Bachelor's Thesis Computing Science

Radboud University Nijmegen

The Acceptance of Digital ID Software among Dutch Elderly Citizens

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June 24, 2022

Abstract

The first decades of the 21st century came with an increased focus on digital privacy. As a result of this, various platforms started incorporating stricter guidelines with regards to password strength and authentication measures. Among these was the incorporation of digital ID software, which allows users to use a single account to sign in to various platforms, such as taxes, pension funds, and healthcare services.

It is well-established that these measures lead to improved security and privacy. However, some of these new measures may prove difficult to use for elderly citizens. This study aims to determine what factors influence the acceptance of digital ID software.

To answer the research question, a questionnaire was distributed. Respondents were queried for their perception of various factors related to digital ID software. These factors were taken from the well-established Technology Acceptance Model 3.

The results showed that Perceived Usefulness, Perceived Ease of Use, and Perception of External Control had the most impact on acceptance, while Social Norm and Output Quality were shown to be the least relevant.

These results suggest that, in general, Perceived Ease of Use (and the factors that contribute to it) were dominant with regards to the acceptance of digital ID software.

Contents

Chapter 1

Introduction

1.1 Introduction

The second decade of the 21st century came with increasing focus and awareness related to password security. As a response to this, many organizations implemented extra levels of security such as Two-Factor-Authentication (2FA). For the same reason, the Dutch government introduced DigiD. DigiD is a Digital ID platform where Dutch citizens can use one single account for authentication related to various services. Examples of these services are educational institutes, pension funds, student loans, and healthcare institutions. By using a single platform for authentication across all services, the Dutch government can more easily regulate and implement security protocols.
From the previous description, it follows clearly that DigiD is ingrained in the lives of Dutch citizens. As such, adoption of DigiD for some platforms (such as tax returns) should be near 100%. A recent report by the Dutch government shows that the number of existing DigiD accounts exceeds the number of Dutch citizens.[1][1] Clearly, adoption of DigiD is at an advanced stage. However, the increasing reliance on DigiD for authentication can prove to be problematic for vulnerable groups such as those with lower level of technical literacy. If these groups (such as elderly citizens) struggle with authentication for platforms such as healthcare, that is a problem. This is why it is important to determine the factors that influence adoption of DigiD, both positively and negatively.

[1]This number can exceed the number of Dutch citizens due to three main reasons. Firstly, accounts belonging to deceased citizens are not deleted until three years after being used for the last time. Secondly, some citizens forgot their authentication information and got a second account issued. Lastly, Dutch citizens that emigrated from the Netherlands continue to have a DigiD account.

1.2 Research question

The present research seeks to answer the following research question:
What are the main factors that affect acceptance of digital ID software among Dutch citizens over the age of 60 in 2022?
Following from this query, the main focus of this research is to investigate the dominant factors that influence willingness among elderly citizens to accept digital identity software. To analyze these factors, the TAM (Technology Acceptance Model) will be applied. Data will be obtained through a questionnaire.
There has been ample prior research in this field, demonstrating the validity and applicability of the TAM in comparable situations. Examples of previously examined fields are Password manager software[2], Telemedicine services[3], cloud computing[4], or even biological crop protection[5]. Additionally, the usage of TAM to model acceptance of technology for specifically elderly subjects has also been verified.[6] A further elaboration on the technology acceptance models is provided in 2. Building on this base of prior research, this study seeks to provide insightful results, firstly for governments trying to implement future technological advances in the Digital ID department. If incorporated, these insights would then result in more easily acceptable software from the perspective of elderly citizens.
The remainder of this paper is structured as follows. First, chapter 2 discusses the various versions of TAM and which model would be best suited for the purpose of the present research. Consequently, the methodology, results, and discussion are discussed in chapter 3. chapter 4 discusses a number of other approaches to the problem of technology acceptance, alongside the underlying literature and similar research projects. Finally, chapter 5 both provides a retrospective view on the paper and discusses future recommendations and possibilities.

Chapter 2

Preliminaries

The acceptance of new technology has been widely researched and various frameworks have been suggested for this purpose. Of these various frameworks, the Technology Acceptance Model [7] is among the most commonly used[8]. This model has been repeatedly tested and verified [9] and will help us reach scientifically valid results.

Which of the versions of TAM was to be applied during the present research was an important decision, based on the relevance of each of the included factors. Intuitively, the most comprehensive model would seem to generate the best results. However, including factors that provide less significance might complicate the model without providing any benefits, so the relevance of the factors has to be analyzed.

2.1 A comparison of Technology Acceptance Models

As a means of finding the model best suited for the present research, we look at the factors that each of the models analyses. For each of these factors, we will then determine whether they are relevant or suitable for the context of elderly people and digital ID software.

2.1.1 TAM

The relationship between the factors defined in the original Technology Acceptance Model [7] is shown in figure 2.1.

The TAM models the use and acceptance of technology by looking at two main factors: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). Perceived Usefulness was defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance". Perceived Ease of Use was defined as "the degree to which

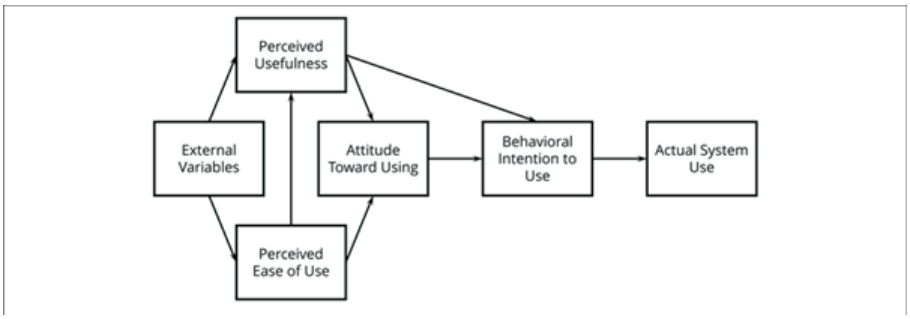

Figure 2.1: The original TAM

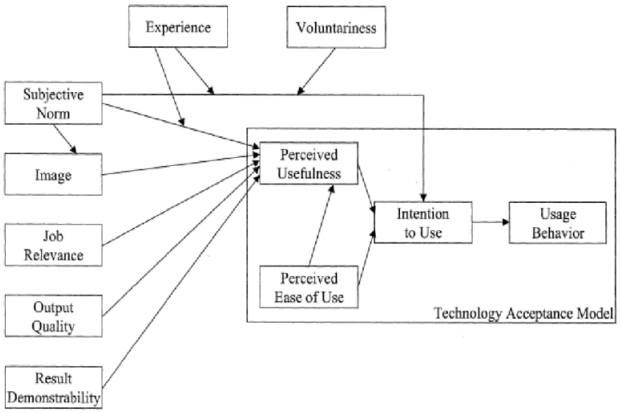

Figure 2.2: TAM2

a person believes that using a particular system would be free of effort". For this study, the definition of PU has to be adjusted because the use case here does not relate to job performance. Instead, a more suitable definition would be "the degree to which a person believes that using a particular system would enhance his or her ability to accomplish a task"
Clearly, we can apply these factors to the context of elderly people and digital ID software. PU concerns itself with the extent to which elderly citizens expect digiD to enhance their ability to interact with the platforms that incorporate digiD. As for PEOU, the aforementioned definition can be rephrased as "The degree to which elderly citizens believe that using digiD would be free of effort."

2.1.2 TAM2

TAM2[10] includes external social factors such as voluntariness and image, and cognitive instrumental processes such as job relevance and output quality. The relationship between these factors is shown in figure 2.2.

1. Social Influence Processes
    (a) Subjective norm
    (b) Voluntariness
    (c) Image
2. Cognitive instrumental Processes
    (a) Job relevance
    (b) Output quality
    (c) Result demonstrability
    (d) Perceived ease of use

TAM2 seeks to expand upon the first TAM by expanding upon the factors that constitute perceived usefulness. The first way in which it does so is by looking at *social influences*. The first factor in this category is *subjective norm*. Subjective norm is defined as a "person's perception that most people who are important to him think he should or should not perform the behavior in question" [10]. We can apply this definition to our context. Previous research[11] has included subjective norm as a direct determinant of behavior intention. This also holds for the elderly citizens in question: they might favor the acceptance of digital ID software more if people they perceive as important do so. A second factor that plays a significant role in TAM2 is *voluntariness*. Hartwick and Barki[12] found that subjective norm had a significant effect on intention to accept new technology in mandatory setting but not in voluntary setting. TAM2 defines voluntariness as "the extent to which potential adopters perceive the adoption decision to be non-mandatory." The last social influence process is *image*. Defined as "the degree to which use of an innovation is perceived to enhance one's ... status in one's social system." The definition of image can be applied to our context without needing adjustment.

TAM2 also incorporates *Cognitive Instrumental Processes*. The first of these is *job relevance*. Job relevance is defined by Venkatesh and Davis as "an individual's perception regarding the degree to which the target system is applicable to his or her job." Clearly, this definition is difficult to apply to our context in its given form. After all, the present research does not focus on technology related to the workplace. Previous research has resolved similar conflicts by redefining job relevance as "an individual's perception regarding the degree to which the target technology is applicable to his or her task or job." [13] A similar approach could be applied in the present research. For the purpose of this thesis, Job Relevance was defined in a similar way. The second cognitive instrumental process is *output quality*. It is described in TAM2 as "how well the system performs those tasks". This

definition poses no difficulty in being applied to our context. Output quality is followed by *result demonstrability*: "the tangibility of the results of using the innovation." For the sake of clarity, this definition is supplemented with the explanation that individuals can be expected to form more positive perceptions of the usefulness of a system if the co-variation between usage and positive results is readily discernible. Finally, TAM2 considers Perceived Ease of Use among the cognitive instrumental processes. This definition remains unchanged.

2.1.3 TAM3

TAM3[14] builds upon TAM2 and includes factors such as Computer Self-efficacy, perception of external control, and perceived enjoyment. These factors were originally proposed by Venkatesh[15]. TAM3 proposes a combination of the original TAM, TAM2 and Venkatesh' additions. Additionally, new relations were also formed between dependent factors. Examples of this are Perceived Ease of Use and Perceived Usefulness each being dependent upon multiple other factors. Added factors:

1. Computer Self-efficacy
2. Perception of External Control
3. Computer Anxiety
4. Computer Playfulness
5. Perceived Enjoyment
6. Objective Usability

The relation between these factors is shown in figure 2.3.

The first factor TAM3 discusses is Computer Self-Efficacy. Defined as "The degree to which an individual believes that he or she has the ability to perform a specific task/job using the computer"[16]. This factor is particularly relevant for the present research, given the sample population consists of elderly citizens that are more likely to face difficulties with modern ITs. Next is *perception of external control*. Venkatesh and Bala define this as "The degree to which an individual believes that organizational and technical resources exist to support the use of the system"[17]. To measure this, attention should be paid both to the actual existence of supportive resources and the awareness of these resources among the target population. Perception of external control is followed by *computer anxiety*: "The degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers"[15] and *computer playfulness*: "...the degree of cognitive spontaneity in microcomputer interactions"[18]. The final two

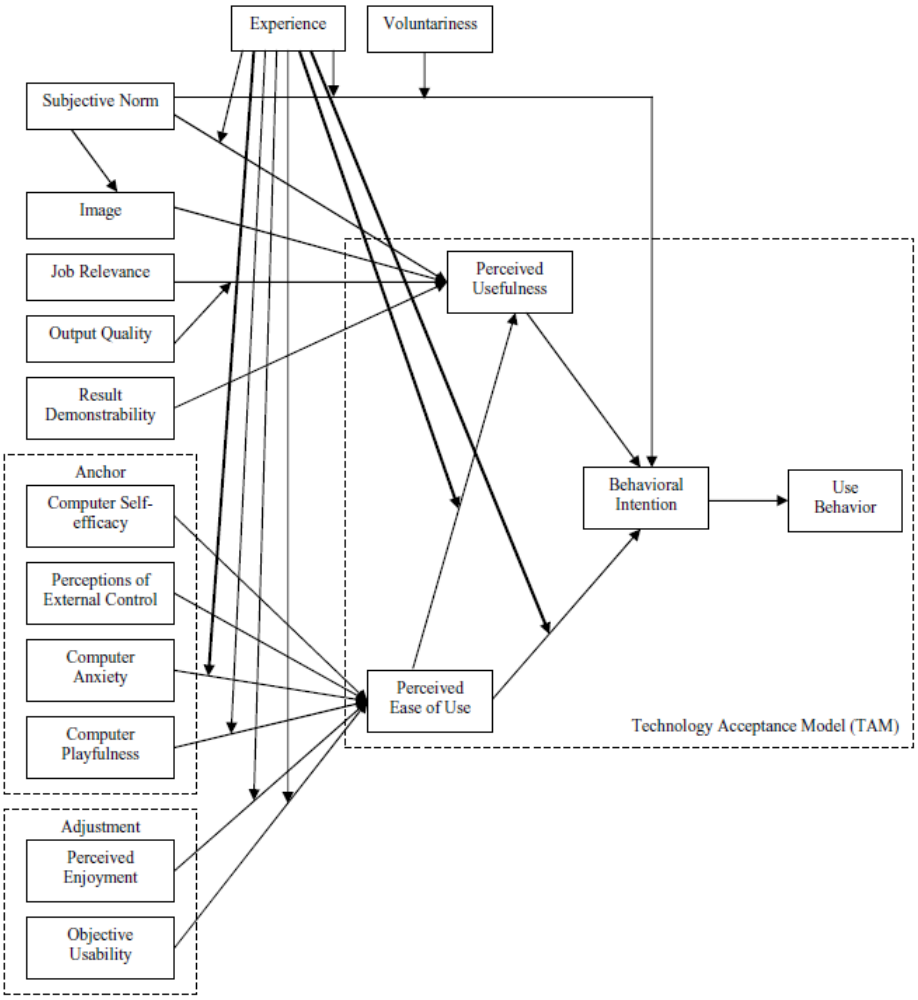

Figure 2.3: TAM3[14]

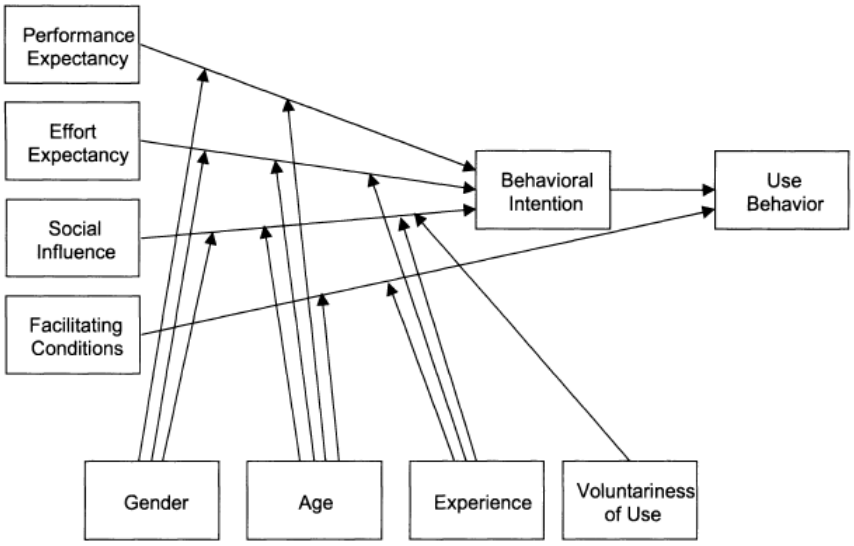

Figure 2.4: UTAUT[17]

considered factors are *perceived enjoyment* and *objective usability*. The former is defined as "The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use."[15]. The latter is defined as "A comparison of systems based on the actual level (rather than perceptions) of effort required to completing specific tasks."[15].

2.1.4 UTAUT

A brief explanation of the relation between the concepts in UTAUT will also be provided.

As shown in 2.4, UTAUT bases itself on four main constructs: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. The effect these conditions have on Behavioral Intention is also influenced by Gender, Age, Experience, and Voluntariness of Use.
While these last four mediating factors are obvious, a definition for the first four factors is useful. Performance Expectancy is defined in UTAUT as "the degree to which an individual believes that using the system will help him or her attain gains in job performance."[17] The effect this has on Behavioral Intention is influenced by Age and Gender. Effort Expectancy is defined as "the degree of ease associated with the use of the system." Aside from Age and Gender, its effect on Behavioral Intention is also influenced by Experience. Following this, UTAUT defines Social Influence as "the degree to which an individual perceives that important others believe he or she should use the new system." Its effects are related to all four factors (Gender, Age,

Experience, Voluntariness of Use). Lastly, Facilitating Conditions is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system." Here, the relation between is not drawn towards Behavioral Intention. Instead, Facilitating Conditions is theorized to directly influence Use Behavior. There is noteworthy similarity between the factors of TAM and those defined in UTAUT. Performance Expectancy is similar to Perceived Usefulness as defined in TAM. Similarly, Effort Expectancy resembles Perceived Ease of Use. Social Influence in UTAUT is closely related to Social Norm in TAM, and finally Facilitating Conditions is similar to TAM's Perception of External Control.
Applying UTAUT to the context of this study would require slightly modifying the definition of Performance Expectancy. Similar to how certain factors were adjusted in the three TAM models, any definition that relates to 'job performance' is not suitable for this research and will therefore be redefined with a more task-oriented view. In the case of Performance Expectancy, we redefine it as "the degree to which an individual believes that using the system will help him or her accomplish a task." With this modification in place, UTAUT is now a suitable model to be used in the present research. However, all of the factors covered in UTAUT are also covered in TAM3, even if there are subtle differences in their definitions. Additionally, TAM3 does consider factors that UTAUT does not. Consequently, TAM3 remains the most comprehensive model and thus the most suitable for the present research.

2.1.5 Two Factor Authentication

In order to properly reason about the implications surrounding Two Factor Authentication, it is important we establish a clear understanding of what exactly this entails. When we refer to Two Factor Authentication (or Multi Factor Authentication(MFA)) we consider an electronic authentication method that requires the user to pass multiple 'checks' to verify their identity. Typically this is separated into something you *know*, something you *have*, and something you *are*. Adding these extra requirements reduces the chances for a malicious user to get access to your account. In the context of digital ID software, we will cover the Dutch implementation. You can sign in using the mobile application, a SMS-verification, using your username and password, or by providing your ID or passport. Logging in with your username and password does not fall under MFA and most platforms that let users log in with digital ID software do not accept this. It is worth noting that the security gained from using MFA has been scrutinized or even proved to be lacking in certain situations[19].

2.1.6 Concluding

As we have seen, TAM2 and TAM3 build upon the previous versions by including more factors or adjusting the relations between each of these factors. It is apparent that TAM3 provides the most comprehensive framework in terms of analysing different factors. We previously posited that this does not automatically make it the best framework for the present research, given that some factors might be hard to apply to our context. As a result of this, the model could become more complicated without the additional factors providing useful insights. To prevent this, we provided a brief analysis of each of the factors and whether or not it would be possible to apply these to the context of elderly citizens using digital ID software.
TAM provided the most simplistic view of technology acceptance by only looking at Perceived Usefulness and Perceived Ease of Use. This would be easy to apply but, as has been previously explored in other research, may very well overlook relevant factors. TAM2 sought to prevent this with the addition of Social Influence Processes and Cognitive Instrumental Processes. Each of these factors was analysed and we concluded that *job relevance* would have to be redefined to better suit our purposes. Additional factors were incorporated in TAM3, leading to the most extensive model. The analysis of these factors did not uncover any potential difficulties. Lastly, UTAUT considers four factors that showed notable significance to the factors analysed in TAM3. However, it is a less comprehensive model than TAM3.
All things considered, we can conclude that TAM3 would be the best model for the present research. It is the most comprehensive model and each factor can be matched well with our context.

Chapter 3

Research

3.1 Methodology

3.1.1 Sampling Method

The sampling was carried out using snowball sampling. An initial pool of respondents was gathered through speaking to relatives. Consequently, each of the resulting respondents was asked to spread the survey to other candidates. To qualify for the survey, a respondent had to be at least 60 years old. No additional requirements were posed, since no other requirements would help in getting a realistic and unbiased sample.

3.1.2 Questionnaire

The questionnaire consists of two parts. The first part concerns itself mostly with demographic information about the respondent (age, education, gender, access to internet, etc.). The second part of the questionnaire contains questions related to various factors of the research model (Perceived Ease of Use, Perceived Usefulness, Perception of External Control, etc.) mapped on a 5-point Likert scale where (1) represents 'Strongly disagree' and (5) represents 'Strongly agree'. Doing a full pilot version of this questionnaire would be beyond the scope of this research. However, it is essential to guarantee the questionnaire is understandable and provides the desired results. Hence, multiple trial versions of questionnaire were administered prior to the distribution of the final version. These trial runs resulted in different phrasings for certain questions and other questions were removed entirely because they simply could not be matched to the context of the present research.

Explanation

It is essential to provide a clear clarification of how the questionnaire translates to the factors to be analysed. Additionally, some factors proved either

Construct	Definition
Perceived Usefulness	PU1: Using digital ID software makes it easier to sign in to healthcare services.
Subjective Norm	SN1: People that I frequently interact with encourage me to use digital ID software. SN2: My family encourages me to use digital ID software.
Voluntariness	V1: Using digital ID software is a voluntary choice I make. V2: I have alternatives to using digital ID software.
Image	IMG1: Using digital ID software allows me to better participate in society.
Job relevance	JR1: The use of digital ID software is relevant to the tasks I need to complete.
Output quality	OQ1: I often experience technical issues when using digital ID software.
Result demonstrability	RD1: I can clearly identity that using digital ID software enhances my ability to sign in to multiple platforms.
Perceived ease of use	PEOU1: Using digital ID software to sign in is easy for me. PEOU2: I would find it easy to explain how to use digital ID software to someone else.
Computer self-efficacy	CSE1: I consider myself capable of using a computer.
Perception of external control	PEC1: When I run in to difficulties, I believe there are organisational and technical resources to help me using digital ID software.
Computer anxiety & Computer playfulness	CAP1: I enjoy using a computer.
Perceived enjoyment	PE1: I consider using digital ID software fun.

Table 3.1: TAM constructs and their respective questions.

difficult to apply to the given context or otherwise difficult to be answered by the target audience. Consequently, notable adjustments will be explained. The full list of constructs and questions is given in Table 3.1.
Firstly, the original intention was to provide multiple questions for each construct. However, after having translated the questions from English to Dutch and having adjusted the wording to be comprehensible for the elderly sample population, it became apparent that there was too much overlap amongst the questions. Thus, only Subjective Norm, Voluntariness, and Perceived Ease of Use have multiple questions. Additionally, the questions for Computer Anxiety and Computer Playfulness were combined due to their inverse relationship in terminology. As such, a strong positive score with regards to Computer Playfulness indicated a strong negative score for Computer Anxiety. Objective Usability was not included in this research because no suitable questions could be phrased for the given context. Finally, the construct Image was originally paired with questions regarding prestige and whether or not the use of digital ID software was perceived as a status symbol. Seeing how digital ID software is government-issued and essentially obligatory, this question was adjusted.
From the initial demographic information, only one of the questions warrants any further explanation. When the respondent is asked "Do you ever log in with digital ID software yourself?" they get the options 'Yes', 'No', or 'I do not know what digital ID software is.' Any respondents that select the last option are excluded from the study. However, even if these respondents are not included in the final analysis, their answer still provides useful insights with regards to the current degree of DigiD acceptance.

3.2 Results

3.2.1 Demographics

Out of 41 distributed questionnaires, 6 fell outside of the required age group. Out of the remaining 35 respondents, 3 respondents did not use Digital ID software themselves. As such, they were not asked to answer the following questions in the questionnaire.

The demographic results of the questionnaire are summarized in Table 3.2.1. As shown, the set of respondents does show bias in fields such as age and ethnicity. This bias can be explained by the sampling method. Snowball Sampling is prone to resulting in bias [20].
As shown in Table 3.2.1, the majority of participants (57.1%) were female. A significant majority of respondents fell within the age range of 60 to 65 years old.

Variable	Frequency	Percentage
Age		
60-65	19	54.3%
66-70	4	11.4%
71-75	4	11.4%
76-80	2	5.7%
Older than 81	6	17.1%
Gender		
Male	14	40%
Female	20	57.1%
Prefer not to disclose	1	2.9%
Background		
Dutch	34	97.1%
Western migration	1	2.9%
Qualifications		
High school	17	48.6%
University*	13	37.1%
Doctorate	5	14.3%
Access to internet**		
Mobile phone	32	91.4%
Computer	28	80%
Tablet	26	74.3%
Other	1	2.9%

Table 3.2: Demographic information
*'University' here also includes University of Applied Sciences.
**Multiple answers allowed.*

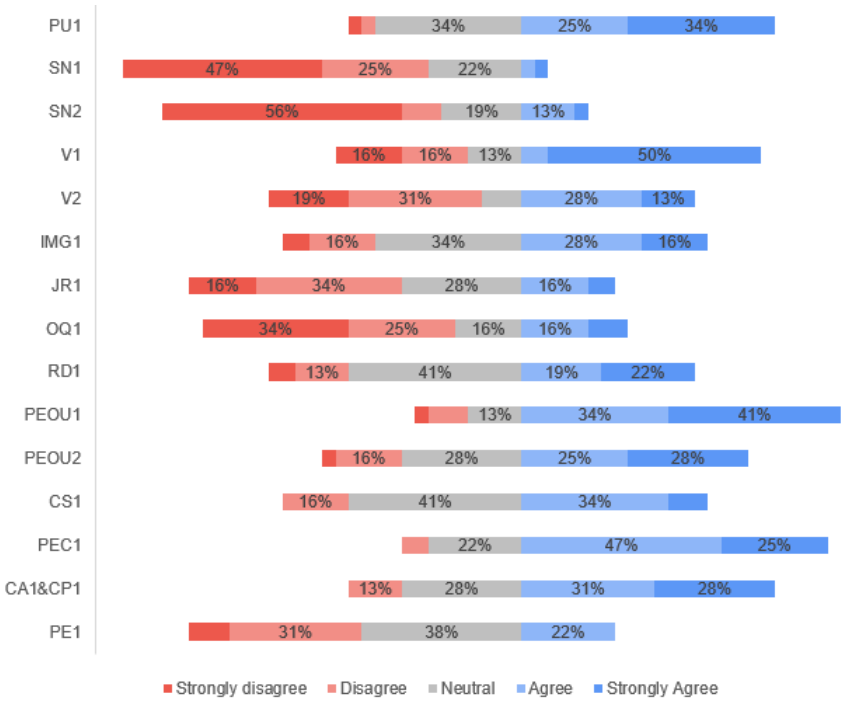

Figure 3.1: Diverging stacked bar chart portraying survey responses.

3.2.2 Results

An overview of the results of the survey can be seen in 3.1. For readability, some numbers were not included in the graph. For the purpose of this research, the most interesting results are those with the largest portion of 'Strongly (dis)agree'. As such, the results will be discussed in a fitting order. A sorted version of the figure is provided in A.1. As for disagrees, there are three main questions that stand out:

1. SN1
2. SN2
3. OQ1

Aside from these, there are also those factors that do not necessarily have the largest percentage of 'Strongly disagree', but do score high in the sum of 'Strongly disagree' and 'Disagree'.

1. JR1
2. PE1
3. V2

With regards to agrees, the following factors stand out as having the largest percentage of 'Strongly agree':

1. V1
2. PEOU1
3. PU1

Finally, the factors below show a notable sum of 'Strongly agree' and 'Agree':

1. PEC1
2. CA1&CP1
3. PEOU2

Relating the aforementioned numbers to the factors of TAM3, it is evident that Social Norm (SN1 and SN2) and Output Quality (OQ1) show significant signs of having little to no impact on the acceptation of Digital ID software. The opposite can be said for Perceived Ease of Use (PEOU1 and PEOU2), Perceived Usefulness (PU1), and Perception of external control (PEC1). It should be noted that attempting to draw significant conclusions from factors with a single question is less conclusive than factors with multiple questions.
Finally, coming back to the original research question *What are the main factors that affect acceptance of digital ID software among Dutch citizens over the age of 60 in 2022?* We see that the factors with the highest associated scores are Perceived Ease of Use, Perceived Usefulness, and Perception of External Control. The implications of this will be discussed in the following section.

3.3 Discussion

As we have seen in the previous section, the factors with the *largest* impact on the acceptance of Digital ID software are Perceived Ease of Use, Perceived Usefulness, and Perception of External Control. The factors with the *smallest* impact are Social Norm and Output quality.
When we look at the factors with the largest impact, Perceived Ease of Use and Perceived Usefulness were expected to score high. Intuitively speaking, it is not surprising that software should be both useful and easy to use in order to reach high acceptance. However, Perception of External Control was a less obvious contender for the most influential factors.
For clarity, now would be a good time to reiterate the definition of Perception of External Control. In chapter 2, this was defined as "The degree

to which an individual believes that organizational and technical resources exist to support the use of the system."[17] A possible explanation for this could be that this research concerns itself with an elderly population. The elderly population is less experienced with digital systems and lack skills to deal with them.[21] As a result of this, they can experience less confidence when using technology[22] (such as digital ID software.) This could explain why the presence of supporting resources has a more significant influence on elderly citizens.
Another interesting perspective can be found by looking at the original TAM 3 model in figure 2.3, and considering the score by which each factor affected acceptance. In the figure, we see that Perceived Usefulness and Perceived Ease of Use are dependent variables. Perceived Usefulness is dependent on Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability. Perceived Ease of Use is dependent on Computer Self-efficacy, Perception of External Control, Computer Anxiety, Computer Playfulness, and Perceived Enjoyment. A table illustrating the scores can be found in A. From this table, we can see that the factors influencing Perceived Usefulness score an average of 14.3% spread across 'Agree' and 'Strongly agree'. For the factors influencing Perceived Ease of Use, these factors average 24.5%.
Both this and the higher individual scores for Perceived Usefulness and Perceived Ease of Use (29.5% and 32%, respectively) seem to indicate that the ease of use of digital ID software had a more significant impact in this research. A possible explanation for this is the fact that the usefulness of digital ID software is determined. It's required for the specific purpose of authenticating users for a variety of essential platforms. Consequentially, the ease with which it helps you accomplish these tasks is the determining factor.

3.3.1 Limitations

Multiple decisions were made throughout the duration of this study that were largely influenced by the scope and limitations of a bachelor thesis. These can be separated across two main areas: the sampling of respondents for the survey and the analysis of the resulting data.

Sampling

The chosen method of sampling for this research was Snowball Sampling[23]. This resulted in both a pool of respondents that was both relatively small and biased. Future research could avoid this by choosing a different sampling method. Two methods that were considered were visiting elderly homes and contacting organisations that represent the elderly. Both of these methods

could potentially generate a larger and less biased sample pool. The reason neither of these methods was deployed for the present research is the limited scope.

Survey

With regards to the survey, the decision was made to restrict most factors to a single question. This decision was made because, aside from a select few factors, the questions were simply too similar and would have made the survey feel more convoluted. This could be resolved by either dedicating more time to designing the survey and phrasing the questions properly, or making sure that a researcher is present to help administer the survey and avoid a situation where two similar questions confuse the respondent.

Analysis

Various forms of statistical analysis were considered, such as Cronbach's Alpha, Chi-square or T-test. However, the limited number of questions and respondents meant that these methods would be significantly limited in the adequacy of their outcomes. This also limited the way factors were scored in A.

Chapter 4

Related Work

4.1 Approaches to technology acceptance

There are multiple well-established models that measure or predict technology acceptance. Among these are the three TAM models (TAM, TAM2, TAM3), the Unified Theory of Acceptance and Use of Technology (UTAUT), and other approaches such as drivers and barriers. All of these have been successfully applied in research. UTAUT was used, for example, to analyse technology acceptance in online learning platforms[24], Early Warning Systems (EWS)[25], and mobile data users[26]. The majority of technology acceptance research was done using the different TAM models. Examples of previously examined fields are telemedicine services[3] (TAM), mobile phone cameras[13] (TAM2), and Cloud Computing Technology[4] (TAM3). It is worth mentioning that these models have also successfully been applied to elderly citizens.[27][28][6][29]

4.2 Knowledge gap

There is a gap in the current body of research with regards to digital ID software. Some tangentially related research[30] can be found, but further research into the acceptance of digital ID software is certainly required. The present research seeks to provide the first steps in resolving this gap in the knowledge base.

Chapter 5

Conclusions

5.1 Concluding

Digital ID software offers great potential benefits. It facilitates better security, reduces the number of required accounts, and provides a secure link between various platforms. However, the required understanding and skills are not a given in less digitally skilled demographics such as elderly citizens. This can result in reduced acceptance of digital ID software among elderly citizens, which may result in them being excluded from necessary services and data.
The present research sought to identify which factors had the largest impact on the acceptance of digital ID software. To evaluate this, a questionnaire was constructed based on Venkatesh and Bala's TAM3 (Technology Acceptance Model 3). This model can be used to provide helpful insights with regards to the acceptance of new ITs. Alternatively, other considered models for this research would have been TAM, TAM2, and UTAUT. An evaluation of these models showed that TAM was limited in the factors it considered. This has also been noted previously in literature.[31] Similarly, UTAUT and TAM2 provided less comprehensive views of the present research than TAM3. As such, TAM3 was chosen to be the most fitting model. Respondents for the questionnaire were gathered through Snowball Sampling. 41 respondents were gathered, of which 35 fell within the required age constraints. The responses showed that the main factors affecting the acceptance of digital ID software are Perceived Ease of Use, Perceived Usefulness, and Perception of External Control. Consequently, it was argued that the perhaps unexpected high score for Perception of External Control could be explained by the relative lack of IT-related experience in elderly citizens. This research adds to the present knowledge body by providing insights into the perception of elderly citizens with regards to upcoming software. This is particularly relevant in the times of the grey digital divide.

5.2 Recommendations

5.2.1 Future research

As mentioned before, further research in this field is necessary. This thesis provided an initial exploration and an indication of the lack of related research. Future research may improve upon this by including a larger pool of respondents or a more elaborate analysis of the data. Suggestions for this are mentioned in 3.3.1. Additionally, it would be interesting to see if an application of the UTAUT model or drivers and barriers would result in different factors. Finally, it is worth doing a more qualitative study in this field to discover if there are any factors beyond TAM3 that impact acceptance.

5.2.2 Application

The present research provided an initial exploration of which factors were perceived by elderly citizens to be the most relevant for their acceptance of digital ID software. It is suggested to take these factors and enter into a dialogue with the elderly citizens that struggle to adapt to digital ID software. This can hopefully help in getting towards complete acceptance, benefiting both the government and the citizens.

Bibliography

[1] Monitor digitale overheid 2021, 2021.

[2] Hassan Jamil, Tanveer Zia, and Tahmid Nayeem. User acceptance of password manager software: Evidence from australian microbusinesses. *Journal of Information Security and Cybercrimes Research*, 4:148–158, 12 2021.

[3] Syeda Ayesha Kamal, Muhammad Shafiq, and Priyanka Kakria. Investigating acceptance of telemedicine services through an extended technology acceptance model (tam). *Technology in Society*, 60:101212, 02 2020.

[4] Esra Cengiz and Hülya Bakırtaş. Technology acceptance model 3 in understanding employee's cloud computing technology. *Global Business Review*, page 097215092095717, 11 2020.

[5] Mohammad Sharif Sharifzadeh, Christos A. Damalas, Gholamhossein Abdollahzadeh, and Hossein Ahmadi-Gorgi. Predicting adoption of biological control among iranian rice farmers: An application of the extended technology acceptance model (tam2). *Crop Protection*, 96:88–96, 06 2017.

[6] Hacer Guner and Cengiz Acarturk. The use and acceptance of ict by senior citizens: a comparison of technology acceptance model (tam) for elderly and young adults. *Universal Access in the Information Society*, 19(2):311–330, 2020.

[7] Fred Davis. Perceived usefulness, perceived ease of use, and user acceptance of information technology on jstor. *Jstor.org*, 13:319–40, 1989.

[8] Mahammad Kayali and Saad Alaaraj. Adoption of cloud based e-learning in developing countries: A combination of doi, tam and utaut. *International Journal of Contemporary Management and information Technology*, 1, 11 2020.

[9] Lemuria Carter and France Bélanger. The utilization of e-government services: citizen trust, innovation and acceptance factors. *Information Systems Journal*, 15:5–25, 01 2005.

[10] Viswanath Venkatesh and Fred Davis. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46:169–332, 02 2000.

[11] M. Fishbein and Icek Ajzen. *Belief, attitude, intention and behaviour: An introduction to theory and research*, volume 27. 05 1975.

[12] John Hartwick and Henri Barki. Explaining the role of user participation in information system use. *Management Science*, 40(4):440–465, 1994.

[13] Kamel Rouibah. *Intention to Use Camera Mobile Phone before e-shopping in the Arab World: Test of the Applicability of TAM 2 Quality for Customer Satisfaction View Project Factors Affecting Switching Behavior in Mobile Services Providers.* 2009.

[14] Viswanath Venkatesh and Hillol Bala. Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39:273–315, 05 2008.

[15] Viswanath Venkatesh. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11(4):342–365, 2000.

[16] Deborah R. Compeau and Christopher A. Higgins. Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19(2):189–211, 1995.

[17] V. Venkatesh, M. Morris, G. Davis, and F. Davis. User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27:425, 2003.

[18] Jane Webster and Joseph J. Martocchio. Microcomputer playfulness: Development of a measure with workplace implications. *MIS Quarterly*, 16(2):204, 1992.

[19] Alexandra Dmitrienko, Christopher Liebchen, Christian Rossow, and Ahmad-Reza Sadeghi. On the (in) security of mobile two-factor authentication. In *International Conference on Financial Cryptography and Data Security*, pages 365–383. Springer, 2014.

[20] Charlie Parker, Sam Scott, and Alistair Geddes. Snowball sampling. *SAGE research methods foundations*, 2019.

[21] Alexander van Deursen. Digitale ongelijkheid in nederland anno 2018, 11 2018.

[22] Jennifer L. Dyck and Janan Al-Awar Smither. Age differences in computer anxiety: The role of computer experience, gender and education. *Journal of Educational Computing Research*, 10(3):239–248, 1994.

[23] L.A. Goodman. *Snowball Sampling. The Annals of Mathematical Statistics.* 1961.

[24] Hsiao-Hui Hsu. The acceptance of moodle: An empirical study based on utaut. *Creative Education*, 3:44, 2012.

[25] Juliana E. Raffaghelli, M. Elena Rodríguez, Ana-Elena Guerrero-Roldán, and David Bañeres. Applying the utaut model to explain the students' acceptance of an early warning system in higher education. *Computers & Education*, 182:104468, 2022.

[26] Yu-Lung Wu, Yu-Hui Tao, and Pei-Chi Yang. Using utaut to explore the behavior of 3g mobile communication users. In *2007 IEEE international conference on industrial engineering and engineering management*, pages 199–203. IEEE, 2007.

[27] Rakibul Hoque and Golam Sorwar. Understanding factors influencing the adoption of mhealth by the elderly: An extension of the utaut model. *International Journal of Medical Informatics*, 101:75–84, 2017.

[28] Chih-Kuang Chen, Tsai-Hsuan Tsai, Yin-Chou Lin, Chung-Chih Lin, Su-Chu Hsu, Chia-Ying Chung, Yu-Cheng Pei, and Alice MK Wong. Acceptance of different design exergames in elders. *PloS one*, 13(7):e0200185, 2018.

[29] Tero Kivimäki, Petra Kölndorfer, Antti-Matti Vainio, Harri Pensas, Timo Vuorela, Markus Garschall, and Jukka Vanhala. User interface for social networking application for the elderly. PETRA '13, New York, NY, USA, 2013. Association for Computing Machinery.

[30] Erico Darmawan and Sulaeman Santoso. Development and evaluation of digital id card as a portfolio portal. *IJNMT (International Journal of New Media Technology)*, 5(2):83–89, Mar. 2019.

[31] Rudy Hirschheim. Introduction to the special issue on" quo vadis tam-issues and reflections on technology acceptance research". *Journal of the Association for Information Systems*, 8(4):9, 2007.

Appendix A

Appendix

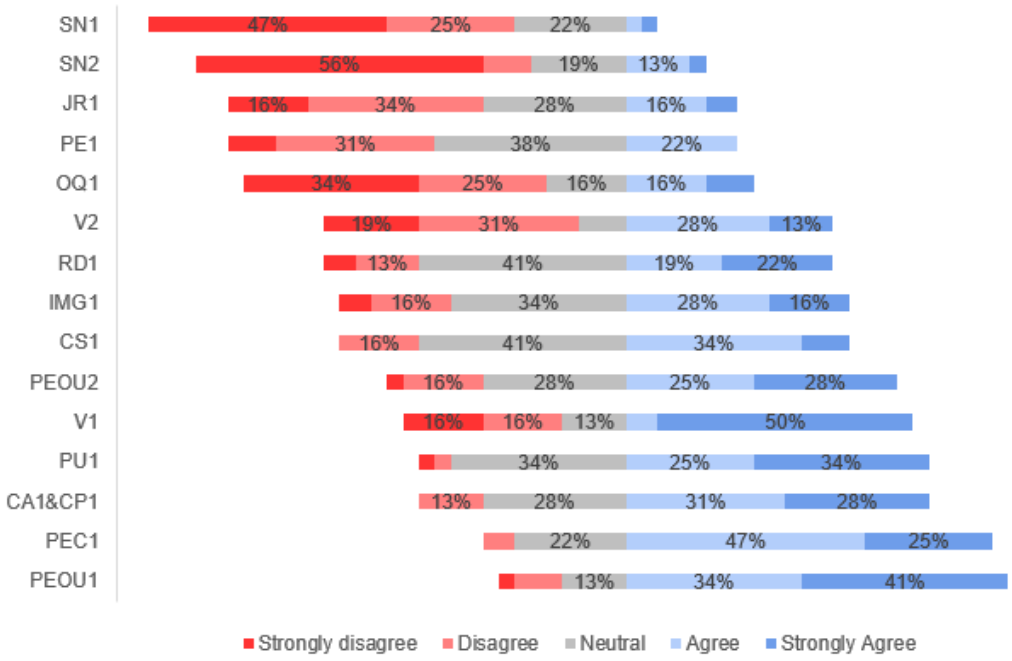

Figure A.1: Diverging stacked bar chart portraying survey responses.

Construct	**Score***
Perceived Usefulness	**29.5%**
Subjective Norm	5.5%
Image	22%
Job Relevance	11%
Output Quality	12.5%
Result Demonstrability	20.5%
Perceived Ease of Use	**32%**
Computer Self-efficacy	21.5%
Perception of External Control	36%
Computer Anxiety	6.5%
Computer Playfulness	29.5%
Perceived Enjoyment	11%

Table A.1: Scores for each factor
**Score is the average of percentages in 'Agree' and 'Strongly agree'*