, during a series of round table conferences among a broad community of ICT4D practitioners this was discussed, and a report with recommendations for development implementor and actors, donors, multilateral organizations was prepared, to move from the principles to practice [12]. Various programs and projects use the nine principles as guiding reference [1].

As there are not yet (case) studies describing the use of guiding frameworks for implementation of digital development practice in the Dutch context, we decided to do this, using the nine principles of digital development as the framework for assessment of digital development in practice [12].

The nine Principles for Digital Development: The nine Principles for Digital Development are formulated at a high conceptual level. They are considered ideally before funding, designing or implementing any technology supported development work [12]. The principles are described on the website: https://digitalprinciples.org/ (accessed 11-11-2019) and can be summarized as follows:

1. *Design with the user*: this principle is concerned with building, testing and redesigning tools, until it effectively meets user needs. This is done by continuously gathering and incorporating user feedback. Through this approach digital tools can be built to better address the specific context, culture, behaviors and expectations of the those who directly interact with the technology.

2. *Understand the existing ecosystem*: adaptation to the ecosystem of the given context helps ensure that selected technology tools are relevant and sustainable. By analyzing the ecosystem before implementation, measures can be taken to adapt the digital technology accordingly.

3. *Design for scale*: interventions for digital inclusion often do not move beyond the pilot stage. To avoid this, one must draw scenarios beyond the pilot phase and make appropriate choices to facilitate the process of diffusion and widespread adoption of an envisaged innovation.

4. *Build for sustainability*: at the start of a program, measures have to be taken, and commitment has to be given, to make sure that initiatives can survive over a longer period. A sound stakeholder analysis and a realistic business case have therefore to be ready at an earlier stage of the project design, with room for adaptation and outlook to the future.

5. *Be data driven*: this principle is related to monitoring and evaluation, as generally required by the donor. Data can be very valuable for decision-making in digital development. However, data can also be sensitive, there can be privacy

issues, and generalizations based on data are not always beneficial for the user. This principle is formulated to satisfy the donor and provide evidence that the project money is "well-spent" and to investigate if impact can be attributed to the action.

6. *Use Open Standards, Open Data, Open Source, and Open Innovation*: Digital development that is funded by public money must obviously in all cases lead to Open Standards, as this must be beneficial to all citizens. It is evident that proprietary software (the opposite of Open) is not to the benefit of the user, especially when the user has a very limited budget.

7. *Reuse and improve*: adaptation of existing products, resources and approaches can often be more effective than creating something entirely new. The time needed for development, testing and costs can be significantly reduced.

8. *Address privacy & security*: it is evident that all measures must be taken to protect the users' privacy, to ensure confidentiality of information and protect the identities of individuals from unauthorized access and manipulation by third parties. Still, it is good to be reminded of this principle, as it may be overlooked during the development process.

9. *Be collaborative*: share information, insights, strategies and resources with partners, organizations and sectors. This leads to increased efficiency and impact. By collaborating, those working in digital development can pool resources and expertise not only to benefit each initiative but also to strengthen the global community.

8.5   Are the nine Principles useful in the Dutch context?

To investigate the efforts to bridge the digital divide in the Netherlands from the perspective of implementing organizations, we formulate the following questions:

How useful are the nine Principles for Digital Development from the perspective of service providers, implementers and practitioners in the Netherlands? Which are the most relevant/important principles? Which are the least relevant/important principles? Which principles are deemed as challenges? Which principles are not deemed as challenges? Are there other principles/concepts that were not mentioned but are still relevant/important?

8.6   Research design and methodology

For this research[6] qualitative data was collected through semi-structured interviews with key experts about the digital divide and digital inclusion in the Netherlands.

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[6]The field work was carried out by the first author, Mickaela Wedervoort, as part of her master research Information Science. For her thesis including detailed info on the interviews, see: https://w4ra.org/wp-content/uploads/2019/07/3July2019_Mickaela-Wedervoort-Thesis-Final.pdf – accessed 11-11-2019.

Table 8.2   Information about the expert interviews.

Interview	Organization	Position	Duration
I1	St. Expertisecentrum Oefenen.nl	Director	60 minutes
I2	Stichting Lezen & Schrijven	Education expert	29 minutes
I3	Seniorweb	Manager of Editorial Department	40 minutes
I4	Instruct Educ. Uitg.	Product developer	56 minutes
I5	St. Leer Zelf Online	Creative director	36 minutes
I6	Lostlemon	Custumer Success manager	54 minutes
I7	Ministry of the Interior and Kingdom Relations	Senior Policy Officer (Digital Inclusion)	66 minutes

This led to a multiple-case study [22, 23, 25]. Similarities and differences were comparatively assessed between the different cases [23].

Most of the interviews were conducted by phone due to the busy schedules of the persons involved. As a result of the semi-structure nature of the interviews and the enthusiasm of the interviewees on the topic we were able to collect good data, without having to consistently intervene and guide the conversation. At times, however, what was meant by certain principles was not clear, so further explanation had to be requested. The openness of all interviewees in sharing information and opinions was very welcome. We tried to incorporate every new insight, gathered from a interview, iteratively into the next one. The interview with policy officer from the Ministry of the Interior – which was the last interview for practical reasons, but which we present first in this chapter, as it describes the overall context – was focused because of the information already collected through the other six interviews.

Data analysis: The qualitative data were analyzed using an inductive approach and by following the iterative method of First and Second Cycle coding [24]. Firstly, the collected data were coded by using elemental methods such as In Vivo and Process coding. Moreover, a set of Provisional codes were also generated based on the Principles for Digital Development. Thereafter, pattern coding, as a Second Cycle method was applied to group the First Cycle codes into a smaller number of themes relating to the nine principles to determine the extent to which the data conform with the theory. The idea was to analyse each case separately, and then comparatively explore patterns of similarity or difference with regard to the theory. The data analysis was performed in five steps:

1. Transcribe data: In order to obtain verbatim record from the conducted interviews, the interview recordings were manually transcribed.

Organisation	Target	Group User
Dutch Ministry of Interior	Every citizen in the country	N/A
Stichting Expertisecentrum Oefenen.nl	Low-literates, Computer illiterates, Seniors	Approx. 500.000
Stichting Lezen & Schrijven	Low-literates	Approx. 80.000
SeniorWeb	Seniors	Approx. 150.000
Instruct Educatieve Uitgeverij	Primary, Secondary and Secondary vocational education students, low-literates	All regional training centers in the Netherlands
Stichting Leer Zelf Online	Mentally disabled people, Low-literates, Seniors	Approx. 1.000.000
Lost Lemon	Low-literates	In 50 municipalities

Table 8.3 All organizations interviewed for this study.

2. Organize data: In this step, the data were organized to familiarize with the data and structure the data. The data were organized according to the themes of the nine design principles by utilizing ATLAS.ti[7]

3. During this process the data were also cleaned to eliminate information that may not be important, and filtered to identify the most important points and the less important ones.

4. Code data: The remnants of the previous step were coded based on patterns found in the data and categorized into themes and categories.

5. Analyze data: Finally, the cases were analyzed on the basis of the nine principles. The focus was on finding patterns of similarity and difference through text analysis. To further interpret the data, primary and secondary data comparison was utilized. Which means that the findings of the interviews are compared to the theory of the nine principles and the difference between them discussed.

8.7 Assessing digital development practice in the Netherlands

Table 8.3 presents an overview of the organizations that were interviewed, their target group and the number of users they serve. We were able to get into contact with these organizations through events, online research and personal social networking.

[7]See: https://atlasti.com/ – accessed 11-11-2019.

Stichting Expertisecentrum Oefenen.nl   is an organization that provides a platform to improve basic knowledge and digital skills. The target group consists of low-literates, computer illiterates and seniors. A number of organizations such as libraries have a license for oefenen.nl, yet their main focus is on individual users at home. This organization provides materials to help improve skills such as language, maths and digital skills. A large part of the programs consists of videos, animations and interactive exercises, to make learning attractive. They provide modules dealing with money, education and health. Their program aimed at improving digital skills is named Klik &Tik. The programs are made for the users to practice with so they can eventually improve their skills. Thus, oefenen.nl assumes some basic digital skills from their users. People who successfully complete the exercise program receive a certificate. For more information, see also https://oefenen.nl/ (accessed 11-11-2019).

Stichting Lezen & Schrijven   was at first focused on low-literates, but has recently transitioned to helping to improve basic skills and knowledge such as language, maths and digital skills. The teaching method Success! is now expanded with Success! Digitale Vaardigheden and a matching e-learning environment. In the course of 2019 various pilots have started to test the new materials. It is intended for people who want to improve their digital skills, using a smartphone, laptop, tablet or desktop. Moreover, it increases the understanding of the digital world such as searching and reviewing information, app, mail and be aware of digital security and privacy. The programs come with exercise books that contain daily situations. The method requires some guidance (an instructor) to the user. Succes! Digitale vaardigheden is part of a collaboration program named *Taal voor het Leven*. This is offered by Stichting Lezen & Schrijven and financed by the Dutch government. For more information see also https://www.lezenenschrijven.nl (accessed 11-11-2019).

SeniorWeb   provides a step-by-step content and various materials to make senior citizens digitally skilled in programs such as Windows 10, tablets and smartphones, WhatsApp, internet security and more. They focus on seniors of 67 years and older. In addition to the content, they also offer PC help. People can contact them online and ask questions or even get help at home from one of the 2900 senior volunteers. SeniorWeb also has 420 learning centers throughout the Netherlands where experts and volunteers give computer courses, workshops and open sessions. The course topics offered are diverse: tablets, Facebook, Windows, security, photo editing, order on your PC and more. For more information, see also https://www.seniorweb.nl/ (accessed 11-11-2019).

Instruct Educatieve Uitgeverij   is an educational publisher that produces materials for primary, secondary and secondary vocational education. This organization offers methods for digital security, social media, language and math, computer skills, IT and typing skills. For digital literacy a program called DIGIT was developed. It offers modules such as Basic Knowledge ICT, Information Skills en Computational Thinking that provide a broad basis for the efficient use of computers, tablets and mobile devices. In the Media Literacy section, students learn how to deal with the

opportunities and use of social media. Besides DIGIT, Instruct also offers other methods catered at improving Digital Skills. Recently, it started developing resources and learning materials for low-literate people. For more information see also https://www.instruct.nl/methoden/digit/ (accessed 11-11-2019).

Stichting Leer Zelf Online   is committed to making vulnerable groups in society more self-reliant in a world that is becoming increasingly complex. The foundation does this by giving all people the opportunity to learn online by themselves and, where necessary, to support them offline. They develop websites and apps for people with mental disabilities, low-literates, seniors, people with temporary impaired cognitive skills and for everyone who can use it. It uses an intuitive design, with clear buttons to make the programs easy to operate. The content of the e-learning environment is characterized by simple text, short sentences and frequently used words. Visualization of the content is used as much as possible and all texts are read aloud when desired. All their products are developed with focus groups, usage tests, panel studies and a strong involvement of the end user in the broadest sense of the word. They have a method named Steffie which is aimed at making programs and digital information easier. Steffie provides users with support with the use of e.g. DigiD, banking, insurances and voting, just to name a few. See also https://www.leerzelfonline.nl/home/ (accessed 11-11-2019).

Lost Lemon   assists 50 Dutch municipalities in bridging the digital gap. They provide the tools so that the municipalities can create digital forms that are both optimized and easy to use. They also provide support training on the lessons-learned from previous trajectories and how to optimally construct a digital form. Municipalities can also request a form design session with target groups. For more information see also https://www.lostlemon.nl (accessed 11-11-2019).

8.8   Assessing practice against the nine principles

The usefulness of the Principles for Digital Development were investigated through interviews with several organizations. During the interviews also other, related issues came up, that are relevant to mention. The results of the discussion for each principle is given below. A summary of the findings is given in Tables 8.4 and 8.5.

1. *Design with the User*: Most organizations reported that they are usually applying this principle, with the exception of (I6) stating that "We want to do it, we know we have to, however, we can not always do it because it is just very expensive. We are now doing it ad hoc, so when the municipality deems it important and supports us financially, we do it". The difference between the organizations applying this principle lies in the extent to which they design with the user and when they do it. For example, (I3) states that "It depends on what kind of content we are developing and the risks attached to it". If there is a very low risk, they will usually use statistics afterwards to look at how the users are responding to it and modify the materials accordingly. In the case of a higher risks, they

lean more towards testing to minimize risks and ensure successful materials. (I3) states that "We always test, we test a lot with our seniors. We have a panel where we can present a lot to. Another example is (I1) stating that "We don't do much with designing with the user, since we work with many people who have direct contact and experience with the target group and with their needs. I am well aware that doing everything with a target group is seen as 'hip', however, it is not necessary for everything". They only do it when they run in to something or when they are in doubt. On the other hand, (I5) thoroughly designs with the user and does everything with focus groups and states that "Focus groups is actually the basis of everything".

2. *Understand the Existing Ecosystem*: Every organization deemed this principle as very relevant, particularly since by applying this principle they are able to keep the content they offer appropriate and updated to the needs of their users. However, the organizations reported that this principle is difficult to keep up with since nowadays new technology emerges fast. (I2) stated that "We must always know what is being used, however, the technological development is going very fast and the ecosystem is constantly changing". Similarly, (I1) states that "We see the possibilities of new technology and they are actually progressing way too fast to keep up with". However, (I1) also stated that "We work with a target group that does not go along with the technology and advancements, but we do follow the developments".

3. *Design for Scale*: Every organization claimed to have this principle adequately implemented. (I4) stated that "We certainly ran into issues in the beginning because we had not properly estimated how many users should use the environment simultaneously, which caused delays. However, after so many years we really have it set up properly".

4. *Build for Sustainability*: The organizations all have different ways of dealing with this principle. For example, (I3) states that "We are an association but we must fend for ourselves, so we do not receive any government support, nothing at all. People can join us for 32 euros per year". (I4) also has a revenue model and states that: "That is also the reason why we have opted for subscriptions or licenses to ensure that there is continuous cash flow. New licenses must be purchased after every year or two years". Other organizations such as (I1) and (I5) believe in providing a free service for the end users. (I5) states that "We want everything for the target group itself to be free. Hence, the municipalities and companies that use it pay, but always provided that it is free for their end users". On the other hand providing a free service can be conflicting, (I1) states that "Every year, the point of which we do not know if we can continue to exist is present. We succeed every time. The dependence on large customers such as the Royal Library, is very tricky for us. We would prefer to stay focused on end users but there are others who pay and you have to tackle that". (I5) states that "What we spend a lot of time on is finding funding because at times it is difficult to find". (I6) has taken into account for their clients to continue on utilizing their

solutions stating that "Because we use open source solutions, that is possible. We have agreements with our customers that should we go bankrupt, we will hand over everything".

5. *Be Data Driven*: This principle is viewed differently among the organizations, although, they all view it as indispensable and are applying it in someway. (I6) states that "We are very much driven by data and data that can be found, so we can use it and make it useful". They are using data to make predictions, to monitor where people are making mistakes on a website and to design standards with which you can exchange data between systems. (I1) also reported to be using data to monitor where people are making mistakes, it states that: "Every year we receive an overview of data where people get stuck in the programs and we use this information to make adjustments to the materials". However, (I1) also states that "We have so many people online, so then we should do something with their data. I do not know anything about data, I only see that it has to be done, so we have to find people with knowledge about data". Moreover, (I4) uses data in an alternative way as well stating that: "We do not use data to develop the content of our products, but we are looking at how we can efficiently get our potential customers attention". On the other hand, (I5) states that "Data driven is a must, but I think its a bit of a hyped term. It also ignores the people who use it. We look at what is in demand, but it is not that we collect user data or location data. We only use data for the sole purpose of developing the materials. Being data driven must never be a goal in itself. Finally, (I3) believes that "You can never blindly work on information alone. Information can only give a signal of a certain trend or something, but then there is also a piece of common sense".

6. *Use Open Standards, Open Data, Open Source, and Open Innovation*: Most organizations are not applying this principle. (I4) states that "We are a publishing company. We are self-sufficient, so we just have to make sure that we sell our products so that we have a right to exist. Therefore, we do not share things via open source, because that does not produce anything, we cannot survive of that". (I1) has a different outlook and states that "It is just how you define open source. Our materials are available to everyone free of charge, I also call that open source. With regards to the technology no, we need something tailor-made because most technologies do not focus on this target group". Furthermore, it was also revealed that (I1) once tried to implement Google's speech technology, however, the conditions changed and they had to stop using it. (I1) states that "But that is also the thing with open source, it is constantly changing, so we do not use it. But where possible, we will use it". On the other hand, (I6) is a major proponent of open source and states that "We do that as much as possible, we cannot always use it, because we also work with systems from large parties and they are not always keen on open standards and open source. However, our starting point is always open source and open standards and our customers want that too".

7. *Reuse and Improve*: Every organization claimed that this principle is essential and that they are applying it. (I3) states that: "I think that is the basis. If our content is not up-to-date, then we have a problem. This actually takes the most of our time, building something new is not that difficult, but keeping existing content neat and relevant is the biggest challenge". Furthermore, (I6) states that We ensure that the municipalities are able to reuse things from each other. We have a cloud solution, so there is a collection of systems on it and they are constantly being improved, because what we implement for one, the other can use. Finally, (I2) states that "We especially expand on our existing projects, we are not yet in the phase where we are really reusing, but we are improving existing projects. Our digital skills materials came from improving existing projects".

8. *Address Privacy & Security*: None of the organization indicated have difficulties with this principle and they all agree with being cautious with their users' data. (I1) states that "We do not collect that much data at all from our users, and we deliberately chose to do so because we deal with a target group that is a bit anxious". Similarly, (I4) states that "We are aware of what data we store, we store student data and test results data and we make sure that we deal with it properly and that we are not easy to hack". Finally, (I6) states that "Our customers just think it is very important, everything that the customers fill in on those forms is only allowed to be accessed by the receiving parties. We cannot offer our products at a social service if we do not have security and privacy in order". Noteworthy is most organizations mentioning the European GDPR privacy law, in Dutch *Algemene verordening gegevensbescherming* (AVG) when discussing this principle.

9. *Be Collaborative*: Every organization interviewed sees the importance of being collaborative and are applying this principle. Every organization except for (I4) says that they are dealing with this principle. (I4) states that "We do not have many partners with whom we develop content together with, but we do have some", whereas (I1) goes as far as stating that "We have to work together, we cannot do anything by ourselves. We actually always collaborate".

8.9   Theme Analysis

Other themes worth mentioning have emerged during the coding process, despite not being directly related to the principles.

Face-to-Face guidance   This theme involves the importance of providing face-to-face guidance to end users. (I3) states that "Face-to-face guidance is very important for the elderly, but what also makes a big difference is speaking the language of the senior and that often means having a good understanding of the problems their dealing with". We have 420 learning centers throughout the Netherlands. Many are

Theme	Findings
Face-to-face guidance	Providing face-to-face guidance increases success for end-users.
Teachers	Teachers must be digitally proficient and must also be taught to give instruction.
Newsletters	Newsletters help users to stay updated and find content
Challenge vs No Challenge	Is it challenging to reach marginalised communities for implementing organizations? Some orgs reports no challenge at all, others confirm difficulties.
Other ways of working	(I4) mainly develops course materials based on published learning goals (I6) firmly believes in open source and tries to incorporate it as much as possible (I5) has a very practical way of working and believes that this should be the norm especially when dealing with disadvantaged communities (I3) incorporates a step-by-step method in all its materials in order to cater to their target group.
Recommendations	(i) There is never a wrong formula, as long as your always testing with your users.
	(ii) Express things as clear and simple as possible for the end users.
	(iii) Make valuable data available to the world so everyone can learn from them. In this way, a network of people dealing with the same issues is created.
	(iv) Listen carefully to people and address the biggest problem first and quickly produce results.
	(v) Stop with producing scientific research but rather take action.
Government	Municipalities do not have enough funds to allocate, they receive a huge number of tasks to deal with and they find it difficult to spend the money in a proper way The central government does not have digital inclusion high enough on the agenda, so within the Netherlands there is just not enough attention towards the issue The Dutch government leaves as much as possible to the free open market. Less money to established institutions and more to small innovative companies would solve issues in practice.

Table 8.4   Summary of main findings extracted from the interviews.

in the library and central public accessible places. Furthermore, (I4) states that "We think it is very important that our users are well aware of the possibilities within the environment and if they are not, we will brush them up and that is always free for paying customers, it is just part of the service package". Additionally, (I1) states that "We are strong proponents of not only online learning but also to face-to-face guidance, because people make more progress this way. In the group of low-literates, people also have the social need to sit in a group together".

Challenge vs no challenge reaching the marginalized community   This theme highlights the opposing views when it comes to reaching the disadvantage community. (I5) states that "If you just step out to the neighborhood and chat with people, you establish contact and you hear what happens. We have a very broad social scope". Similarly, (I1) reports that "We experience no challenges in reaching marginalized community, although that is the perception of the municipality". Moreover, (I3) states that "We reach a lot of people, we often come across Twitter or other social media channels where people report that they found an answer at Seniorweb. The question often is whether people also want to pay for the information and you can see a difference in that as the younger someone is, the less open they are to it since they are used to information being available for free". Contrarily, (I6) states that: "Designing together with the target group is the most challenging for all organizations because you have to have a good overview of your target group and you have to be able to find them and every time you have to have a fresh batch of target users because a low-literate person is not low-literate anymore after 3 test sessions. The positive is that you make them digitally proficient with test sessions and the disadvantage is that you cannot use the same people again". Their research group together with the library, developed a method for finding low-literate people when doing a project.

Teachers   This theme is concerned with the persons teaching and helping end users to be digitally skilled. According to (I1), there is a bottle neck when it comes to digital skills materials that stems from teachers and not from students. (I1) reports that "Teachers are not digitally proficient in any way and often keep participants away from materials that are available. In the meanwhile, basic skills modules have also been developed for teachers. The discussion is now about what knowledge a teacher must master so that they can effectively help the end users. (I2) also mentioned that they offer training to volunteers that are teaching end users. Furthermore, (I3) have their own way of teaching end users and states that "End users can even get help at home, one of our senior volunteers comes by for a small fee. Our volunteers are all seniors themselves, so they understand exactly where users run into problems". The courses they offer varies per lesson location and are also dependent on the volunteers what knowledge and expertise is available at a particular location.

Newsletters   This theme addresses the importance of newsletters by taking (I3) as an example who stated that "We have a lot of newsletters, which is also specific to

the target group because if you dont specifically point them out, then they often do not find it".

Other ways of working   In this theme all the alternative or peculiar ways of working will be addressed. (I4) makes course materials based on learning goals that have been published. They ensure that all learning outcomes are incorporated into the material. This way of working has its perks as some modules are reviewed by examination offices which they receive an approval certificate for. Furthermore, (I6) firmly believes in being open source. (I6) states that "If I put the technology in order for one municipality, the other 49 municipalities can participate at the same time. In this way, they can all exchange with each other and get better from it. Hence, the other municipalities can use it even though one municipality is the only that paid for it." Moreover, (I5) does not believe in scientific research but more in doing. (I5) states that "We really believe in practical work. We ask people, we do a lot of field research with people with a mental disability, or people who come to the food bank. We go into the neighborhoods and we interview the people there. You often come across more this way, than with all kinds of scientific research. The only thing is that it is very practical. You have to focus on the conversation and you have to make sure you ask open questions and you have to make people feel comfortable, so always bring food, a gift card, Chinese food, pizza ... you name it. These ingredients are much more important than any method or research".

Finally, (I3) incorporates a step-by-step method in all its materials. (I3) reports that "We have a step-by-step method especially in favor of the elderly, but that is also something that everyone likes, but with seniors it is explicitly important to have a step-by-step method". However, this way of working brings challenges relating to fragmentation and keeping information up-to-date and tailor-made for seniors to remain relevant. (I3) states that "If there is a deviation between the reality and the material, for example, if something has 4 steps instead of 3 or the button is in a different place or it has a different name. Well if you are a little younger, you will figure it out but a senior will think "I can't find it", so he/she quits".

Recommendations from service providers   Here below follows a summary of the recommendations given by the implementing organizations, about how to do Digital Development.

- There is never a wrong formula, as long as you are always testing with your users;

- Express things as clear and simple as possible for the end users;

- Make valuable data available to the world so everyone can learn from them; In this way, a network of people dealing with the same issues is created;

- Listen carefully to people and address the biggest problem first and quickly produce results;

- Quit producing scientific research but rather take action, since many reports are already written and screams bloody murder, however, if no one does anything then nothing will ever change.

The Government's role according to the service providers   A reccurring theme in the interviews with the practioners was the role of the Dutch government. This theme reports the different opinions and views the organizations mentioned.

- "Municipalities simply do not have enough money to allocate, they receive a huge number of tasks to deal with and they find it difficult to spend the money in a proper way".

- "The government does not have the Digital Divide high enough on their agenda, so within the Netherlands there is just not enough attention towards the issue".

- "The BZK does not always have the possibilities/opportunities and wants to leave as much as possible to the market".

- "The government should give less money to established institutions and more to small innovative companies that solve issues through practice. This is much more effective than, subsidising government-related parties that burn money without providing valuable output".

8.10   The nine Principles for Digital Development in practice

This research yielded new insights about the applicability of the nine Principles for Digital Development in practice and action.

The three principles which are "Design with the User", "Understand the Existing Ecosystem" and "Build for Sustainability" are considered the most important principles. "Design with the User" is considered very important among all the organizations, although they are not always actively working with their end users, as [I5] is. Some organizations have a very defined target group, which makes it possible to have already a process in place to fully commit to their target group without the need to always have the users to be part of every step of the design process. Furthermore, the organizations receive feedback on their materials on a regular basis from learning centres that directly work with the users. The context in the Netherlands facilitates this principle, in contrast to developing contexts in e.g. rural Africa [11].

"Understand the Existing Ecosystem" is very important in the context of the Netherlands, as technology emerges fast along with the digitization of government services and other sorts of online services. For any organization it is important to keep up while catering for its users and their respective needs.

The three principles: "Be Collaborative", "Reuse and Improve" and "Be Data Driven" were also considered important and indispensable by all the organization involved. however, the organizations declared not to be so keen on an open approach

Principle	Similarities	Differences	Constraints
Design with the User	Every organization is applying it except for (I6)	An organization such as (I5) is thoroughly applying it while others claim that it depends on the scenario	Very expensive & time consuming (I6)
Understand the Existing Ecosystem	Every organization deemed this principle as very relevant.	(I1) claims that its target group does not necessarily go along with every new technology and advancements.	New technologies emerge fast
Design for Scale	Every organization claims to have this principle adequately implemented	–	–
Build for Sustainability	All organizations have a form of income and their own way of keeping afloat.	All organizations have different ways of dealing with the principle such as licences or yearly subscriptions.	Difficulties finding funding
Be Data Driven	Every organization view it as indispensable and are applying it in some way	All the organizations have their own way of handling and utilizing data.	–
Use of Open Standards/Data	Most organizations are not applying this principle.	(I6) is major proponent of this principle and is the only organization applying it.	Not being able to be self-sufficient due to sharing information
Reuse and Improve	Every organization claimed that this principle is an essential principle that they are applying.	(I2) claims that they are not necessarily reusing but more improving.	
Address Privacy & Security	None of the organization indicated having difficulties with this principle and they all agree with being cautious with their users data.	–	–
Be Collaborative	Every organization interviewed sees the importance of being collaborative and are applying this principle.	(I4) is not profusely dealing with the principle as the other organizations are.	–

Table 8.5   Summary of the comparative assessment of the nine Principles, from the perspective of Dutch service providers.

which can help to increase collaboration. Still they do acknowledge the importance of collaboration (with each other).

As for "Reusing and Improving", the organizations all stated that it is a core part in developing their materials especially in the context of digital materials that are constantly changing.

"Be Data Driven" is mainly applied to inform decision making with regard to the materials developed. Most organizations are not actively using data. What they are currently doing on data collection is considered sufficient. That information drawn from raw data should be continuously validated.

Two principles: "Design for Scale" and "Address Privacy & Security were considered equaly important by all organizations interviewed. They reported not having difficulties with its implementation, as both principles are technology-related, and therefore not challenging in the Dutch context of the organizations involved. Whereas in the context of developing countries technology may not be readily available. "Design for Scale" was considered as something evident by the interviewees.

In essence, the organizations are not applying "Build for Sustainability" in the way it is intended to, which is with institutionalization as end-goal. Most organizations do not aspire to achieve this goal as they want to be able to make their own decisions at all times. (I2) is the only institution among the organizations. The organizations are all doing what they can do to keep their business running with some organizations even offering free access to materials, although it might be difficult sometimes to acquire funds.

One principle was regarded as less important by the organization that were interviewed: "Use Open Standards, Open Data, Open Source and Open Innovation". Most organizations are self-sufficient which results in the thought that they cannot adopt an open approach, otherwise they will lose income and cease to exist. The reason for which [I7] is in favor of an open approach may stem from its customers mainly belonging to the public sector and the fact that its service is not catered to developing materials as the other organizations are.

Table 8.6 presents a categorization of the principles according to the interviewees. As can be seen from Table 8.6, "Understand the Existing Ecosystem" belongs to the mostly important and challenging principles and "Design for Scale" to the least important and least challenging principles. Although the principle "Reuse and Improve" is indispensable and widely applied, it is not considered to belong to one of these categories.

8.11 Proposing another Principle for Digital Development: "Maintaining the User"

A notable outcome of the interviews is the opposing views when it comes to reaching the disadvantaged communities. On one hand some practitioners claim that reaching the disadvantage community is not a challenge while the government believes it is. In this case, following the recommendation of one of the practitioners expressing to stop pursuing scientific publications and to take action will likely help resolve this

Most challenging	Understand the Existing Ecosystem
	Build for Sustainability
Least challenging	Design for Scale
	Address Privacy Security
Most important	Design with the User
	Understand the Existing Ecosystem
	Be Collaborative
Least important	Design for Scale
	Be Data Driven
Mostly not applied	Use Open Standards, Open Data, Open Source and Open Innovation

Table 8.6   The Principles for Digital Development categorized.

issue, although it is time intensive. The government reported that determining who is not digitally skilled is one of the biggest challenges in bridging the digital divide. According to van Deursen (2018) the most valid research method to determine the level of digital skills are through performance measurements; this is inevitably time-consuming and costly [6].

Our government has the obligation to serve all citizens in this country. With the current pace of digitization, the digital divide is expected to expand in the near future, thus, spending a great deal of time on understanding the problem rather than actively taking action will not solve this issue since the unconnected groups are very heterogeneous can be found in all levels of the population. As the government also mentioned, most people are not even aware that they might not be digital skilled so the issue should firstly be tackled on a national level with campaigns and the promotion of training facilities where everyone is welcome. The insights from this initiative can be utilized as a means for figuring out more direct and effective approaches.

The issue of fragmentation should be addressed. A great deal of materials are being developed by diverse organizations and there is no overview of all the materials available in order to inform end users and to prevent duplicate efforts. This was suggested by the Senior Policy Officer for digital inclusion of the Ministry of the Interior to create a platform with the necessary information. However, the proper manner how this should come about is unclear. A first step should be taken in developing such platform and afterwards in looking at the technicalities of competition. Setting up something such as the Good Things Foundation [13] where everyone effectively collaborates together with the one main goal in mind of bridging the digital divide seems promising. The government has to engage organizations to participate in such initiatives by stressing the importance and providing the appropriate resources.

In order to effectively reach and serve end users in this context, face-to-face guidance, teachers and newsletters are essential. As end-users often have difficulties

finding what they are looking for online, newsletters are a convenient way to help keeping them informed. In this particular context teachers should be digitally proficient and continuously being updated, to not inhibit end-users who may be already confused.

It can be concluded that all principles are being applied by the practitioners except for "Use Open Standards", "Open Data", "Open Source" and "Open Innovation", thus the manner in which the practitioners view these principles is as quite relevant and important. Additionally, most principles are realistic to implement as well, except for aforementioned principle which stems of the self-sufficiency approach most practitioners take when applying Build for Sustainability. The Principles for Digital Development definitely ensures successful outcomes, however, in the Netherlands organizations are already actively applying them, with some principles such as Design for Scale and Address Privacy & Security not even being challenges due to the self-evident nature of the principles. Thus, in this case the extent to which the principles lead to more successful outcomes cannot be concluded.

However, there are very important principles such as Design with the User, Understand the Existing Ecosystem and Be Collaborative which ensures project success. Finally, applying the principles cannot be deemed effortless since Understanding the Existing Ecosystem and Building for Sustainability are still considered challenging.

From our further findings we conclude that there should be a principle in place that deals with the users *after* development as well. Thus, not solely Designing with the Users, however, also *Maintaining the Users*. This will enable organizations to further extent their users commitments and the sustainability of their service by not only designing something catered to their needs but also ensuring they know how to fully and properly utilize the solution. Similar to the service providers in the Netherlands, "Maintaining the User" should take a long-term approach.

8.12 Conclusion

In this chapter we have assessed the usefulness and applicability of the nine Principles for Digital Development in the Dutch context of service providers and implementing organizations. It can be concluded that the organizations are applying the majority of principles and consider them as essential to project success. The difference between the organizations lies in the extent to which a principle is viewed as important and whether a principle is seen as a challenge.

Based on the (pattern) analysis of the qualitative data and the ongoing discussions, we propose a new principle to the Principles for Digital Development: "Maintaining the User". This principle is concerned with an ongoing long-term relationship, after the development process, assisting them with navigating and understanding the service developed, to further ensure user commitment and sustainability of the service.

To bridge the digital divide at the national level, the problem of *who* is digitally skilled and *how* to reach them, should be better understood, for which more effective action research is needed. Additionally, the issue of fragmentation of efforts needs to be addressed and prevented. Organizations should work more closely together and

the government should continue pursuing the alliance between public and private sectors.

This study has limitations in size and time frame: only six organizations have been consulted, over a period of several months. Extending this research to a wider circle of organizations in the field of digital develoment could provide more detailed understanding. Despite the limited scale, this research makes clear the importance of having the Principles for Digital Development, as this assessment brings insights into the current practices, the commonalities and different approaches. Moreover, it creates a common language about shared concepts among all stakeholders. In the future, studying the application of the Principles for Digital Development in other contexts (e.g. urban vs. rural contexts or low resource contexts vs. poverty enclaves in wealthy regions) could increase knowledge, necessary to inform policy and practice how to effectively serve and include disadvantage communities.

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AFTERWORD

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As this book has shown, vulnerable groups such as homeless people, poor migrants, low-literates, or people with limited digital skills, often grapple with the complexities of a rapidly digitizing and changing society. Digital inclusion in society is severely lacking for many people, even while living in an urban context in one of the wealthy and best connected nations of the world.

The digital divide in urban environments is a multi-faceted problem. To grasp its complexity multiple perspectives are needed. Knowledge from domain experts — such as representatives of the end-users target groups — is indispensable. We involved people from different backgrounds and knowledge domains (academics and non-academics) to work with us and explore solutions. In this trans-disciplinary Participatory Action Research setting, the research goal is not just to *analyze* the problems, but also to collaboratively *seek for solutions* in practice.

It is encouraging to see that it is possible to reach the target groups, talk with them about daily problems, collaborate in digital development and co-create innovative solutions. Many people from the target groups have shown their interest in participating in this. Stakeholder organizations have been very supportive.

It is furthermore encouraging that, despite clear limitations in time and scope, the student projects have shown that even small efforts, in relatively limited timeframes (of a few weeks or months), can lead to valuable insights how to digitally support and serve the various target groups.

The studies also confirm that a flexible, iterative and adaptive, approach is needed in digital development. It is not possible to predict things in advance. Multiple cycles of designing and prototype testing are needed, not only to get the user interface right (a common, but way too narrow technical view), but even in defining the project goals themselves — which we would say reflects the proper meaning of the (too) often used terms *participatory* and *co-creation*. The developer may have pre-existing ideas and theories on what might be useful for the user group, but this is often unfounded and must always be discussed and investigated first.

To facilitate communication and understanding between people from highly diverse backgrounds and cultures, a methodology for digital development has been employed named ICT4D 3.0 (briefly described in Chapter 3). This methodology covers the full lifecycle of information systems development and puts special emphasis on context analysis and associated user-centered needs assessment. ICT4D 3.0 was designed to guide digital development in low-resource environments (such as rural Africa or Asia) but it has proven useful also for digital development in a technologically 'advanced' urban context such as Amsterdam. ICT4D 3.0 facilitates and structures the process of digital development for digital inclusion.

What has appeared most challenging in digital development, is (i) to build for *sustainability* and (ii) maintain contact with the user group over time. Since student research projects with a limited time frame of six months cannot achieve or guarantee long-term sustainability, support is indispensable from other stakeholders, with *long-term commitment* to the target groups.

The cases presented in this book do not claim to be business mature deployments of digital solutions. They are small pilot projects with a view to improve a real world situation with a simple sociotechnical solution. Still, the overall study presented in this book is inspired by the idea of addressing big societal challenges through trans-disciplinary, real world research and education. This study aligns well with the Sustainable Development Goal SDG 10: reduce inequality and empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status.

The less privileged groups in focus are, due to a low status and limited purchasing power, generally not the most interesting market segment for commercial service providers. A recommendation for the supporting donor agencies — in casu the national government and municipalities in the Netherlands who strive for inclusion of disadvantaged groups — is to enable long-lasting projects, support, and commitment. Supporting organizations, e.g. universities that foster community service learning as a form of socially engaged education, must act for impact. One cannot expect quick wins from isolated actions for digital inclusion. Community service learning is more than just a proof of concept and requires institutional strategy, responsibility and commitment.

Despite all difficulties encountered, we have attempted to treat the end-users as first class citizens and experts in their respective domains, so as to learn how digital development for digital inclusion can be done in the context of an urban digital divide. We hope that these efforts can be continued and that (the reason for this book) the acquired knowledge is disseminated, shared, re-used and adapted for further digital and social inclusion, to the benefit of the least connected citizens.

ABOUT THE AUTHORS

Anna Bon is a lecturer, researcher and international consultant, specialized in Information and Communication Technologies for Development. She works at the Centre for International Cooperation of the Vrije Universiteit Amsterdam and for the Network Institute and the Computer Science Department. From 2006 to 2020 she managed international projects of socio-technical innovation in close collaboration with universities in Africa, Asia and Latin America. She has designed and coordinated an international master course in community service learning and ICT for a mixed classroom of students from Malaysia and the Netherlands in 2018 and 2019. In 2018 Anna initiated the Amsterdam Digital Divide student project and supervised the master research of the five Information Science students.

Derek van den Nieuwenhuijzen is co-editor of this book. He did this research project as part of his master in Information Sciences at Vrije Universiteit Amsterdam, where he graduated in October 2019. For his master thesis he designed a virtual agent to make online government forms easier for low literate people. Derek is interested in making valuable IT solutions for social and business contexts. Next to his affinity with IT, Derek has a business minded view that he developed during his bachelor international business at Maastricht University. By combining these two perspectives he thinks he can make the most impact.

Hans Akkermans is full professor (emeritus) of Business Informatics at Vrije Universiteit Amsterdam and Founding Director of its interdisciplinary Network Institute (www.networkinstitute.org). He is an initiator of the W4RA research and education program, the Web alliance for Regreening in Africa (w4ra.org). The mission of W4RA is to support farmer-led regreening activities in the Sahel by developing new (ICT) means for information, communication and knowledge sharing for rural development. He is also one of the conveners of the Vienna Manifesto on Digital Humanism (www.informatik.tuwien.ac.at/dighum/) published in 2019.

Wouter de Boer is an MSc graduate in Information Science from the Vrije Universiteit Amsterdam. His bachelor program was in Artificial Intelligence, at the Rijksuniversiteit Groningen. During his master research he was part of the research group "Digital Divide", supervised by Anna Bon. By focusing on migrants, he tried to find real-world solutions for people that have difficulty in connecting to the digital society. By making use of simple smartphone applications he tried to increase the comprehensibility of letters that citizens receive from the municipality or other institutions.

Carlbandro Edoga holds a bachelors degree in computer science from the Goethe University Frankfurt (GER) in Germany and a masters degree in Information Sciences from the Vrije Universiteit Amsterdam, in the Netherlands. In the course of both his academic and his professional career he focuses on the analysis and visualization of large amounts of data. He is equally experienced in the technical realization especially in the field of Machine Learning (Natural Language Processing) and the subsequent functional interpretation. For his master thesis, which was supervised by Anna Bon from the research group "Digital Divide", he created an application that automatically provides homeless people in Amsterdam with the most crucial information including on where to find shelter, food banks or medical aid.

Marc Hegeman is a MSc graduate from Vrije Universiteit Amsterdam in Information Sciences. For his thesis he was part of a research team investigating how to bridge the digital gap between the Municipality and the citizens of Amsterdam. His research focused on the group of homeless people who find it difficult to get valuable information online. He has investigated how an application could help to bridge the digital information gap for homeless people, how such kind of application could work and delivered a working prototype for it.

Mickaela Wedervoort studied at RMIT University in Melbourne, Australia and moved to Amsterdam where she studied Information Science at Vrije Universiteit Amsterdam and carried out an internship at the Centre for Advanced Studies of IBM in Amsterdam. In 2019 she received her master degree in Information Science. Her master research focused on the question of applicability of the Principles for Digital Development in the digital divide context of the Netherlands. Currently she works as an ICT policy advisor at the Openbaar Lichaam, Bonaire.

Nicole Sylvia Goedhart   MSc. is a PhD candidate and lecturer at the Athena Institute for Research on Innovation and Communication in Health and Life Sciences, of the Faculty of Science, Vrije Universiteit Amsterdam. Her research focuses on the inclusion of citizens in vulnerable circumstances in research and policymaking. She is mainly involved in projects concerning the digital divide. By applying participatory methods, she explores the perspectives, experiences, and needs of disadvantaged groups with respect to ICT.

Christine Dedding   Christine Dedding is Associate Professor at the Department of Medical Humanities at the Amsterdam UMC, location VU University Medical Center. Her background is in anthropology. She is specialized in Participatory Action Research with people living in vulnerable circumstances. She has developed multiple arts-based methodologies in order to gain an in-depth understanding of what counts as meaningful in the lives of people. As action researcher, she is committed to the development of innovations with an impact on science and society.

AD VALVAS

ONAFHANKELIJK PLATFORM VAN DE VRIJE UNIVERSITEIT AMSTERDAM

Maatschappij 26 juni 2019

Studenten maken app voor daklozen

Bandro Edoga en Marc Hegeman bij de maaltijdvoorziening voor daklozen van Sant Egidio

Het team van de Amsterdam Digital Divide afstudeerprojecten; (vlnr) Bandro Edoga, Marc Hegeman, Wouter de Boer, Anna Bon (supervisor), en Mickaela Wedervoort

Op basis van de Amsterdam Digital Divide afstudeerprojecten wordt op 7 februari 2020 een boek gelanceerd: **Digital Divide, Citizenship, and Inclusion in Amsterdam**

W4RA

https://w4ra.org

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Daklozen hebben vaak wel een smartphone, maar ze gebruiken hem niet optimaal. Ook is relevante informatie voor hen soms moeilijk te vinden. Daarom ontwikkelden studenten informatiewetenschappen Marc Hegeman en Bandro Edoga een app voor daklozen.

Wat zijn eigenlijk de vragen die een dakloze heeft? Om dat te weten te komen, hielpen Hegeman en Edoga een paar keer mee bij Sant Egidio, een liefdadigheidsorganisatie die op dinsdagavond in de Mozes en Aäronkerk aan het Waterlooplein een gratis maaltijd serveert aan daklozen, vluchtelingen en eenzamen.

Het afstudeerproject van Hegeman, Bandro en een aantal andere studenten gaat over de digitale tweedeling: hoe bereik je mensen die zichzelf niet kunnen redden in de digitale wereld? Ouderen bijvoorbeeld en laaggeletterden. Voor hen is het een probleem dat tegenwoordig bijna alles digitaal gaat en dat ook de overheid, verzekeraars en banken in toenemende mate van hun klanten verwachten dat ze digitaal vaardig zijn. Studenten informatiewetenschappen bedenken in dit vak oplossingen om het leven van digibeten gemakkelijker te maken. Dit jaar waren voor het eerst ook daklozen opgenomen als doelgroep.

Vaak dezelfde vragen

"Bij Sant Egidio krijgen ze een driegangenmaaltijd, verzorgd door een cateraar", vertelt Hegeman. Het idee is dat de mensen die niet meetellen in de maatschappij nu eens worden bediend. Die bediening gebeurt door vrijwilligers en daarbij hielpen Hegeman en Edoga om een beter beeld te krijgen van hun doelgroep.

Bij die maaltijden praatten ze met de daklozen en met de vrijwilligers. "Van mensen die daar als vrijwilliger werken hoorden we dat ze vaak dezelfde vragen krijgen: weet je een plek waar ik vanavond kan slapen? Waar kan ik op de andere dagen van de week gratis eten krijgen?"

Ongeveer de helft van de daklozen heeft een smartphone

Uit de gesprekken met daklozen bleek onder meer dat ze weliswaar niet allemaal een smartphone hebben, maar dat ze zich vaak in een groep bevinden waarin in elk geval wel één persoon een smartphone heeft. "Uit Amerikaans onderzoek blijkt dat ongeveer de helft van de daklozen een smartphone heeft. In Nederland is er geen onderzoek naar gedaan, maar ik denk dat het aandeel vergelijkbaar is", vertelt Edoga.

Chinees, Pools en Arabisch

Op basis van de gesprekken ontwierpen Edoga en Hegeman een app waarin de relevante informatie voor daklozen op een rijtje staat: plekken om te slapen, plekken waar ze kunnen douchen, gratis internet, plekken waar ze kunnen eten, voedselbanken en medische voorzieningen waar daklozen welkom zijn. Hegeman ontwierp de app en Edoga zorgde dat de programmering aan de achterkant werkt. Omdat hulporganisaties het vaak druk hebben, bedacht Edoga een systeem dat organisaties niet actief hoeven bij te houden. De app haalt gegevens van internet op basis van allerlei zoekwoorden.

De gemeente Amsterdam kijkt belangstellend toe

Een app waarin je precies kunt zien in welke opvang vanavond nog plek is, is het dus (nog) niet. Een feedbackformulier is er al wel, op termijn wil Edoga daar een echt rating systeem van maken, waarin daklozen hun waardering voor de voorzieningen kunnen geven. Omdat Edoga en Hegeman constateerden dat veel daklozen weinig Nederlands spreken, is de app ook in het Spaans, het Engels, het Russisch, het Arabisch, Chinees, Poos, Frans en Duits te raadplegen.

Hegeman maakte drie verschillende ontwerpen en testte die op daklozen en koos toen voor een ontwerp met heldere, simpele iconen. De gemeente Amsterdam kijkt belangstellend toe naar het project: ook zij heeft moeite deze doelgroep te bereiken. "We willen nogmaals met de gemeente in gesprek om van deze app de gemeentelijke app te maken", vertelt Hegeman.

Andere steden

Ook hebben ze plannen om de app te exporteren naar andere steden: "Het maakt niet zoveel uit of je deze app in Utrecht, of Moskou zou willen lanceren. Ik heb het zo geprogrammeerd dat met Google Translate de relevante informatie ook in andere steden zo te vinden is", besluit Edoga.

De app die nog geen naam heeft, is te gebruiken via: app.digitize.amsterdam.

WELMOED VISSER

Figure 9.1   Reprinted and adapted from Ad Valvas, 26 June 2019, interview by Welmoed Visser.

The Digital Divide is commonly associated with those parts of the world where access to Internet and Web is poor or lacking. However, even in places such as the city of Amsterdam, where Internet infrastructure and access are commonplace, a Digital Divide exists. A significant part of the population (1 out of 5) is currently de facto excluded, for a variety of reasons including poverty, low literacy, lack of digital skills, problems with speaking and reading the official language (Amsterdam, a city of under 1 million, hosts 180 different nationalities), and homelessness. This book is based on several community- oriented Participatory Action Research projects by Information Science master students and staff at the Vrije Universiteit Amsterdam. It considers in depth the Digital Divide in an advanced metropolitan context and, even more importantly, lays out practical ways and solutions showing what can be done against digital inequalities and social exclusion in society --- one of the UN's Sustainable Development Goals (SDGs).

De Digitale Kloof wordt vaak geassocieerd met die delen van de wereld waar toegang tot Internet en Web slecht is of zelfs geheel ontbreekt. Maar ook daar waar Internet infrastructuur en toegang wijd verbreid zijn zoals in Amsterdam, blijkt er een Digitale Kloof te bestaan. Maar liefst 1 op de 5 inwoners is praktisch gesproken niet in staat gebruik te maken van Internet. Dit als gevolg van armoede, dakloosheid, laag-geletterdheid, problemen met spreken en lezen van officieel Nederlands (Amsterdam herbergt maar liefst 180 verschillende nationaliteiten), of gebrek aan digitale vaardigheden. Dit boek is het resultaat van een aantal Action Research afstudeerprojecten door Information Science master studenten en stafleden van de Vrije Universiteit Amsterdam, uitgevoerd in directe samenwerking met locale communities. Het geeft een beeld van de Digitale Kloof in een geavanceerde metropool-context, maar belangrijker nog, het laat zien wat er praktisch aan gedaan kan worden door oplossingen die beogen digitale ongelijkheden en sociale uitsluiting in onze maatschappij tegen te gaan --- één van de Sustainable Development Goals (SDGs) van de Verenigde Naties

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