Understanding e-health adoption costs in a Dutch nursing and homecare organization

A case study investigating adoption of a Smart Glass in wound care

Lisanne A.C.P. Nuijen

Radboud Universiteit Nijmegen

Understanding e-health adoption costs in a Dutch nursing and homecare organization: a case study investigating adoption of a Smart Glass in wound care.

Master thesis

Science, Management & Innovation master specialisation

Faculty of Science, Radboud University Nijmegen

Name	Lisanne Anna Cornelia Petronella Nuijen
Discipline	Medical Biology
Host organization	Q-Consult Zorg
Start Date	01 February 2021
Presentation Date	13 August 2021
Academic year	2020 – 2021
University coach	Dr. Ir. C.L. Barzola Iza
Host organization coaches	Drs. Ing. B.H. Mulder & Dr. J.F. de Visser-Velu
Reader	Dr. F. Kruse
This thesis is confidential?	~~Yes~~/No

Preface & Acknowledgements

Hereby I present my thesis "Understanding E-health Adoption Costs in a Dutch Nursing and Homecare Organization", a qualitative research studying factors influencing the adoption of a Smart Glass together with identifying and estimating (hidden) cost drivers involved in this adoption process. This research was conducted from February to August 2021 to meet the Science, Management and Innovation graduation requirements at the Radboud University Nijmegen. During this project I learned much about e-health adoption and how to conduct qualitative research. In addition, I was given the opportunity for self-development and to discover other interests as well.

This research project was commissioned by Q-Consult Zorg where I was doing an internship under great supervision. Henry, it was a pleasure working with you. Your enthusiasm, creativity and don't forget your broad knowledge on this topic was really catching and most of all very helpful. Juliëtte, whenever I got lost in all the provided ideas and thoughts you helped me to focus and to get me back on track. Your motivation, drive and passion inspired me much throughout this project.

I also wish to thank my university supervisor Carlos Barzola for his inspiring thoughts and academic advice. Furthermore, I would also like to thank all the respondents for their enthusiasm and openness. Without their cooperation I would not have been able to conduct this research.

Many thanks to all the colleagues of Q-Consult Zorg which I can't thank individually. It was amazing that you all freed time for me to bat ideas, to discuss different ways of analysis and to provide me from inspiring feedback. I am very grateful for the opportunities Q-Consult Zorg has provided me throughout this project.

I hope you enjoy reading my thesis!

Lisanne Nuijen

Nijmegen, July 27, 2021

Abstract

Different forms of e-health are currently in development that could be a solution for keeping the Dutch healthcare system sustainable. Main problem is that many healthcare organizations fail in successful e-health adoption. This study aims to understand factors influencing successful adoption of a Smart Glass in a Dutch nursing and homecare organization together with identifying and estimating (hidden) cost drivers involved in this adoption process. A conceptual model is proposed combining the extended Unified Theory of Acceptance and Use of Technology (UTAUT2), Technological-Organizational-Environmental (TOE) and Knowledge Management (KM) framework. Cost drivers were identified by using Time Driven Activity Based Costing (TDABC). Data was collected using semi-structured interviews (n=10) and analysed using a thematic content analysis showing that there is a complex interplay between individual- and organizational factors that influences successful e-health adoption. Main cost drivers in this project were personnel costs (43%) of which 19% were hidden costs: unidentified project costs. Of the time that should have been spent on care, 3,4% was spent on adoption of the Smart Glass resulting in reduced productivity and increased workloads of healthcare workers. Overall, successful adoption of e-health is a complex and dynamic process between individual and organizational factors that involves mainly time investments of personnel. Mapping how e-health adoption affects productivity and workloads is required for e-health adoption to succeed. Furthermore, this study suggests the implementation of new technologies one by one or when e-health is implemented in parallel to schedule dedicated time per employee for the adoption process.

Key words: e-health – adoption – individual- and organizational factors - costs drivers – Smart Glass - nursing and homecare - Netherlands

Lists of abbreviations

BI	Behaviour Intention
DOI	Diffusion of Innovation
EE	Effort Expectancy
FC	Facilitating Conditions
GDP	Gross Domestic Product
GP	General Practitioner
ICT	Information and Communication Technologies
IT	Information Technology
IoT	Internet of Things
KM	Knowledge Management
Min Ez	Ministry of Economic Affairs (in Dutch: Ministerie van Economische Zaken)
MM	Motivational Model
MPCU	Model of PC Utilization
PE	Performance Expectancy
RC	Root Construct
RVO	Netherlands Enterprise Agency (in Dutch: Rijksdienst voor Ondernemend Nederland)
SCT	Social Cognitive Theory
SDG	Sustainable Development Goals
SI	Social Influence
TAM	Technology Acceptance Model
TAM-TPB	Model combining TAM & TPB
TDABC	Time Driven Activity Based Costing
TOE	Technology, Organization, Environment
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology
VVT	Nursing and homecare organization (in Dutch: Verpleeg- en Verzorgingshuizen en Thuiszorg)

Used Figures and Tables

Table of Contents

1. Introduction

1.1 Topic & General Problem

Healthcare systems worldwide face challenges to maintain high-quality, efficient and safe healthcare (1). Currently there is a rising development and diffusion of health technology. Besides, there is an increasing demand and use of services due to an aging population and increased numbers of chronic patients. Furthermore, unhealthy lifestyles, higher expectations of patients and low efficiency of healthcare models are all causing a rise in healthcare expenditures (2). These health expenses are rising more than countries' gross domestic product (GDP) (2, 3). On the one hand, the economic sustainability of health systems is questioned. On the other hand, the Sustainable Development Goals (SDGs) aim for health improvement to achieve a more sustainable future (4). Possible solutions are therefore suggested to focus on health improvements while reducing health expenditures (3).

Since 2000, these issues started to gain importance in The Netherlands as well because the GDP share of health expenditures grew in only a couple years by nearly 2%. This trend continued even further and in 2010 health expenditures were already 10% of the GDP (3, 5). Two main factors that contribute to these rising expenditures are on the one hand the technological progression of better diagnostics and on the other hand the ageing population (6, 7). Apart from that, increasing numbers of chronic illness patients and shortage of medical professionals have resulted in an increased workload (8, 9) causing lower job satisfaction (10), higher absenteeism (11), worsened job outcomes (12) and higher intensions to leave (13). If these problems will not be addressed, the prospective is that expenditures will rise to 22-31% of the Dutch GDP in 2040 (14). Besides, in order to meet the demands in the healthcare system, 25% of the Dutch working population needs to be employed in this sector (15) whereas a shortage of medical personal is already an existing issue (8).

In order to address these issues, long term efforts towards a sustainable Dutch healthcare system are present (14). The Dutch health system has undergone many large and small reforms on all levels of the system aiming to constrain expenditures. In 2006, a single

healthcare insurance scheme was introduced to manage competition. This reform aimed for more efficiency, reducing central governance and improving access to healthcare with acceptable costs. Nevertheless, this reform did not contribute to sustainable cost-containment (16). After the financial crisis in 2008 this became an even more urgent problem. Consensus-based arrangements with organizations of providers, insurers and patients resulted in a slower growth of expenditures (16). However, focus in the purchasing process is mostly on price and volume, not on the quality of the care. Another reform was implemented in 2014, shifting mental healthcare from secondary care into the primary care. As for other reforms, this one also did not result in lower healthcare costs (16). Most of the implemented reforms did not result in stopping the increase in expenditures. In cases where growth of expenditures was slowing down, the quality of care was compromised.

Since possible solutions for the ever-increasing healthcare expenditures require a focus on being cost-efficient while remaining high quality of care, E-health could be a potential solution for these requirements (15, 17, 18). Benefits of implementing e-health are automation of business functions (19), public health surveillance (20) and an increase in accessibility of patient care and data (21). E-health supposedly improves selfcare, self-management and patient participation in healthcare systems (22). Whereas e-health seems a nice solution, recent studies show that e-health is still not adopted well in the Dutch healthcare system (15, 23).

One requirement for using e-health properly and efficiently is that healthcare workers need digital skills. Based on research, 49% of the Dutch healthcare workers do not have enough digital skills to perform their job (24), resulting in less job satisfaction and higher workloads (25). The adoption process also depends on the type of e-health being implemented. E-health implementation in healthcare happens in multiple forms, from applications (26) to cloud services (27) or Internet of Things (IoT). IoT encompasses physical objects with intelligence that are connected to the internet allowing for communication between humans or other devices (28, 29). An example of the implementation of IoT in healthcare is using a Smart Glass in clinical and surgical applications (30). Utilizations of the Smart Glass nowadays extends also to nursing and homecare organizations for wound care. Normally, a wound expert visits the organization once a week to assess the progression of wound healing and to initiate follow-up

treatments where necessary such as visiting a hospital or even hospitalization. With the use of the Smart Glass, care can be provided remotely. Nurses will be wearing the Smart Glass that has a build-in camera. Via an application on their mobile phone or tablet they can contact the wound expert remotely. Together they can make a wound assessment based on this video call. Using the Smart Glass aims for the following results: reducing workload and making care more efficient while remaining high quality of care.

These adoption problems are not only present in healthcare systems, this also is the case in the economic sector. Here, adoption of technology systems into enterprises requires mindful management, planning, execution and budgeting of the project (31). Costs are often overrun during the adoption process and therefore budgeting and cost estimation is required for successful adoption (31). These cost estimations are also important in the healthcare sector. Adoption of e-health depends on demographic characteristics (32), technological context (27), organizational- (33-35) and environmental factors (27, 36). For effective adoption, active coordination and participation of all stakeholders is required (37) including changes and learning at both micro-level (patients and medical professionals) as well as meso-level (healthcare organizations) (38). High investment costs for the adoption of e-health include investments in the technology itself as well as the costs for educating employers and the time investment to implement the e-health to the customer or patient (15, 33, 39). Technology costs are often relatively easy to identify. However, in the adoption process there are often also hidden costs such as time investments for education and training together with time spending on familiarizing themselves with the new technology. Both, running costs and hidden costs, need to be identified early on in the adoption process to prevent adoption failure (40). As the necessity for cost estimation is clear, it seems that not all healthcare workers get specific dedicated time for this adoption process and therefore contribute to the development of hidden costs.

This project aims to understand and identify factors influencing successful e-health adoption together with costs involved in the adoption of e-health in a Dutch nursing and homecare organization. At the moment of writing, this organization is in the middle of the adoption process of using a Smart Glass in their wound care.

1.2 Problem definition

Sustainability of the Dutch healthcare is under attack due to increasing health expenditures. Despite multiple reforms of the Dutch health system, health expenditures are still rising. A promising solution could be the use of e-health improving efficiency and quality of care while reducing healthcare expenditures. Even though e-health might be available for use, adoption of e-health in most healthcare organizations seem to be low. Successful adoption of new technologies in the health sector is influenced by different demographic-, technological-, organizational- and environmental factors. These factors may entail cost drivers. Some of these cost drivers are relatively easy to identify, whereas there are also hidden costs during the adoption process. Currently, the total costs of e-health adoption are often unknown and there is a need to identify, map and estimate all the cost drivers for e-health adoption. More understanding of these cost drivers could increase the success rate of adoption, resulting in reduced workloads of medical personnel, higher job satisfaction, higher quality of care and could be a promising step towards a solution for the increasing healthcare expenditures.

2. Goal & Research Questions

2.1 Goals

The goal of this research is to identify, estimate and understand cost drivers involved in e-health adoption focusing on a case study in a Dutch nursing and homecare organization from February 2021 until August 2021. Identification and understanding of costs involved in adoption of e-health is important to increase the success rate of e-health adoption aiming to reduce workloads of nurses that consequently could lead to higher job satisfaction. More successful e-health adoption may eventually contribute towards a solution for the increasing healthcare expenditures.

2.2 Research Questions

Based on the goal of this project the main objective of this project is to understand factors and cost drivers that influence successful adoption of e-health in a nursing- and homecare organization in the Netherlands. Achieving these goals will in this study be done by answering the following research question:

"*How is successful adoption of a Smart Glass technology influenced in a nursing and homecare organization in the Netherlands?"*

- Which individual and organizational factors influence successful adoption of a Smart Glass in a Dutch nursing and homecare organization?
- Which stakeholders are involved in the adoption of a Smart Glass in a Dutch nursing and homecare organization and how do they influence factors of successful adoption?
- What are major (hidden) cost drivers for the adoption of a Smart Glass in a Dutch nursing and homecare organization?
- To what extend does time spent on adoption of a Smart Glass affect the normal operations in a Dutch nursing and homecare organization?

3. Theoretical framework

This section seeks to provide an understanding of the principles used in the area of acceptance, usage and adoption of e-health. As there are multiple definitions of e-health, this study defines e-health as "the use of emergent information and communication technologies (ICT) to improve health and healthcare in terms of operational efficiency and quality" (15). E-health adoption is in this project defined as the internalization, acceptance and incorporation of e-health into every day practice (15). Given the fact that much has been published about the adoption of new innovations, most studies focus on understanding which factors influence successful adoption. However, these studies often lack a link to the total costs associated with these adoption factors. Unexpected higher costs associated with the adoption process often result in failure of adoption (31). Cost drivers are therefore an important factor for successful adoption and therefore this study focuses on understanding, mapping and estimating these cost drivers better. An overview of the theoretical framework is visualized in Figure 1.

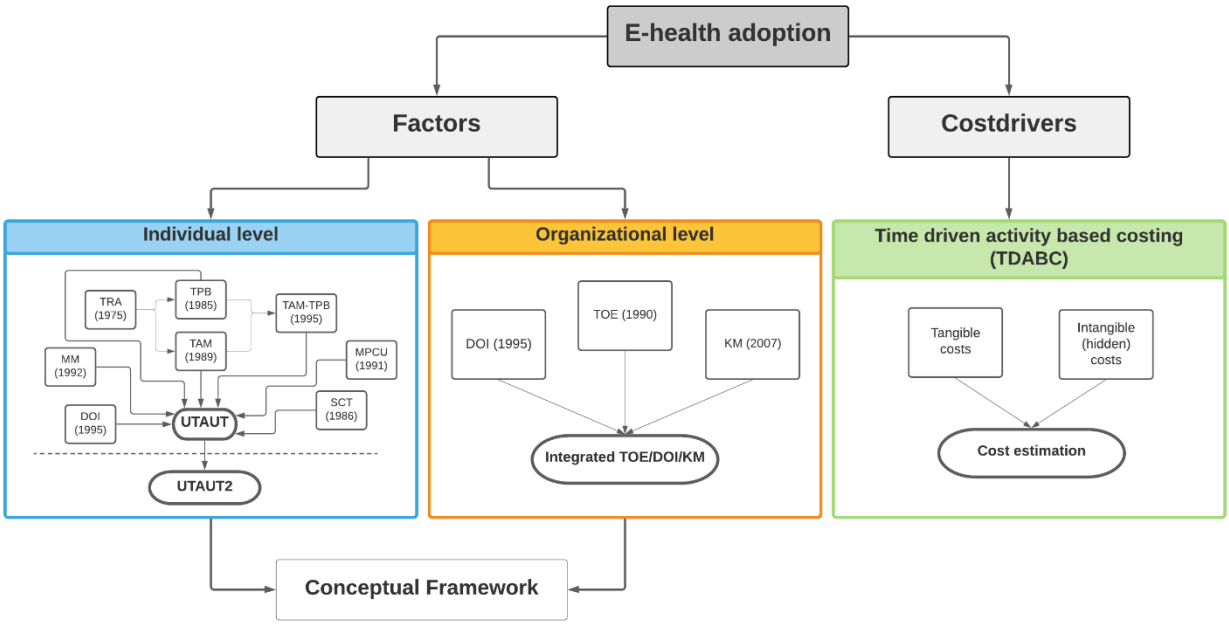


Figure 1. Overview of the theoretical framework used in this project where factors were identified on both the individual and organizational level using respectively UTAUT and an integrated TOE/DOE/KM framework. Furthermore, this project identified and estimating cost drivers using the TDABC model.

3.1 Theoretical Models for E-health Adoption

E-health adoption can be measured by several theoretical models (41-43). The models that are most popular and often used for technology adoption are Theory of Reasoned Action (TRA) (44) that extended to the Theory of Planned Behaviour (TPB) (45), Technology Acceptance Model (TAM) (46), Unified Theory of Acceptance and Use of Technology (UTAUT) (47), Diffusion of Innovation (DOI) (48, 49) and Technology-Organization-Environment (TOE) framework (50). For a literature review, see (47).

Innovation is only successful if the invention is adopted and implemented into the organization and if individuals continue to use the new technology (51). Also, an individual cannot adopt (technology) innovations easily if the organization hasn't adopted it first (48). Therefore, these levels of e-health adoption are both required to get a main overview of adoption factors involved in the implementation of new technologies.

3.1.1 Individual level

The UTAUT model was specifically designed to integrate eight models: TRA (44), TAM (46), motivational model (MM) (52), TPB (53), model combining TAM and TPB (TAM-TPB), model of PC utilization (MPCU) (54), innovation diffusion theory (48) and social cognitive theory (SCT) (47). The UTAUT model consists of four constructs: performance expectancy, effort expectancy, social influence and facilitating conditions. All constructs have an influence on the intention to use a new technology and/or the real use of the new technology. Age, gender, experience and voluntariness are suggested to moderate these relationships. Limitations of this model is the high number of independent variables. Whereas other models content validity is only 40 percent, the UTAUT has already the ability to justify 70 percent of the variances in behavioural intention (47, 55).

Venkatesh et al. (2012) extended the UTAUT model even further by adding three constructs: hedonic motivation, price value and habit (56). The individual difference variable voluntariness is in this extended model dropped to make the model applicable in the context of voluntary behaviour. The UTAUT2 model is able to explain 52-56% variance of technology use behaviour (UB) and 70-74% variance of behaviour intention (BI) (56). This model is applied and replicated in several studies, increasing the generalizability of

this model (56-59). The UTAUT model is also applied in Dutch healthcare organizations investigating acceptance and use of information technology (IT). An example is the study of Toebes (2020) that investigates the effect of implementing e-health (video consultation) in Dutch hospitals (60). It remains however unclear if these individual factors also influence successful adoption of e-health in Dutch nursing and homecare organizations.

3.1.2 Organizational level

In addition to factors that influence adoption at the individual level, there are also factors that influence adoption on the organizational level. An example is the Rogers' adoption curve which focuses mainly on the individual. However, Roger also states that an individual cannot adopt (technology) innovations easily if the organization hasn't adopted it first (48). Therefore, Rogers designed another model with independent variables influencing adoption of innovation at the organizational level divided into three main categories: 1) the individual characteristics including leader attitude toward change; 2) internal characteristics of organizational structure defined by within organization characteristics that positively or negatively influence innovativeness of the organization and; 3) external characteristics of the organizations defined by system openness and formalization (48).

Tornatzky and Fleirscher (1990) also designed a model looking at adoption of innovation at the organizational level, called the technology-organization-environment (TOE) framework. Three types of contexts influence adoption of (technological) innovations: technology-, organizational- and environmental context. All three contexts together are the design for the technological innovation decision making of an organization.

Faber et al. (2014) designed an integrated model using the DOI and TOE framework investigating factors that influence e-health adoption in Dutch hospitals. Factors within this model that are suggested to influence successful adoption are centralization, size of the organization, organisational readiness, top management support and absorptive capacity. Because Faber et al. (2014) did their research at multiple hospitals, the size of the organizations and centralization could be compared among each other. However, these constructs are irrelevant for this research since this model will be applied in only

one Dutch nursing and homecare organization. Therefore, in the final model the construct size of the organization and centralization will be left out.

The UTAUT framework is in studies also combined with parts of the integrated TOE/DOI framework and originally designed for the adoption of knowledge management (KM) processes. It is suggested to be applicable for technology adoption as well (61). This model is divided into a KM infrastructure that depends on the organizational structure, IT infrastructure and the organizational culture. These factors influence performance expectancy and/or effort expectancy of the consumer that again together with the KM infrastructure influences the readiness for adoption of innovations (61).

Factors that influence adoption of e-health among patients, professionals and nurses are investigated in Dutch hospitals and within elderly care (62, 63). Focus of these studies was on a small part of factors within the UTAUT model such as performance expectancy, effort expectancy, social influence and price value (62, 63). It remains therefore unclear if all factors specified in the UTAUT framework influence successful adoption of e-health in Dutch nursing and homecare organizations. Furthermore, these studies also often lack the link with organizational readiness.

3.1.3 Conceptual model

Within this research, factors that influence adoption will be investigated both on the individual level as well as the organizational level (Figure 2). The UTAUT, TOE and KM framework will be integrated into one model including the following factors:

Performance Expectancy (PE)

Performance expectancy is "the degree to which using a technology will provide benefits to consumers in performing certain activities" (56). This construct is derived from constructs used in other models: perceived usefulness (TAM), extrinsic motivation (MM), job-fit (MPCU), relative advantage (DOI) and outcome expectations (SCT) (47). PE is suggested to positively influence BI (56). In other words, higher performance expectancy is hypothesized to result in higher behaviour intention.

Effort expectancy (EE)

Effort expectancy refers to "the degree of ease associated with consumers' use of technology" (56). This construct is derived from other model constructs: (perceived) ease of use (TAM, ROI) and complexity (MPCU) (47). EE is suggested to positively influence BI. If people find a new technology easier to use, they tend to have higher intention of using that product (56).

Social influence (SI)

Social influence is defined as "the extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology" (56). SI is derived from the constructs: subjective norm (TRA, TAM2, TPB, C-TAM-TPB), social factors (MPCU) and image (DOI) (47).

SI affects BI through three factors: compliance, internalization and identification (64, 65). In response to social pressure, compliance induces a person to alter his or her intention. Internalization and identification alter the belief system of an individual and/or cause the individual to react to possible gains in social status (66). SI tends to positively influence BI. In other words, higher social influence results in higher behavioural intention (47).

Facilitating conditions (FC)

Facilitating conditions "refer to consumers' perceptions of the resources and support available to perform a behavior" (56). FC is derived from the MPCU model, as well as the perceived behavioural control (TPB, TAM) and compatibility (DOI) constructs (47).

FC is suggested to positively influence both use behaviour (UB) and BI. If people perceive to have more recourses available, their intention of using the product and their actual use behaviour increases.

Hedonic motivation (HM)

Hedonic motivation is by Venkatesh et al. defined as "the fun or pleasure derived from using a technology"(56). It plays an important role in determining use and acceptance of new technologies both on the organizational level as well as the individual level (67, 68).

HM seems to positively influence BI. If people perceive the use of a new technology as fun and entertaining, they have a higher intention of using this new technology. When a new technology is introduced, the individual will pay more attention to the novel features which may even be the main reason for using it (69).

Price value (PV)

Price value is defined as "consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" (p.161)(56). Price value tends to positively influence BI (56). If people perceive more benefits compared to the costs of using the new technology, their intention to use the new technology is higher.

Habit (HT)

The following definition has been used by Venkatesh et al. (2013) for habit: "the extent to which people tend to perform behaviors automatically because of learning" (56, 70). Repeated behaviour can contribute to well-established intentions and attitudes (71) that will guide behaviour automatically without the need for conscious mental activities such as retrieval or belief formation (72). Habit is suggested to positively influence both UB and BI (56). If people create more habits, they have a higher intention of using the product together with a higher frequency of using the product.

Organizational readiness (OR)

Organizational readiness has been defined as "the availability of the needed organizational resources for adoption" (73). In relation to successful innovations, organizations that have more resources available tend to be more successful (48).

Organizational readiness can be divided into two main elements: technological readiness and financial readiness.

Technological readiness (TR) includes the level of technological (tangible and intangible) resources required for adoption and implementation of innovations (66, 73). It can be divided into four dimensions: IT infrastructure, IT human resources, IT governance and IT security (66). If an organization has more technological resources, the perceived ease of use is higher. TR is therefore suggested to positively influence EE of the consumer (61). Financial readiness (FR) includes the availability of financial resources, meaning the ability of organizations to pay for innovation adoption and expected expenditures (66, 73). E-health adoption is based on these findings suggested to be positively affected by OR.

Top management support (TMS)

Refers to the commitment and support given by top management for changes within the organization, such as e-health adoption (74). Top management support has a positive influence on adoption of innovations because they ensure commitment to resourcing innovation implementation and they are able to stimulate change by influencing acceptance among members within the organization (75, 76). Based on these findings, it is suggested that top management support is positively associated with e-health adoption.

Absorptive capacity (AC)

Absorptive capacity is defined by the "dynamic capability pertaining to knowledge creation and utilisation that enhances an organisation's ability to gain and sustain a competitive advantage" (77). Zahra and George (2002) describe in their review four aspects influencing absorptive capacity: acquisition, assimilation, transformation and exploitation. Acquisition involves the ability to easily and effectively discover and prioritize new information. Assimilation includes the ability to comprehend new information and associate it with current knowledge. Transformation refers to merging, transforming and recode this new information and exploitation means the ability to make productive use of this new knowledge (77). These four aspects together enable organizations to define, capture, analyse, exchange, re-frame and recode new knowledge.

Furthermore, organizations can relate and make effective use of this new information within their own internal knowledge base. This will result in an enhanced capacity to assimilate innovations (75, 77, 78). Based on these findings, absorptive capacity of an organization seems to be positively associated with e-health adoption.

Organizational culture (OC)

Organizational culture is defined as "the ways in which people know and understand the values and beliefs of a specific group of people or an institution" (79). Organizational culture defines what kind of knowledge is valued and which knowledge should remain within the organization for innovative advantages (80, 81). Key aspects that influence organizational culture are collaboration, trust and learning (61, 80, 82). Collaboration means 'the degree of active support and helps in [the] organization' (80). Trust involves the 'degree of reciprocal faith in others' intentions, behaviour and skills toward organizational goals.' (80) Learning includes the 'degree of opportunity, variety, satisfaction and encouragement for learning and development in [the] organization.' (80)

Beliefs and values of an individual towards the organization are guiding principles influencing an individual's attitude, the decisions individuals within that culture make and the choice of how individuals invest their time (83). A supportive organizational culture is therefore expected to positively influence successful adoption, perceived usefulness (PE) and the intention (BI) of using a new technology (61).

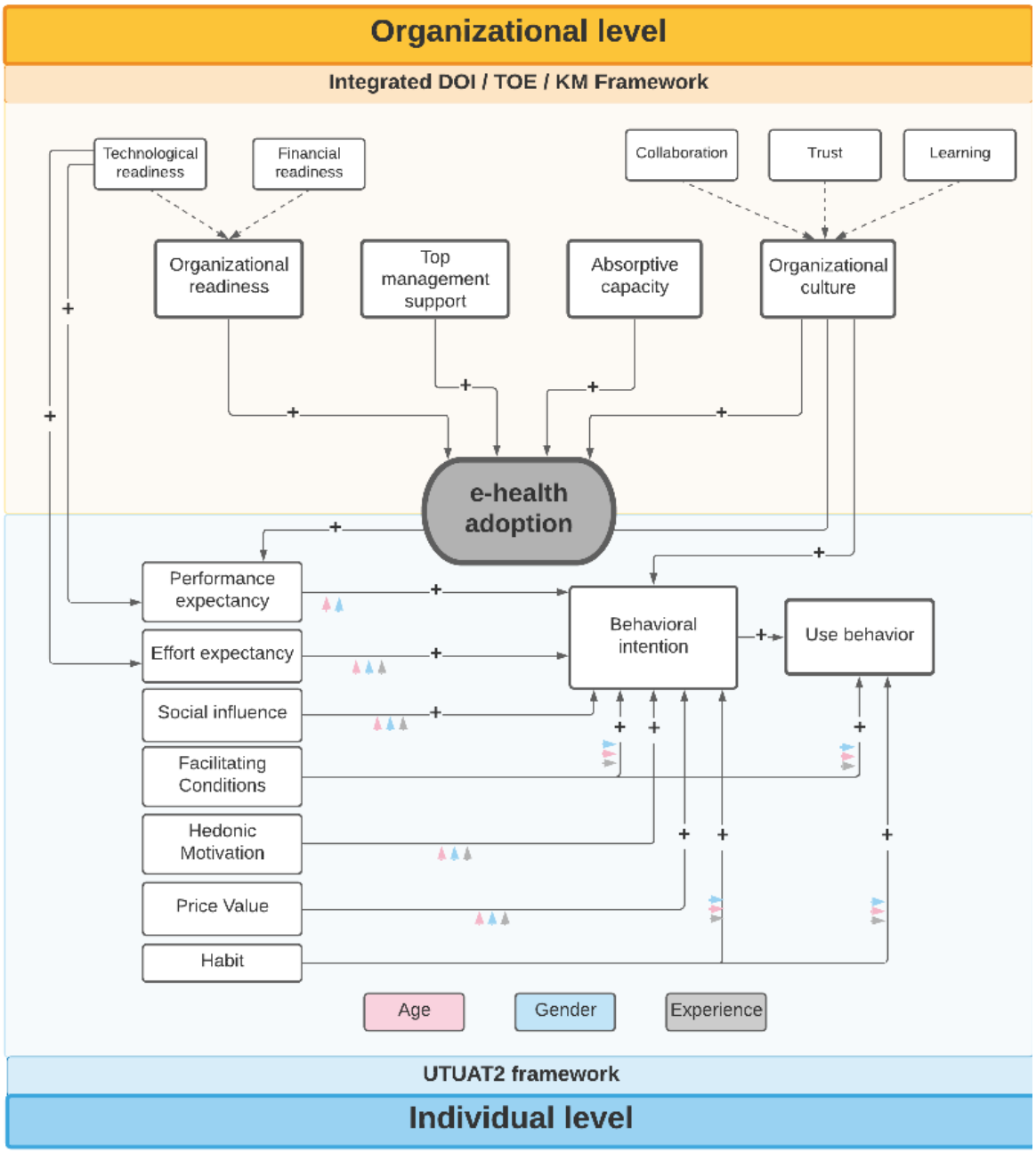


Figure 2. Conceptual model for measuring e-health adoption in a Dutch nursing and homecare organization including two scopes: individual- and organizational level. Main theoretical model used for individual e-health adoption is the UTUAT framework. Main models used for e-health adoption at the organizational level is the integrated DOI / TOE / KM framework. The influence of individual difference variables age (pink), gender (blue) and experience (grey) are indicated with arrows.

3.2 Cost estimation

As aforementioned, e-health adoption occurs both at the individual- and organizational level. Most studies investigate factors that influence the adoption process, however limited is known about the economic return (84). To understand the cost drivers involved for successful e-health adoption, all the cost drivers should be identified and mapped. Different approaches are developed over the years to determine the value of investments for e-health adoption such as cost-effectiveness and financial benefit (84). It is often unknown if these investments come with positive returns regarding e-health use. Economic evaluation can be studied using a cost-benefit analysis, cost-effectiveness analysis or cost-utility analysis. All these analyses include the comparison between costs and consequences and is therefore considered a full economic evaluation (84).

Economic evaluation analysis could also study only the costs, called partial or one-sided economic evaluation. This is often done with an input cost analysis that only examines the costs (84). There are three types of input costs:

1. one-time direct costs; costs paid for implementation of e-health. Examples are costs regarding purchasing of hardware, (software) licenses, system configuration, development and customization of applications, customer support and technical support.
2. ongoing direct costs; recurring costs after implementation to manage e-health use. These costs include maintenance of hardware and software, system upgrades, technical staff, support, ongoing training and related services such as system checks.
3. ongoing indirect costs; recurring costs after implementation of e-health allocated by the organization. These costs involve managing privacy, security, policies, help desk and staff workloads.

Both tangible and intangible costs should be identified. Tangible costs are the costs that are relatively easy to identify whereas intangible costs refers to the costs that are unquantifiable or hard to measure (84). In e-health adoption these intangible costs are changes in staff morale or changes in patient anxiety during pre- and post-implementation but also involve the costs associated with education and training of staff

and staff getting used with new work routines (85). Often these intangible costs are estimated as input or outcome, but are not present on the balance sheet (84, 85) and are therefore in this study called hidden costs. Since the aim of this study is to identify and map costs involved in the adoption process, no specific distinction is required in this project between ongoing direct costs and ongoing indirect costs. Costs from both categories will be therefore merged together.

3.2.1 Digital skills in healthcare

As mentioned in the introduction, 49% of the Dutch healthcare professionals do not have enough digital skills to perform their job (24), and there are clear differences visible between them. Vilans divided healthcare professionals in four distinct groups, based on their digital skills. This model is based on Rogers' adoption curve. Rogers proposes that there are five types of adopters: innovators, early adopters, early majority, late majority and laggards (48). Vilans used a reversed form of Rogers' adoption curve, and divided healthcare professionals into five so called personas based on their willingness and ability to use digital skills: analogue idealist ('analoge idealist'), reluctant technology user ('aarzelende technologiegebruiker'), busy prioritizer ('drukke prioriteitensteller'), digitally skilled professional ('digivaardige professional') and the digital enthusiast ('digitale enthousiasteling') (24).

As aforementioned, it differs between the personas if a healthcare professional has the ability and/or is willing to adopt a new technology. Adopting such new technologies requires big (personal) changes for the analogue idealist, whereas this process is much easier for the digital enthusiast. Multiple elements need to be addressed for successful adoption of the new technology, which can be explained by the Knoster Model of change (86). Healthcare professionals require a clear vision, an incentive, agreement, an action plan, skills and resources (Figure 3). If healthcare professionals lack skills, they are anxious in using the new technology. This fear can be allayed by providing and teaching the healthcare professional basic digital skills. If there are not enough resources available of using the new technology, this could lead to frustration. To avoid frustration, proper functioning technology must be provided with the right support. A lacking action plan results in chaos that can be prevented by clearly formulating policy and objectives of using the new technology. Healthcare professionals that have no incentive of using the new

technology will cause resistance which can be reduced by making the necessity of using the new technology clear. Last but not least, the use of the new technology must fit within the personal vision in order to prevent confusion.

Figure 3. Six elements required for successful adoption: a vision, incentive, action plan, resources and skills. If one of these elements is lacking, this will respectively cause confusion, resistance, chaos, frustration or anxiety. Framework is based on the Knoster model of change.

Successful adoption not only depends on the adoption of the new technology by the individuals (48). It is a continuous process between the adoption of the new technology by healthcare professionals, adjustments of the technology to make job performance more efficient and the acceptance within the organization. This process requires time and money.

3.2.2 Time-driven activity-based costing

Based on a literature review, the most common costs in healthcare are personnel costs (87). As aforementioned, e-health adoption involves education and training of staff. This requires a time investment in training and education, whereas this time would normally be spent on patient care. One method to estimate the costs involved in the time investment is time-driven activity-based costing (TDABC). This method involves the transformation of time investment into cost drivers. Here, the time necessary for performing the activity is expressed as a function of time consumption (88, 89). First, the

costs of one time-unit needs to be identified. Next, the number of time units needs to be identified per task which can be multiplied by the costs of each time unit. In other words, TDABC enables to identify costs involving organizational activities as well as the time spent on these activities (89).

Since most of the costs in healthcare are labour costs, it is assumed that this is also the case in the e-health adoption process. Within the adoption process, the healthcare professionals need to learn how to work with e-health and it is required that they are getting used to working with it to into their medical practice workflow (17, 90). Healthcare professionals also need to be educated in order to work with e-health properly (91, 92) and the usage should be coordinated and organized within the organization (66).

4. Research Methodology

4.1 Study Population

This project focusses on the adoption of e-health in a Dutch nursing and homecare organisation. Multiple forms of e-health are currently implemented and actively used within this organization such as a Smart Glass, telemedicine, personalized drug dispenser and m-Health (the delivery of healthcare services via mobile communications devices (93)). One specific project regarding e-health is the use of a Smart Glass for wound care, which is at the moment of writing still in the adoption phase. The Smart Glass is currently used within the nursing department (intramurally care) as well as in the homecare setting (extramurally care).

In this project, employees that actively work with a form of e-health within the organization were invited to fill in the questionnaires. Next to the questionnaires, in-depth interviews were conducted among key stakeholders that were actively involved in the use of a Smart Glass in wound care. These stakeholders include the nurses wearing the Smart Glass, the wound experts that communicate via the application, the innovation manager of the organization, the project manager of this project and the functional application manager who provides support for the end users of the Smart Glass and/or additional applications (n = 10; 1 male). In this study, the name of the organization remains anonymously to ensure privacy of the participants and to prevent biased answers in the questionnaires and interviews.

4.2 Research Methods

To answer the research questions described in section 2.2 data was collected via questionnaires and in-depth semi-structured interviews. In the next section, the methodology for each research question separately will be explained in further detail.

4.2.1 Adoption factors

To investigate which factors are influencing effective adoption of e-health in this nursing and homecare organization, digital questionnaires were designed in Formdesk (version 4.1). Formdesk was chosen because Q-Consult Zorg has a paid license and to make sure that the data will be available for follow-up projects after this research project is finished. Adoption factors on both the individual- and organizational level were investigated using the conceptual model described in section 3.1.3 Conceptual model (Figure 2). Questionnaires consisted of 77 statements (Table S1). Questionnaires were sent as a pilot to employees within the organisation that have an active role in the implementation and adoption process of any form of e-health. Participants were asked in Dutch to what extent they agree or disagree with the statements on a 7-point Likert scale. For each form of e-health, the stage of the organisation innovation adoption process was asked on an 8-point scale (Table S1). Participants had the possibility to give feedback at the end of the questionnaires. In total, this pilot collected data of 20 participants which was too low for further quantitative analysis. Due to the low response via the questionnaires, only qualitative data collected via semi-structured interviews were used to answer the research questions. Detailed information about the collection of qualitative data is described in section 4.2.4 Semi-structured interviews.

4.2.2 Stakeholders

To identify and understand (hidden) costs involved for the adoption of e-health, all individuals, groups or parties that had an interest in the project or were affected by the outcomes (in this project called stakeholders) needed to be identified and mapped. For this purpose, a stakeholder analysis was carried out which is a technique to understand which stakeholders are involved that are interested in the project and which individual nuances could affect the risk of a successful project (94). First, stakeholders were identified which was done in collaboration with the project managers of Q-Consult Zorg that were closely involved in the adoption process of using the Smart Glass in the nursing and homecare organization. Next, to investigate how stakeholders influence factors of e-health adoption in a Dutch nursing and homecare organization, their key interests, potential impact level and relative priority in relation to other stakeholders involved in the adoption process were identified and visualized in a power-interest matrix designed by Gardner et al. (1986)

(95). Next, key stakeholders were identified who are individuals, groups or parties that have the power to prevent the project from achieving its objectives and potentially cause failure of successful adoption of the Smart Glass. After mapping and identifying the stakeholders, the contribution of each stakeholder to the adoption of e-health is validated during the semi-structed interviews by asking where the stakeholder would position itself within an empty power-interest matrix. The position of stakeholders that were not interviewed were validated based on the experiences of the project manager of the nursing and homecare organization.

4.2.3 Cost drivers

Previous methods allowed to identify (key) stakeholders involved in the project together with important factors for adoption of e-health both on the individual level as well as on the organizational level. The next aim is to identify which cost drivers are involved in the adoption of e-health. First, the major cost drivers will be identified via in-depth semi-structured interviews. How the interviews are conducted is described in detail in section 4.2.4. In the interviews, the TDABC model was used. Participants were asked to estimate the amount of time spent on a certain task or event. Next, these time investments needed to be translated into costs which was done by multiplying the time consumption to the average gross salary of the particular function (derived from the collective labour agreement VVT), followed by a multiplication of 1.85 to include pension costs, travel costs and expense allowance (96). Next, average costs per stakeholder were calculated to gain insights into the distribution of costs between the stakeholders. To identify costs of the entire project, the average costs per person for each stakeholder was multiplied by the number of persons involved for that stakeholder group. Five nurses working in the intramurally care participated in this pilot group together with eight nurses working in the extramurally setting, two wound experts, one project manager, one innovation manager, one functional application manager and one regional manager.

4.2.4 Semi-structured interviews

The goal of the interview was to have an in-depth conversation to identify and map factors influencing e-health adoption and (hidden) costs regarding the adoption of e-health in a Dutch nursing and homecare organization. Assuming that the majority of the hidden costs

include the (extra) time investments of key stakeholders (nurses, wound experts, project manager, innovation manager and functional application manager), these stakeholders were invited for an interview of ~1 hour. Five semi-structured interviews were held online using video conferencing software Microsoft Teams (version 1.4.00.4167). Due to technical problems, the other five interviews were held online using video conferencing software Zoom (version 5.6.1). Participants received before the interview an information letter and were required to give informed consent. The interview was recorded using the in-app recording tool of Microsoft Teams or Zoom and for privacy purposes converted to mp3 format using VLC media player (version 3.0.7.1). Privacy sensitive information was removed from the mp3 file using Adobe Premiere Pro 2020 (version 14.0). Interviews were carried out using an interview guide for semi-structured interviews. The guide was designed in such way that participants could still freely and intuitively speak. Recorded audio fragments were transcribed at verbatim in Microsoft Office Word 2019 (version 2103). Interviews were transcribed in Dutch to ensure correct interpretation of nuances and expressions of the data. Quotes were translated by the researcher and checked by one of the supervisors of this project. Note that Dutch interpretation has been assumed during the translation process. To ensure privacy and anonymity of the participants, only researchers involved in this study had access to the data.

4.2.5 Procedure & Analysis

Identification of the stakeholders was important to identify stakeholders which were actively involved in the project. Based on the results of this stakeholder analysis, invitations for interviews were sent out to investigate which factors influence successful adoption. Qualitative data was analysed using a thematic content analysis (97). Transcriptions of the interviews were coded by the researcher using a coding scheme with the program Atlas TI (version 8.4.25.0). Themes were generated that were relevant to the research question. All the themes were divided into topics, with each topic their specific code. Based on this information, a thematic map was created that consisted of six themes: education, cost drivers, benefits, influence on their work, support and replacement of knowledgeable staff (see supplementary; section 10.2). Quotes from participants' own words were used to highlight aspects of the specific themes and how they relate to successful adoption.

5. Results

5.1 Adoption factors

Experiences of using the Smart Glass were mostly positive among all stakeholders. However multiple barriers were discussed that made using the Smart Glass more challenging. In general, participants described the Smart Glass as easy to use, very user friendly and especially for the patient and wound expert a very beneficial tool in wound care. Factors that influence successful adoption will be discussed separately below. Factors on an individual level include performance expectancy, effort expectancy, facilitating conditions, hedonic motivation, price value, social influence and habit. One individual factor is added to the conceptual framework, namely digital skills. Factors on the organizational level include top management support, organizational readiness, absorptive capacity and organizational culture. An overview of all factors can be found in Figure 4.

5.1.1 Performance expectancy

Nurses and the wound experts experience several benefits from using the Smart Glass. For the wound experts the use of the Smart Glass will reduce travel time and costs, they have a wider patient range and the duration of a consult is shortened. Besides, the wound expert can also reduce their time investments on administrative tasks. Normally these tasks were done after the consult finished, whereas with the use of the Smart Glass these tasks can be done during the consult. Furthermore, the quality of wound treatment seems to be improved because using the Smart Glass facilitates a clear overview of the situation.

> *"Sometimes I got for example a couple of mails including a picture asking what my findings were, end. Well, I can't do anything with that. With a Smart Glass you can quickly ask about the situation."* (Wound expert)

Three nurses (P7, P8, P9) and two wound experts (P5, P6) find the use of the Smart Glass beneficial since professional knowledge can be transferred and therefore, the nurses learn

more about wound treatment. The wound expert can give easily feedback on the nurses' actions and the use of the Smart Glass is therefore conducive for increasing expertise among nurses. One nurse (P7) therefore also feels more involved in the treatment process:

> *"You have interaction with the specialized nurse and they give you input like, what are we seeing? You have a conversation together, so you are more involved [...] and you will learn from that."* (Nurse - nursing home)

Due to the fact that the wound expert can easily assess and monitor a wound, preventive measures are more quickly applied which is beneficial for wound healing. Besides, it is relatively easy to contact a second opinion. Furthermore, knowledge transfer is beneficial for wound treatment since the nurses can deliver longer autonomous care without consultation of a wound expert. Performance expectancy therefore seems to positively influences behaviour intention (Figure 4).

Next to the knowledge transfer other important benefits that were indicated is to have faster communication, which is often in favour of the patient. Other benefits for the patient include reducing the number of hospital visits and reducing treatment time. Especially during the COVID pandemic, another benefit was having less people visiting the client while care was provided by a trusted nurse.

Another important benefit is that the quality of care improves due to the use of the Smart Glass. The innovation manager, four nurses (P7, P9, P10, P13) and one wound expert (P6) experience that the quality of care increased after using the Smart Glass. One nurse (P8) does not experience this yet, but expects that the quality of care might improve over time when the Smart Glass is used more often. This suggests that use behaviour positively influences performance expectancy (Figure 4).

5.1.2 Effort Expectancy

As mentioned before, in general the users of the Smart Glass perceived it as easy to use and very user friendly. All users mention that it is not hard to understand how the Smart Glass works. Also, the flexibility of choosing when the Smart Glass is being used makes the use of the Glass easier with the side note that this is under the condition that the wound

expert is also available. Due to the fact that appointments don't necessarily have to be at peak times, it is easier for the nurses to schedule appointments when it fits for them the best. It therefore seems that effort expectancy positively influences behavioural intention (Figure 4).

Due to this perceived ease of use, nurses think that if the use of the Smart Glass will extend in the future that it is easy for other colleagues to learn how to use it. Due to this result, it is suggested that effort expectancy positively influences learning (Figure 4).

5.1.3 Facilitating Conditions

Facilitating conditions in this research can be divided into four main categories: time, coordination, technological resources and cases. Facilitating conditions tend to positively influence behavioural intention, use behaviour and effort expectancy (Figure 4). These categories and relationships will be explained below in more detail.

5.1.3.1 Time

If there is not enough time for the nurses to use the Smart Glass, the wound experts have to put in more effort by for example making extra phone calls. Facilitating conditions therefore tend to positively influence effort expectancy (Figure 4). Besides, facilitating conditions also positively influence use behaviour (Figure 4). When the nurses are busy, the intention of using the Smart Glass is high since appointments were made, however when it comes to the actual use of the product, they do not have enough time for it.

Other explanations of not using the Smart Glass were shortage of staff, sickness, working pressure and the COVID pandemic. Furthermore, making an appointment depends on both the agenda of the wound expert and that of the nurse.

5.1.3.2 Cases

Another important part of facilitating conditions is the number of wound cases where a consult with the wound expert is necessary. Over time, the number of cases varies and depending on the severity of the wound cases, an appointment with the wound expert will be made. Since there were not many wound cases in the nursing home, they experienced

that the glass was not used often. If these numbers will increase over time, it is expected that the Smart Glass will also be used more.

5.1.3.3 Coordination

Real use of the Smart Glass depends on the number of cases as mentioned in the section above. Especially in the nursing home the Smart Glass was not used often. Surprisingly, reasons for this lack of usage were unclear for the wound experts. Therefore, communication between the user of the Smart Glass and the wound expert is crucial.

Not only communication about the number of cases is required, it also involves communication about coordination and mutual agreements of using the Smart Glass. In the nursing home, the Smart Glass was not used much especially in the beginning of the project. As a possible solution they scheduled a fixed day and time of the week where the wound expert would always be available for a consult. Due to this change, they noticed that the Smart Glass was used more often compared to the situation before this new arrangement.

Furthermore, one nurse (nursing home) noticed that the location where the Smart Glass was stored was not ideal since the Smart Glass was stored on another floor. Picking up the Smart Glass from that location took sometimes too long and therefore the Smart Glass was not used in all cases where it was possible. As a solution, they changed the storage location to their office. Due to this change they hope that the Smart Glass will be used more often.

> *"Colleagues may not use it so quickly because it is stored upstairs, […] then you first have to go to the fifth floor. Not that it takes a lot of time but for me I sometimes thought oh dear, I don't have enough time right now. And then now […] it's on my desk and then you just grab it faster."* (Nurse - nursing home)

5.1.3.4 Technological resources

Another important facilitating condition that influences adoption of the Smart Glass is having the right technological resources which include:

- The Smart Glass needs to be charged.
- In cases where the Smart Glass is not charged, the availability of a power bank is required.
- Stable internet connection via a Wi-Fi box including a SIM-cared or via a tablet or smartphone using a hotspot.
- A working application to connect to the Glass.
- Updates should not pop up on the screen or the ability to postpone the update to a later moment.
- The Smart Glass must be stored at a central location so that the users can easily get the Glass.
- The right technological support in case the Smart Glass is not working properly.

These technological resources have a positive effect on the effort expectancy (Figure 4). Four nurses (P7, P8, P9, P10) and two wound experts (P5, P6) mention that if the technique is working properly, the Smart Glass is very easy to use. However, if one of these technological resources is lacking or not functioning properly, the ease of using the Smart Glass decreases.

Furthermore, properly functioning technology is required for the project to succeed and this has an effect on use behaviour (Figure 4). If the technology is working fine, the nurses are using the Smart Glass more often, whereas if there are problems with one of the technological resources, the actual use of the Smart Glass decreases.

> *"I also have one district team with whom I made three appointments [...] the first time couldn't go on because the Wi-Fi box was not charged properly. Second time couldn't go through because the goggles themselves weren't charged properly and the third time we had some connectivity issues which was exactly in such a gray connection area. [...] These conditions are important, that the technology works."* (Wound expert)

5.1.4 Digital Skills

Despite the fact that the organization did not select based on digital skills which nurses could participate in the pilot group, all the participants identified themselves during the interviews with the persona 'digital professional' or even the 'digital enthusiast'. Based on these findings, we may assume that the participants in our sample are all digitally skilful. Looking at the level of digital skills among nurses in the entire organization, these percentages can be compared with the distribution that Rogers described in his innovation theory.

The level of digital skills seems to positively influence behaviour intention, effort expectancy and hedonic motivation (Figure 4). Nurses tend to derive more fun and/or pleasure from using the Smart Glass when they have more digital skills. Besides, nurses that have fewer digital skills tend to find learning the Smart Glass more effortful. These relationships are moderated by age. Younger employees tend to accept new technologies easier and are more open and enthusiastic towards using the Smart Glass. Older employees with less digital skills tend to spent more time getting used to new technologies and find it harder to learn using them.

> *"Look, we are a generation that really grew up with technology and that really makes a difference to the generation that didn't. So those [...] sometimes just need more time for that or they might be afraid of doing things wrong. They may dare a little less."* (Wound expert)

Next to the abovementioned relationships, digital skills also tend to positively influence use behaviour (Figure 4). People that have digital skills tend to use the Smart Glass more often.

5.1.5 Hedonic Motivation

In general, all the stakeholders were enthusiastic about the Smart Glass. Two nurses (P7, P10) mentioned that their job satisfaction increased after the implementation of the Smart Glass. The other end users do not experience an increase in job satisfaction per se, but find using the Smart Glass interesting and fun. Since their job satisfaction was already high,

this did not increase further when using the Smart Glass. Nurses that were more excited about the product seem to have a higher intention of using the product and they will use the product also more often, suggesting that hedonic motivation positively influences both behavioural intention and use behaviour (Figure 4). Under the condition that the experiences with using the Smart Glass are good, they get even more excited about using it. Therefore, it seems that use behaviour influences hedonic motivation under the condition that there are positive experiences (Figure 4).

> *"I have to say that I am actually quite excited about it. I always like it when new things come up and to try them out. And especially if it also works out well because [...] I only have positive experiences with it [...] then I get excited again."* (Nurse – nursing home)

5.1.6 Price Value

Overall, the stakeholders are aware that the Smart Glass is an expensive product. Even though the nurses do not know the exact investment costs of the Smart Glass, their opinion is that the benefits from using the Smart Glass outweigh the costs. Benefits include having clarity and new wound policy more quickly but also time savings during their daily job. Therefore, it seems that price value influences behavioural intention (Figure 4).

Using the Smart Glass comes with qualitative benefits for the nurses, wound experts and clients described in section 5.1.1. However, the Smart Glass does not (yet) lead to cost reductions, since it does not reduce the number of care moments. For cost reductions to happen the implementation of the Smart Glass should expand towards for example transmurally care, meaning in collaboration with hospitals. However, this collaboration may only result in cost reductions at the hospital level since a visit to the patient remains required even though the Smart Glass is used.

5.1.7 Social Influence

In this project, colleagues motivated each other to use the Smart Glass. Here, the experiences regarding the use of the Smart Glass together with the enthusiasm of the

nurses are important for other colleagues to become curious in this new technology and to increase their intention in using the Smart Glass in the future. This suggests, that social influence among colleagues positively influences behavioural intention (Figure 4).

> *"I notice that [...] if we are enthusiastic about it [...] the team becomes curious and they want [to use] it as well."* (Nurse – homecare)

Besides the relationship of social influence on behavioural intention, there seems to be a positive relationship between use behaviour towards social influence (Figure 4). When the nurses were using the Smart Glass more often, they started to exchange their experiences resulting in new tips and ideas of how to use it in practice.

5.1.8 Habit

All the users of the Smart Glass experienced a start-up phase where they still needed to familiarize themselves with the product. During the adoption phase, they noticed that when the use of the Smart Glass was implemented in routines, the Glass was also used more. For example, after scheduling a fixed date and time helped to increase use behaviour. Implementing the Smart Glass in routines also had an effect on behavioural intention because this fixed date and time made sure that it raised awareness among the nurses to think about using it.

Also, in the early implementation phase the Smart Glass was often not charged. Now, they made it a habit that after using the Smart Glass they put it in the charger. Therefore, habit seems to influence use behaviour (Figure 4).

5.1.9 Organizational Culture

Within the organization, there are two settings: the homecare setting and the nursing home. Clearly there are differences in working methods between these two settings. Nurses working in a nursing home tend to rely more on habits, routines and their colleagues whereas the homecare setting is more individualistic and these nurses seem to be proactive and looking for new solutions. Organizational culture therefore tends to positively influence behavioural intention. After the implementation of the Smart Glass,

it was clear that the adoption of the Smart Glass differed between the nursing home and the homecare setting. Where the nurses in the homecare setting immediately started using the Smart Glass, the project did not directly get off the ground in the nursing home. Here, it took more time and more facilitating conditions were required before the nurses started to actually use the Smart Glass (see section 5.1.3 Facilitating Conditions for a detailed description). It is therefore suggested that organizational culture also has an effect on use behaviour (Figure 4).

Due to the differences between the two settings, also the perceived ease of using the Smart Glass and the hedonic motivation differed in the eyes of the wound expert. From the perspective of the wound expert, they needed to put more effort in the adoption of the Smart Glass in the intramurally setting compared to the extramurally setting. Besides, the extramurally care was more excited using the Smart Glass compared to the intramurally setting. Therefore, it seems that effort expectancy and hedonic motivation both seem to be influenced by the organizational culture (Figure 4).

5.1.9.1 Learning

Nurses from both the intramurally and extramurally care did receive the same education. One wound expert (P5) noticed that there was a difference between the intramurally and extramurally care especially in the way how nurses dealt with the provided information. Where nurses from the extramurally care were very enthusiastic and proactively tried to apply the Smart Glass as soon as possible, nurses from the intramurally care needed more guidance and support. Therefore, learning as part of the organizational culture tends to influence effort expectancy, hedonic motivation and behaviour intention (Figure 4).

5.1.10 Organizational Readiness

Organizational readiness tends to positively influence behavioural intention (Figure 4). Technical support was during the adoption phase mainly provided by the e-health provider. When the nurses have questions about the Smart Glass, they first ask their own colleagues or go to the wound expert. When questions still remain, the next step is to go to the e-health provider asking for support instead of going to the internal ICT department. Main reason for this is that the e-health provider has more in-depth content

knowledge about the Smart Glass. One nurse (nursing home) would go for relatively simple technical questions to the digicoach but this had not been necessary until the moment of the interview. Other nurses experienced that the role of the digicoach is unclear or they did not experience the necessity for help or support. For one nurse (nursing home) it was completely unknown who could be contacted in case of questions. Lacking the ability of providing internal support could be problematic if the use of the Smart Glass will expand throughout the organization or if the Smart Glass will be used in other disciplines as well. The idea is that technological management will shift towards the internal ICT department of the organization. However, ideas of how this should look like are not discussed yet.

Furthermore, within the organization there are differences in working methods among healthcare workers. Some of them work within a hybrid environment whereas others have local files on their own computers. Others again work at a local server which is stored at the organization whereas there are also employees that already work with Cloud services. Due to this jumble of methods, it is hard to keep track of all this information and to ensure privacy. Especially for further expansion of the Smart Glass, it seems that the organization is not ready yet.

> *"My advice has been to wait a while until we really are in a good and well secured [...] in our own Cloud, which is also completely shielded from the rest of the world."* (Functional Application Manager)

5.1.10.1 Technological readiness

One task of the ICT department was to provide where necessary the nurses from tablets. One problem that nurses experienced was a bad and unstable internet connection making it impossible to communicate with the wound expert. The solution was to use a hotspot via a smartphone or tablet. However, not every nurse was in the possession of a smartphone. One nurse experienced that using the Smart Glass was more effortful when having issues with the connection. It seems that technological readiness therefore positively influences effort expectancy because if the organization would provide this nurse from a smartphone this might result in time savings due to a better internet connection.

5.1.11 Top Management Support

Top management support tends to have an effect on behavioural intention (Figure 4). Since the beginning of the project, especially the project manager and the two wound experts played an important role in the implementation and adoption of the Smart Glass. Due to their enthusiasm and reachability when there were questions, the nurses also got motivated and enthusiast about using the Smart Glass.

Furthermore, the organization is open for new ideas and new innovations. The aim of the organization is to work as demand-driven as possible. Demands of patients and their employees are central and from this point they try to develop concepts and where possible implement new technologies. The innovation department actively promotes this working method. Besides, they actively tried to make it as easy as possible to contact one of the members of the innovation department.

Nine weeks after implementation of the Smart Glass, there was an evaluation moment with the project managers, the wound experts and the nurses. During this evaluation the results, benefits and barriers of using the Smart Glass were discussed and experiences were shared among colleagues. Problems that came up during the evaluation were immediately tackled and possible solutions were discussed. An example of a problem that the nurses experienced was the battery life of the Smart Glass. This problem was solved quickly with the idea to buy power banks. A couple of days after the evaluation, the power banks were already bought and available for the nurses. Based on these results, top management support tends to positively influence BI (Figure 4).

5.1.12 Absorptive Capacity

Within the organization there is an innovation department that has a specific role to look at national and local developments regarding new technologies and innovations. Based on these developments and ideas, new concepts are actively developed in collaboration with the entire innovation team. Digital care is also one main topic in this healthcare organization since the aim of the innovation department is to provide 20-30% digital care in the future. However, to achieve this goal, digital tools are required. Within the organization, there are multiple projects where a new technology plays a crucial role such as the use of tablets, sensor technology, telemonitoring, using AI and the development of

an app helping with capacity planning. Furthermore, the organization provided education for all district teams.

Next to looking actively for new technologies, there is the possibility to gain knowledge from information sessions. In 2019, the innovation manager visited with one wound expert that is involved in this project and another colleague a presentation about the Smart Glass. Here, the benefits were discussed and a live demonstration was given. After the presentation everybody became more enthusiastic and motivated to use the Smart Glass also within their organization as well. Based on these findings, it seems that absorptive capacity tends to positively influence behavioural intention (Figure 4).

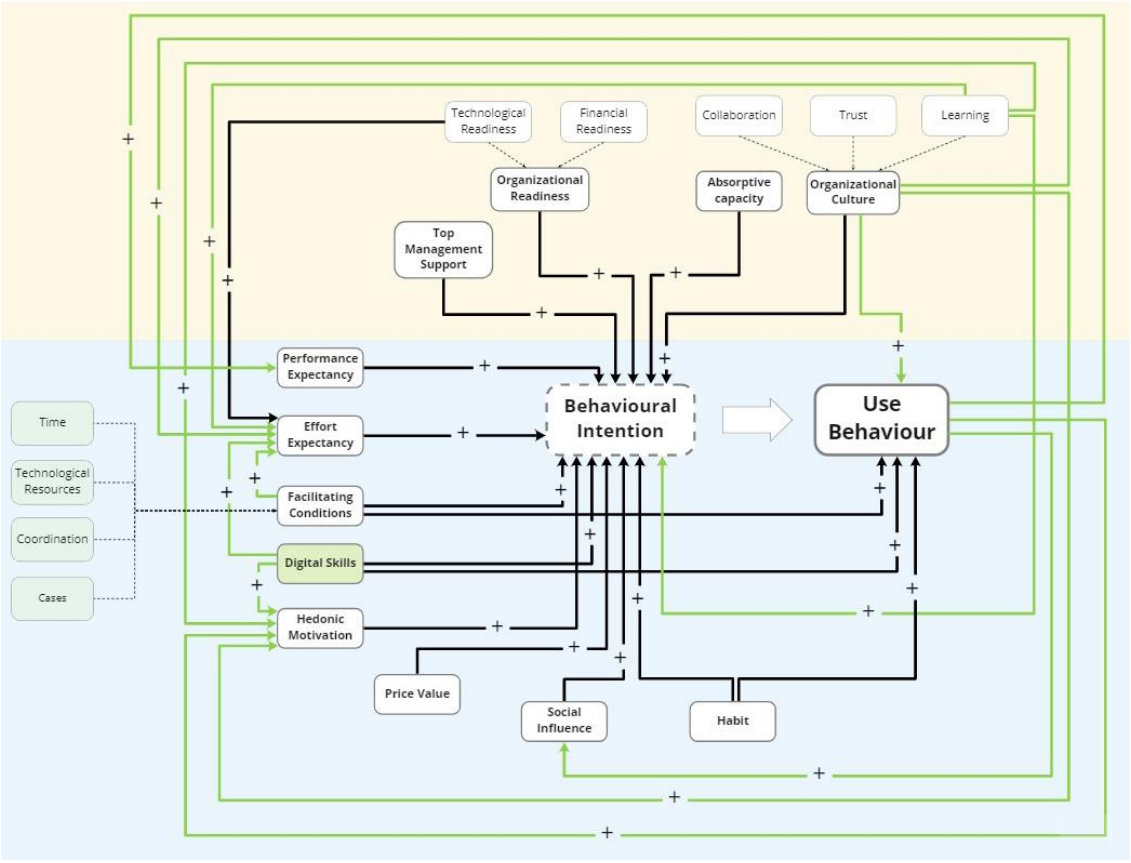


Figure 4. Final model based on the results of the interviews. Black arrows indicate relationships that were already known. Green arrows indicate new identified relationships. Dashed arrow lines indicate the root constructs (RC; box not outlined) that are part of the main constructs (C; box grey outlined). A green variable indicates that this variable is added to the model compared to the conceptual framework. Variables within the blue frame are factors on an individual level whereas variables in the yellow frame are factors on the organizational level.

5.2 Stakeholders

This section will focus on stakeholders involved in the adoption process of a Smart Glass in a nursing- and homecare organization in the Netherlands.

5.2.1 Power, interest and funding of stakeholders

Stakeholders were identified and mapped in a power-interest matrix (Figure 5). The matrix can be divided into four quadrants: 1) high power, high interests; 2) high power, low interest; 3) low power, high interests; and 4) low power, low interests. In the sections below the position of each stakeholder will be discussed and analysed.

5.2.1.1 High power, high interests

Looking at the internal stakeholders, the project manager manages and organizes contact and communication between internal and external stakeholders involved in the project together with keeping track of the financial budget. Next to the project manager, the innovation manager made important decisions within the project, such as the collaboration with external stakeholders: a consultancy firm (Q-Consult Zorg) and the e-health provider. The role of the innovation manager in this specific project is to guard the project and make in the end of the adoption process the decision if the organization will continue using the Smart Glass. The project manager and the innovation manager both yield great power of this project and have high interests. The project manager is involved in the entire project whereas the innovation manager had an important role mostly in the beginning and at the end of the project. Therefore, the interest of the project manager will be a little bit higher compared to the innovation manager. Since the innovation manager needs to make important decisions about the follow-up of this project, this stakeholder yields great power and was therefore first positioned at the right top corner, below the wound expert. However, these decisions are based on the opinion and experiences of the wound experts, the nurses and the project manager and therefore the position of the innovation manager changed towards less power compared to the other internal stakeholders in this quadrant.

> *"I am the one who gives advice to the board of directors and management. Only that is, of course, based on practical experiences but above all what the professionals think about it."* (Innovation Manager)

Next to the managing functions, the end users of the Smart Glass are important key stakeholders such as the wound experts and the nurses. Successful adoption depends on their acceptance towards the e-health technology. Therefore, their power is high, because if they are not using the Smart Glass successful adoption will fail.

> *"I think that my interests are high, because we want to reach more patients and have less travel time, so working more efficiently"* (Wound expert)

The interests of the wound experts are the most since this stakeholder will benefit, together with the patients, the most of using the Smart Glass in wound care.

> *"The interests are higher in particular for the clients but also for the wound experts [...], the interests of the client are high because it often saves them a visit to the hospital. And if all goes well, the recovery time for them is shorter. So, treatment time is shorter."* (Project Manager)

External stakeholders in this quadrant are the e-health provider and the consultancy firm Q-Consult Zorg. The e-health provider ensures that the correct materials are available for the use of the product, together with support on how to use it. Examples of such support are making an instruction video on how to install and use the application, or when the technique is not working properly to help getting the technology working again. If this e-health provider does not deliver the right materials, or materials that are not working properly the adoption process is doomed to fail. The interest of the e-health provider in this project is high, since these projects are their main business model. Another external stakeholder in this quadrant is Q-Consult Zorg. This consultancy firm has an umbrella function of all stakeholders involved in this project, from funding towards successful

adoption and implementation of the Smart Glass. Without the role of Q-Consult Zorg in this project, there is a high risk of failing adoption of the Smart Glass in the organization.

All the aforementioned stakeholders in this quadrant have the biggest impact on successful adoption of the Smart Glass and their expectations should therefore be managed closely.

5.2.1.2 High power, low interests

Stakeholders in this quadrant may not be very interested in successful adoption of the Smart Glass. However, they yield great power over the project and therefore these stakeholders should be remained satisfied.

One of the most important factors of successful e-health adoption is funding of the project. RVO is a Dutch financing organisation providing funding for health research and care innovation. RVO provided in this project funding via the SET COVID 2.0 subsidy and is therefore an important external key stakeholder. Without this funding, the organisation would not be able to start this project. RVO yields great power over this project, but has not much interests in the outcome because the activities of RVO does not depend on successful adoption of the Smart Glass in the organizations of this study. RVO is part of the Dutch ministry of economic affairs (min EZ) and therefore the ministry is also an external stakeholder in this project. Since RVO is working for the ministry, they yield less power in this particular project compared to the ministry. One of the main roles of the ministry in the Dutch healthcare system is controlling collective healthcare expenditures. Therefore, the interest of the ministry in this project is higher compared to the interest of RVO because successful adoption of the Smart Glass aims for more effective healthcare that may result in the future to reduced health expenditures.

Internal stakeholders in this quadrant are the board of the organization and the quality officer. Both stakeholders are key stakeholders because they yield great power. If they do not agree or if their expectations are not met, successful adoption will fail. Since this is not the main project and objective of the organization, they have relatively low interest. However, their interests are higher compared to the external stakeholders because this project does impact the organization and the way the organization provides care.

5.2.1.3 Low power, high interests

All the stakeholders in this quadrant can be helpful with the detail of the project and should therefore be informed adequately.

An internal stakeholder in this quadrant is the digicoach. A digicoach is a healthcare professional who is educated to support and coach its colleagues in increasing their digital skills step by step. Digicoaches have high affinity with technology and their interest in this project is therefore high. They yield not much power over the project, because they only have a supportive role in the adoption process. Without the digicoach successful adoption may take longer and would be less effective, but the digicoach is not crucial or required for successful adoption of the Smart Glass. Other internal key stakeholders in this quadrant are the communication, marketing and financial departments. How information is communicated among the staff, and how the project is marketed within and outside the organization makes or breaks successful adoption of the Smart Glass and are therefore classified as key stakeholder.

> *"What you notice with this project is that there is a lot of interest for it. How are you doing and how does it work? So, it is actually in terms of appearance and a bit of communication and marketing of your care which can be used very nicely."* (Project Manager)

Another internal key stakeholder is the financial department that is responsible for the administration of income and expenditures of the project. This stakeholder also has no decisive function, and therefore they yield low power in this project. They are a key stakeholder because it is very important to keep track of the expenditures. If there are more expenses than income, successful adoption will eventually fail.

Next to the digicoach, patients are often represented by patient associations. These associations are external stakeholders in this project focussing on contact between patients, representation of patient interests together with information and education for affiliated patients or third parties. Because of this focus, they yield high interest but low power in the successful adoption of the Smart Glass. This is different for the individual patient. They must accept the use of this new technology by medical staff in order to

achieve successful adoption. If patients do not give consent on using the Smart Glass, this affects successful adoption of using the Smart Glass and therefore patients yield relative high power. Since the aim of using the Smart Glass is to make care more efficient and to provide early interventions preventing worsening of wound healing, patients yield the most interest in successful adoption.

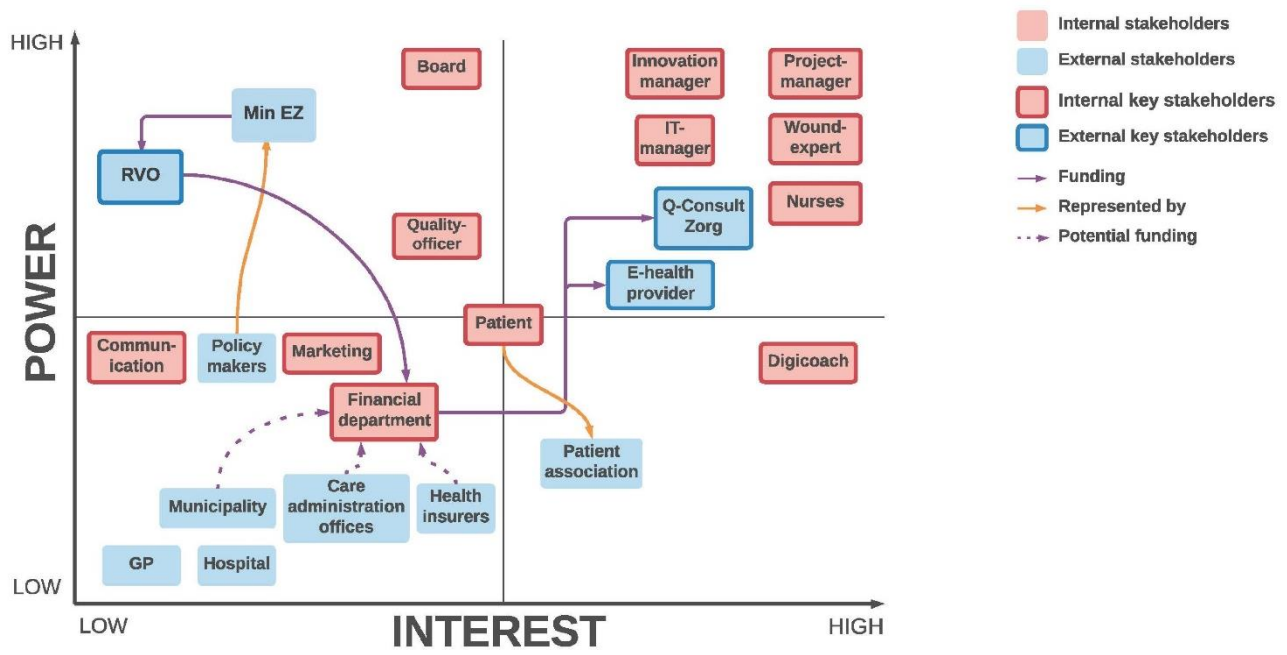
5.2.1.4 Low power, low interests

Stakeholders in this quadrant have low interests and low power in the successful adoption of the Smart Glass. They should be monitored but not provided with excessive communication. Without the right help and support of the IT department, including functional application management, successful adoption will fail. However, in this specific project, the main support was given by the e-health provider and since the technology was easy to use, the functional application manager's main role was supportive in this specific project. In practice, their contribution was minimal since the application and technology was relatively easy to use.

> *"When it comes to control, use or actually even the support, we soon found out that the software used in combination with the Smart Glass was so accessible and easy to use for the healthcare professionals that my support was actually not desirable at all."* (Functional Application Manager)

Main income of this project comes from the subsidy provided by the external stakeholder RVO (section 5.2.1.2). This type of funding is however not sustainable in the long term. Structural funding can be provided by municipalities, care administration offices and health insurers. Since these stakeholders are not yet actively involved in this project, they still have low interest and low power in the successful adoption of the Smart Glass. This is also the case for individual policy makers. Policy makers are represented by the ministry of economic affairs that do yield higher power within the project described in section 5.2.1.2. Besides, general practitioners (GPs) and hospitals may be potential (co)users of the Smart Glass in the future but are also not yet actively involved and yield therefore low power and low interest.

A)



B)

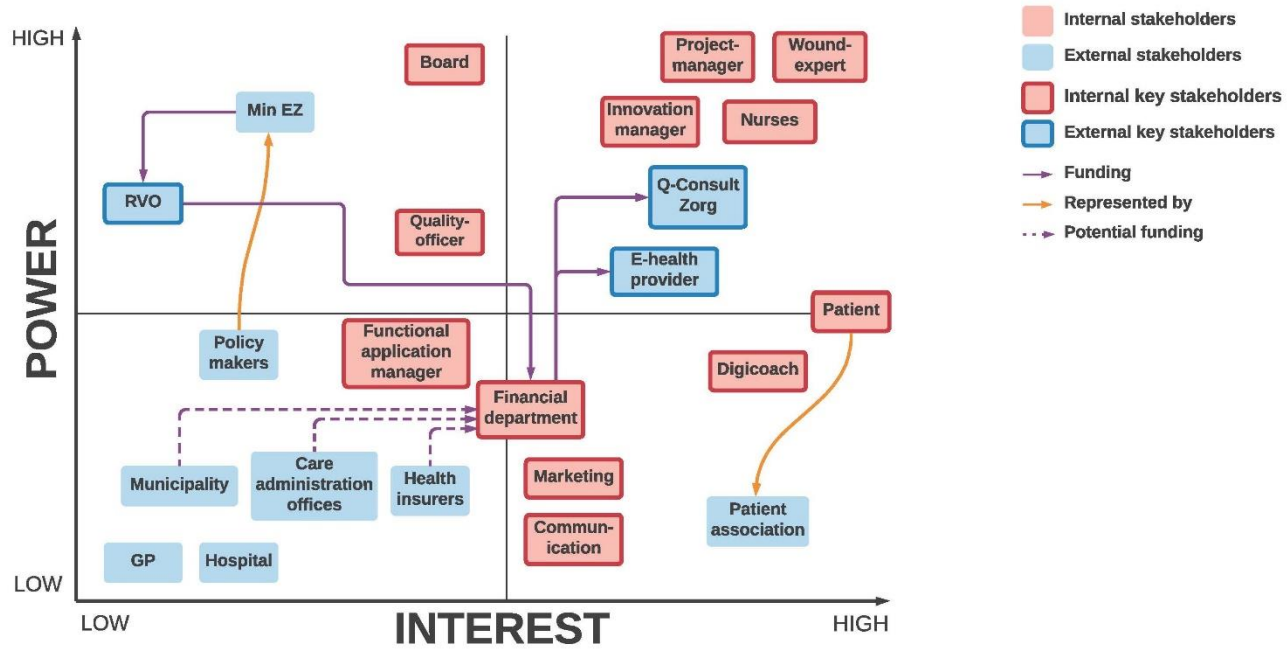


Figure 5. **A)** Internal (red) and external (blue) key (outlined) stakeholders involved in the adoption process of a Smart Glass identified and mapped in a power-interest matrix based on experiences of the project managers of Q-Consult Zorg. Purple arrows indicate the (potential – dashed line) funding within this project. Yellow arrows indicate a stakeholder that is represented by a larger group. **B)** Same power-interest matrix after validation with the stakeholders.

5.3 Cost drivers

5.3.1 Main Cost Drivers

The main cost driver in the adoption of a Smart Glass in a Dutch nursing and homecare organization are personnel costs that include the scheduled project hours and the hidden adoption costs (43%; Figure 6). Personnel costs include both ongoing direct costs (ODC) and ongoing indirect costs (OID). Besides, one-time direct costs include raw materials (36%) together with the external support of Q-Consult Zorg (18%) and support of the e-health provider (3%). Of these ongoing direct and indirect costs, 24% of these costs are planned project hours and 19% of the total costs involve hidden adoption costs (Figure 6). These costs are called hidden adoption costs since these costs involve unidentified time spending on the project whereas these hours should actually be spent on care. (Table S2). The most important cost drivers of these hidden adoption costs are respectively coordination (27%), learning the technique (22%), communication (22%) and education (19%; Figure 6) A minority of these hidden costs involve gathering information (6%), evaluation (4%) and support (1%; Figure 6).

The time spent on the adoption process of the Smart Glass was mainly done within working hours (97%) and only a small portion was spent outside working hours (3%; Table S3).

5.3.2 Stakeholders & Adoption Costs

Looking at the distribution of the total adoption costs among the stakeholders, the wound experts and the project manager seem to contribute most to the total adoption costs (Figure 7). Note, that within this figure also the scheduled project hours are included. For a detailed overview of the costs per stakeholder see Table S4.

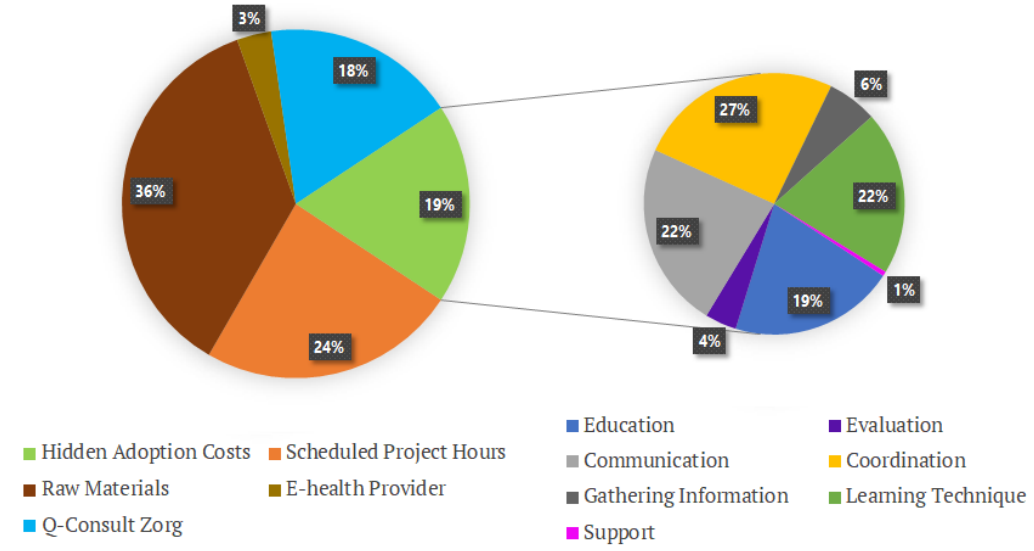


Figure 6. Overview of the identified costs regarding the adoption of a Smart Glass (n=10). Left pie chart consists of one-time direct costs (material costs & external stakeholders) and ongoing direct and indirect costs that is divided into project hours that were already planned (orange) and hidden adoption cost (dark green; 19%). Right pie chart shows the distribution of the hidden adoption costs divided into seven categories.

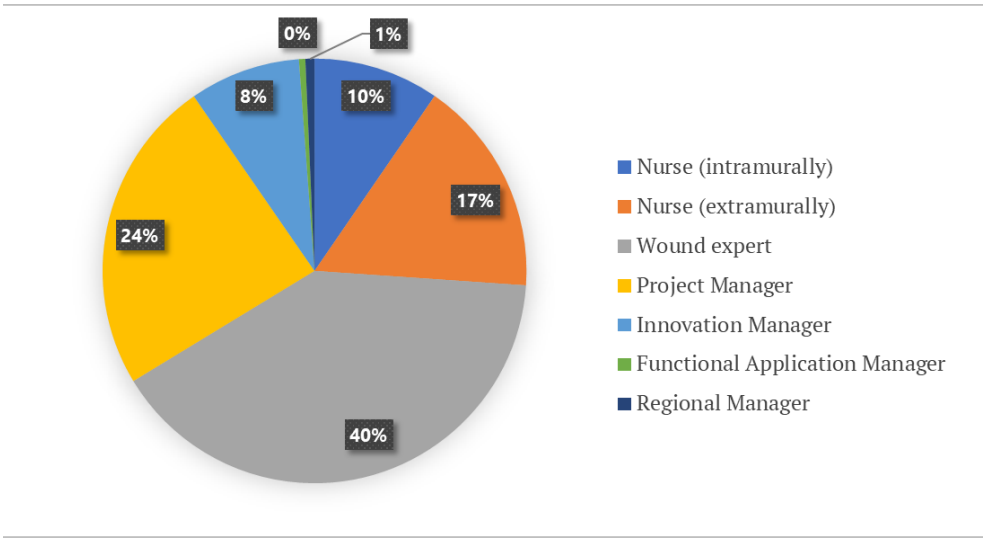


Figure 7. Distribution of **total costs** regarding the adoption of a Smart Glass in wound care between internal stakeholders based on TDABC (n=19). These costs include the scheduled project hours of the project manager and one wound expert.

Looking at hidden adoption costs only, the wound expert and the nurses working in the extramurally setting tend to be the main contributors for these costs, contribution for 32% of the costs each (Figure 8). In other words, the wound experts and nurses from the homecare setting spent most hours on the project whereas these hours are actually meant for care. There is also a big difference visible between the contribution of the nurses from the intramurally care (18%) and the nurses from the extramurally care (32%). The innovation manager has approximately the same contribution to the hidden adoption costs (16%) as the nurse working in the intramurally care (18%). Furthermore, the regional manager and functional application manager have hardly contributed to the hidden adoption costs (both 1%) which is also the case for the project manager (0%) since the project manager did not spend time outside of the scheduled hours.

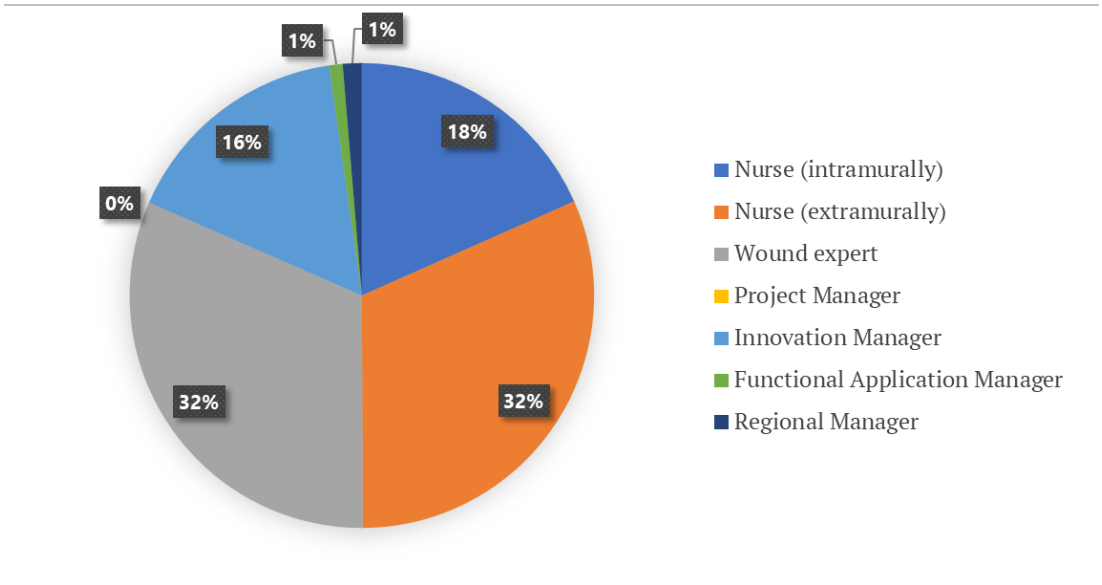


Figure 8. Distribution of **hidden costs** regarding the adoption of a Smart Glass in wound care between internal stakeholders based on TDABC (n=19).

5.3.3 Adoption versus Care

Next to the main cost drivers and the contribution of stakeholders therein, it is important to know what the ratio is between the hours spent on learning the technology and the hours where actual care was given. One FTE includes approximately 1500 hours a year of which on average 1200 hours are spent on patient care. This means, that in this project, which is running for approximately six months up until the moment of writing, 600 hours could be spent on patient care per FTE. A total of 15 FTE's participated in this projects' pilot group resulting in a total of 9000 hours available for patient care. The total amount of hours that caregivers spent on the adoption process is in total 304 (total of hours spent within working hours minus the scheduled hours of the project manager). As a result, 3,4% of the time that should have been spent on care is during the project spent on the adoption process.

.

6. Discussion

The aim of this study was to identify factors that influence successful adoption together with mapping and estimating cost drivers related to the adoption of a Smart Glass in a Dutch nursing and homecare organization. Results showed a complex interplay between individual and organizational factors that tend to influence successful adoption of a Smart Glass in wound care. Four factors on the organizational level (top management support, organizational readiness, absorptive capacity and organizational culture) and eight factors on the individual level (performance expectancy, effort expectancy, facilitating conditions, digital skills, hedonic motivation, price value, social influence and habit) influences the intention of using the Smart Glass or have an effect on real usage (Figure 4). Furthermore, main cost drivers involved in the adoption of the Smart Glass in wound care are personnel costs that was subdivided into scheduled project hours and hidden adoption costs. Coordination, learning the technique, communication and education were important cost drivers looking at these hidden costs only. Furthermore, 3,4% of the time that should have been spent on care is in this project spent on the adoption of the Smart Glass.

Relationships described in the conceptual model (section 3.1.3; Figure 2) were also replicated in this project. Therefore, these results support the idea of important factors on both the individual and organizational level that influence successful adoption of e-health (15, 56, 61). Besides, an interesting finding is that one individual factor was added to the conceptual model, namely 'digital skills'. Results of this study show that having the right (digital) skills is important for successful adoption of new technologies in a nursing and homecare organization. These results are in line with recent studies indicating that the level of digital skills is an important factor for successful e-health adoption in health organizations in general (98-100). One may argue whether 'digital skills' should be added to the model as a separate factor or whether this element falls under one of the existing factors such as facilitating conditions. The reason why 'digital skills' is added as an extra factor is based on the Knoster model of change (Figure 3). For successful change, six elements must be present to facilitate behaviour change: vision, incentive, agreement, action plan, skills and resources. Since resources are in this study comparable with

facilitating conditions, the element 'skills' is in the Knoster model of change also defined as a separate factor.

Besides adding one factor to the conceptual model, this study has been able to demonstrate that these factors does not influence adoption of e-health alone. An important finding of this research was that there seems to be a complex interplay between these factors, enabling the researcher to add multiple intervariable relationships to the conceptual model. One reason why previous models did not focus on intervariable relationships may be the use of different methods of data collection. Since the models used in the conceptual model were mainly based on quantitative research (questionnaire data), this project used a qualitative approach via semi-structured interviews. A meta-analysis of the UTAUT model also revealed that the majority of studies applying this model used a quantitative approach whereas a minority of studies used this model in combination with qualitative research (101). Qualitative research methods enables the researcher to get an in-depth opinion of participants and to explore experiences, attitudes and behaviour (102). Quantitative methods generate statistics and your focus of research depends on previously defined hypothesis (102). This difference may explain why it is harder to find intervariable relationships when using quantitative methods if these relationships are not included in a-priori hypothesis. Definitely not to argue that one method is better than the other, applying these theoretical models using both types of collection methods is very beneficial to gain more insights and a better understanding of e-health adoption. Based on these findings, it seems that the adoption of e-health is way more complex than previously thought and the possibilities of intervariable relationships should be taken into account into future research to gain more understanding in how successful adoption is influenced.

In the conceptual model, three moderating variables were taken into account, namely gender, experience and age. In this project, the nursing and homecare organization started with a pilot group consisting of mainly female nurses. Within this study the experiences of only 1 male nurse were taken into account lacking the ability to draw conclusions about the moderating effect of gender differences. Besides, results of this moderating gender effects on factors influencing successful adoption of e-health are contradictive in the literature. Where the original UTAUT model found a moderating effect of gender on the adoption of new technologies (56), multiple studies are contradictive to the original model

since they found no moderating effect of gender on successful adoption of new technologies (103-105). Other studies find that some relationships of factors influencing adoption of new technologies are moderated by gender, but not all of them (56, 106). While these studies all use the same UTAUT framework, the differences might be explained due to the fact that they focus on different technologies. The moderating effect of gender may differ for each form of e-health. It may also be the case that gender influences not the direct relationship between the factors and e-health adoption, but that gender has a moderating effect on the intervariable relationships. Therefore, future studies are advised to take the moderating effect of gender into account, not only at the direct relationships but also at the relationships between the different factors. Experience as moderating effect was also not included in this study. Within this pilot group all the nurses started this project at the same time and therefore all the nurses have the same amount of experience with the Smart Glass. To study the moderating effect of experience, it is required to compare the use of multiple forms of e-health within the organization which is already done in other studies (56, 107, 108). Another way of investigating the moderating effect of experience is to compare different pilot groups that started the adoption phase on different time points. When doing this, one group has more experience using e-health compared to another group enabling to measure the effect of experience on e-health adoption.

In the future, the organization wants to extend the use of the Smart Glass towards other teams, but also in collaboration with other healthcare organizations. One interesting finding is that the functional application manager advices the organization to wait with expanding the Smart Glass until cloud services are ready and completely implemented in the organization. Even though the organization seems not ready yet for further expansion of the Smart Glass, concrete plans have already been made. Results of this research show that if the organization continues to expand the Smart Glass before having the right facilitating conditions, successful e-health adoption in the new teams will eventually fail. In addition, the internal IT department is also not ready yet to provide the right support for their employees. Therefore, the workloads of the wound experts will increase even more since results from this study showed that the nurses go for questions mainly to the wound experts. If the organization chooses to continue with the expansion of the Smart

Glass, it is advisable to keep track of the productivity and workloads of the wound experts and define borders when support should be shifted towards the internal IT department.

Also, in line with previous findings, this study confirmed that personnel costs are an important cost driver in healthcare (87, 109, 110). In previous studies, the TDABC model was applied in different ways such as investigating decision making and transparency in healthcare (109) as well as investigating costs in particular treatments or patient groups (110). This study adds to these findings, that personnel costs are also a main cost driver in the adoption process of e-health. Interestingly, results showed that nurses working in the intramurally setting contributed to half the amount of adoption costs compared to nurses working in the extramurally setting. One reason for this big difference might be that the intramurally care used the Smart Glass less compared to the extramurally setting mainly due to a lack of facilitating conditions. Besides, there were also organizational culture differences between these two settings. The extramurally care tend to be more proactive and more individualistic whereas the intramurally care tend to rely more on their colleagues and they need more guidance and support. In the nursing home the project did first not come off the ground which may explain why the contribution of the wound expert is high. Hidden adoption costs of the wound expert include only the costs of the wound expert from the intramurally care, since the wound expert working in the extramurally care got scheduled hours and were therefore excluded from the hidden adoption costs. Since the intramurally care needed more guidance and support, the wound expert from the intramurally care invested much time in making it as easy as possible for the nurses to use the Smart Glass. Furthermore, the wound experts were leading this project in collaboration with the project manager and therefore also contributed for a large extend on the total and hidden adoption costs.

Another important finding is that 3,4 percent of the assumed time on patient care consisted of hidden time spending regarding the adoption of the Smart Glass. Since the nurses are implementing a new technology in the same amount of time that they usually have on patient care, workloads are increasing and productivity decreases. These results suggest that there is also an individual component of absorptive capacity whereas theories only suggest an effect of absorptive capacity on the organizational level. Absorptive capacity on the individual level might be defined as to which extend an individual is capable pertaining new knowledge and knowledge creation to gain and sustain advantages

in performing activities. When workloads are too high or the productivity is too low, this may result in failure of the adoption process. This is also in line with other studies showing that during early implementation of new technologies, reduced productivity brings indirect costs and is related to lower e-health uptake (111-114). Lower productivity and higher workloads are often also seen as barriers for e-health adoption (114-116). Therefore, one may suggest based on the results of this study and the literature that absorptive capacity affects behavioural intention on both the individual level as well as the organizational level. One important thing to note is that in healthcare you see that multiple forms of e-health are implemented at the same time. Sometimes it is even suggested to have multiple new technologies implemented in parallel if they complement each other (117). On the one hand, if all these different projects result in reduced productivity of 3.4 percent each, you can imagine that workloads will become too high resulting in adoption failure. On the other hand, multiple forms of e-health might be implemented at the same time but if that's the case, the organization should take into account that extra time per employee is required for the adoption process. Looking at the nursing and homecare organization of this project, they are currently busy with multiple forms of e-health such as and electronic patient record (EPR), using medicine dispensers or for example image care. It is important to take these hidden adoption costs into account and to try to identify and estimate them to gain insights in workloads and productivity of healthcare workers. Especially in the early stages of the implementation process each implementation of new technology result into higher workloads and lower productivity. Therefore, it would be advisable to implement different forms of e-health in series or to schedule in the case of a Smart Glass at least 3.4% of the time as project hours. Implementing new technologies in parallel without explicitly scheduling time for this process might increase workloads of the end users so much that adoption of these technologies is doomed to fail.

One thing that should be taken into account is that in this study the TDABC model was applied in interviews. There were no physical observations or time measures and all the results are based on estimations of the stakeholders. Therefore, this study can only make estimations on the total costs regarding the adoption of e-health and no claims can be made that these are the total costs involved in this project. Although these estimations may not be the exact numbers, they give first indications what cost drivers are in the

adoption process of e-health in healthcare. Gaining more insights in these cost drivers is important for future e-health implementations and to increase the amount of successful adoption cases.

Due to the COVID-19 pandemic, all interviews were held online using a conference software which obviously has its advantages and disadvantages. Technical difficulties were challenging since the participants were not familiar with the conference software Zoom. Joining the meeting took much longer resulting in reduced time for the interviews. Because the participants were not able to download external programs on their working phone or tablet most of the interviews via Zoom were conducted on their private phone which was sometimes not ideal when showing the participants images or graphs during the interview. Also, one interview was interrupted due to connection issues. Conducting online interviews made it for the researcher harder to read participants' visual cues and it felt less personal. Research shows contradictive results about the quality of data when interviews are conducted online instead of face-to-face. However, in a situation such as a COVID-19 pandemic digital interviews tend to be a good alternative for face-to-face interviews (118).

One important thing to note is that it is hard to conclude that these findings are generalizable for other forms of e-health since this project focussed specifically at the adoption of a Smart Glass in wound care. From these results it remains unknown if the relationships between the factors and e-health adoption last when looking at other forms of e-health applied within this organization. To make these results generalizable, follow-up studies are required which can be done using qualitative methods for other e-health forms or using the questionnaires used in this study as a pilot (Table S1). As mentioned before, it is recommended to use both (quantitative and qualitative) research methods to gain better insights and understanding in the adoption of e-health in this nursing and homecare organization. The next step to make these findings even more generalizable is to extend the research towards multiple nursing and homecare organizations. Extending the research towards multiple nursing and homecare organizations enables to include the factors size and centralization on the organizational level. These factors were excluded in this project due to the disability to compare multiple organizations with each other.

7.Future Perspectives

This research project mainly focussed on factors that influence successful adoption and to identify and map the costs involved in the adoption process of a Smart Glass in a Dutch nursing and homecare organization. What remains still unknown from this project is for example to what extend the Smart Glass is adopted in the organization. This might give a more in-depth insight in how factors influence different levels of e-health adoption and if different levels of e-health adoption come with a different amount of costs. What also remains unclear from this study is to what extend factors influence effective adoption of e-health. This might be relevant for organizations to know if a factor contributes to successful adoption more, since they can focus and even invest in these factors. To have detailed knowledge about these factors might result in higher cases of successful adoption. Related to this, it might be interesting to also look at possible ways of how these factors can be influenced. Especially for the organization this is insightful since they can influence successful e-health adoption themselves.

The adoption process of the Smart Glass is running for approximately 14 weeks up until the time of writing and the number of cases where the Smart Glass is used is relatively low. It might be interesting for future research to do a follow up study using value-based network analysis looking at the complex dynamics between the factors. Results in this study showed that there is a complex interplay between the different factors that influence successful adoption. However, you might expect also relationships between use behaviour back on the factors which is visualized in Figure 9. If the organization is using the product more often and gains more experience you might expect the following relationships:

A) Organization will get feedback from the end users and will therefore able to optimize processes, such as IT processes and support. As a result, the organizational readiness will increase when there is more experience using e-health.
B) Top management support might change since stories about using the Smart Glass might influence top management's attitude regarding new technologies. For example, if there are lots of positive stories and evidence that e-health is useful

for the patient and reducing the workload of the wound experts, top management might be more likely to change their attitude towards organizational changes.

C) Habits might be created when the product is used more often, since it may be implemented more in routines of the end users.

D) On the one hand, more experiences using e-health might increase the knowledge and insights in other implementations regarding e-health. Therefore, use behaviour might influence the competitive advantage of the organization. On the other hand, negative experiences or if an individual is using too many technologies at the same time might result in lower absorptive capacity.

E) Good experiences using the Smart Glass might confirm expected benefits or gain insights in other benefits that come together with using the Smart Glass.

F) If the Smart Glass is used more often, end users get used to the technique and this might increase the ease of using this new technology.

G) Using the Smart Glass more often gains more insight in the (practical) benefits. Especially the early stage of the implementation process is expensive and the benefits of the product are sometimes not visible yet. Over time these expenses might decrease and the benefits might become clearer. More experience using the product therefore might affect the price value of the new technology.

H) If the Smart Glass is used more often and end users gain more experiences, they will talk about it among colleagues. This might affect organizational culture. For example, in this project the intramurally care uses the Smart Glass less often. If they hear good experiences of the nurses from the extramurally care they might become more enthusiastic and learn from their experiences.

I) Gaining more experiences with the Smart Glass might increase knowledge using technology together with end users' level of digital skills.

J) If people perceive the use of e-health as easy, they might actually use it more often.

Altogether, e-health will be implemented more and more in the future since it seems to be a proper solution for a sustainable Dutch healthcare system. However, in order to successfully adopt all these new technologies, it is required to have in-depth insights in factors that influence successful adoption and to make sure that changes in both productivity and workloads of the end users of the techniques stay within limits.

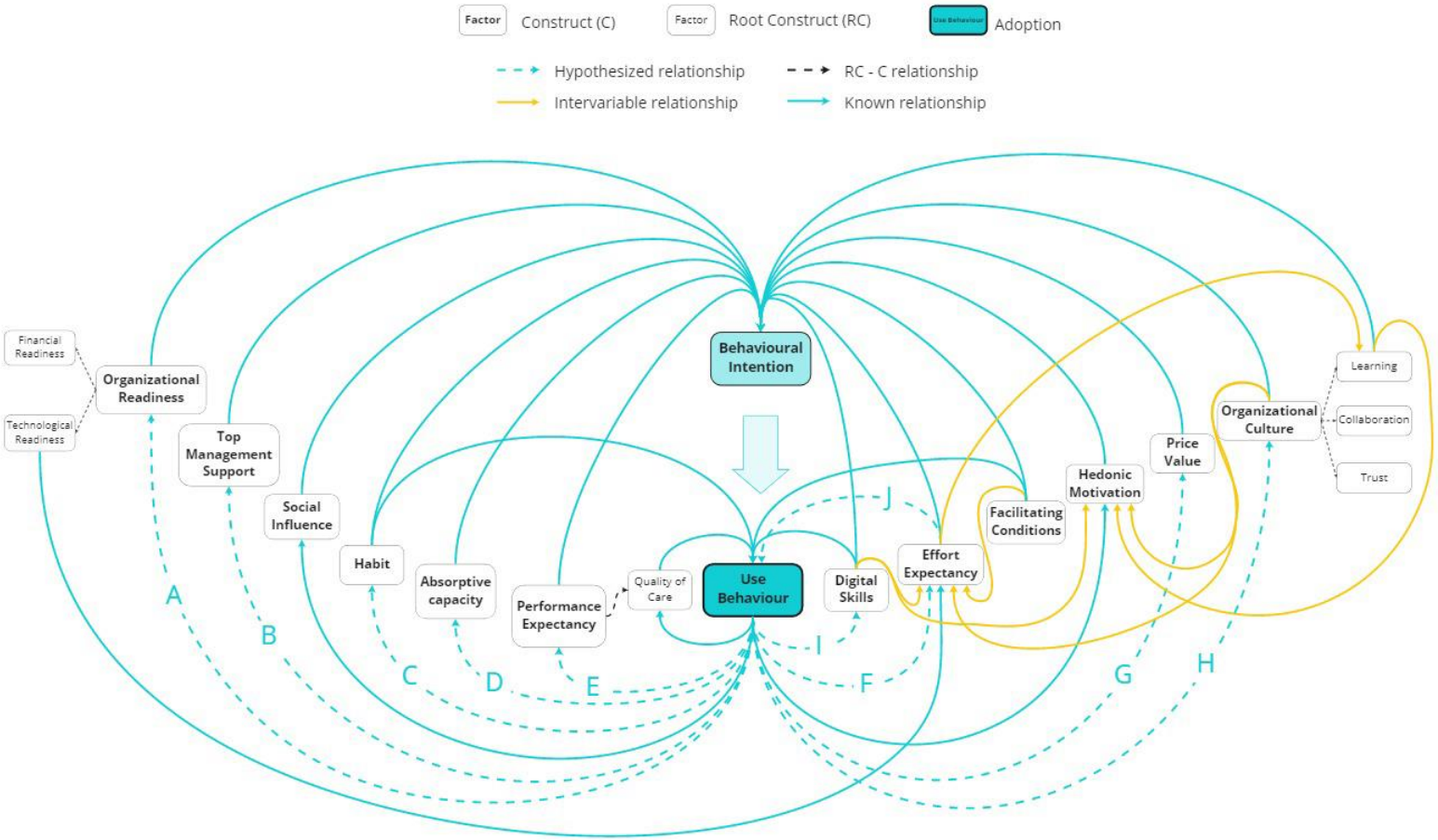


Figure 9. Visualization of the (hypothesized) contribution of factors on successful adoption of a Smart Glass in a nursing and homecare organization. Straight blue lines indicate known relationships between factors influencing e-health adoption. Dashed blue lines are hypothesized relationships. Yellow straight lines are intervariable relationships between factors. Letters A til J explain the assumed relationships.

8. Conclusion

Factors on both the individual level and the organizational level together with important cost drivers tend to influence adoption of a Smart Glass in a Dutch nursing and homecare organization. Seven factors on the individual level include performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value and habit. Current results demonstrated that an eighth individual factor is important namely 'digital skills'. Additionally, four factors on the organizational level tend to influence adoption of the Smart Glass: organizational readiness, top management support, absorptive capacity and organizational culture. Stakeholders that are actively involved in the adoption process are the project manager, wound experts, nurses from the intramurally- and extramurally setting, digicoach, innovation manager and functional application manager. Since the organization is not ready for further expansion of the Smart Glass, the functional application manager is currently working on the organizational readiness. Adoption of the Smart Glass also differed for nurses working in the nursing home compared to nurses working in homecare mainly due to differences in organizational culture and the availability of facilitating conditions. Especially the nurses, wound experts and the project manager proactively contributed to improvements in lacking facilitating conditions. Furthermore, most important cost drivers in this project were personnel costs, material costs and external support. Of the total costs, 19% consists of hidden costs - time spending on the project which should have been spent on care. In total, 3.4% of the time that normally is spent on normal operations, is now spent on the adoption of the Smart Glass. To increase cases of successful e-health adoption in the future, it is required to take these factors and hidden cost drivers into account and it is suggested to optimize absorptive capacity of both the organization and individual by implementing different forms of e-health one by one or to schedule specific dedicated time per healthcare worker if parallel implementation is beneficial or required. Since results of this study demonstrate that e-health adoption is a complex interplay between different factors, future research should not focus on unidirectional relationships only. To gain a better understanding of successful adoption, future research should take circular effects into account since it is hypothesized to affect successful adoption.

9. References

1. Schoen C, Osborn R, Doty MM, Bishop M, Peugh J, Murukutla N. Toward Higher-Performance Health Systems: Adults' Health Care Experiences In Seven Countries, 2007: Actual experiences with health care systems bring to light, and to life, the systemwide problems in these countries. Health Affairs. 2007;26(Suppl2):w717-w34.
2. Peiró M, Barrubés J. New context and old challenges in the healthcare system. Revista Española de Cardiología (English Edition). 2012;65(7):651-5.
3. Affairs EaF. Joint report on health care and long-term care systems & fiscal sustainability. Volume 2, Country documents. European Economy Institutional Papers 2016;2.
4. Organization WH. World health statistics 2016: monitoring health for the SDGs sustainable development goals: World Health Organization; 2016.
5. Schut E, Sorbe S, Høj J. Health care reform and long-term care in the Netherlands. 2013.
6. Martín JJM, Puerto Lopez del Amo Gonzalez M, Dolores Cano Garcia M. Review of the literature on the determinants of healthcare expenditure. Applied Economics. 2011;43(1):19-46.
7. Dall TM, Gallo PD, Chakrabarti R, West T, Semilla AP, Storm MV. An aging population and growing disease burden will require alarge and specialized health care workforce by 2025. Health affairs. 2013;32(11):2013-20.
8. Oulton JA. The global nursing shortage: an overview of issues and actions. Policy, Politics, & Nursing Practice. 2006;7(3_suppl):34S-9S.
9. Van Ewijk C, Van Der Horst A, Besseling P. The future of health care. 2013.
10. Laschinger HKS, Grau AL, Finegan J, Wilk P. Predictors of new graduate nurses' workplace well-being: Testing the job demands–resources model. Health care management review. 2012;37(2):175-86.
11. Davey MM, Cummings G, NEWBURN-COOK CV, Lo EA. Predictors of nurse absenteeism in hospitals: a systematic review. Journal of nursing management. 2009;17(3):312-30.
12. Van Bogaert P, van Heusden D, Timmermans O, Franck E. Nurse work engagement impacts job outcome and nurse-assessed quality of care: model testing with nurse practice environment and nurse work characteristics as predictors. Frontiers in psychology. 2014;5:1261.
13. Leone C, Bruyneel L, Anderson JE, Murrells T, Dussault G, de Jesus ÉH, et al. Work environment issues and intention-to-leave in Portuguese nurses: a cross-sectional study. Health Policy. 2015;119(12):1584-92.
14. Maarse H, Jeurissen P, Ruwaard D. Concerns over the financial sustainability of the Dutch healthcare system. CESifo DICE Report. 2013;11(1):32-6.
15. Faber S--vG, M.-//-de Reuver, M. eHealth adoption factors in medical hospitals: A focus on the Netherlands. International journal of medical informatics. 2017;100:77-89.
16. Eriksen S, Wiese R. Policy induced increases in private healthcare financing provide short-term relief of total healthcare expenditure growth: Evidence from OECD countries. European Journal of Political Economy. 2019;59:71-82.
17. Li J--T-K, A.-//-Seale, H.-//-Ray, P.-//-Macintyre, C. R. Health Care Provider Adoption of eHealth: Systematic Literature Review. Interactive journal of medical research. 2013;2(1):e7.
18. Car J, Black A, Anandan C, Cresswell K, Pagliari C, McKinstry B, et al. The impact of eHealth on the quality and safety of healthcare. A Systemic Overview & Synthesis of the Literature Report for the NHS Connecting for Health Evaluation Programme. 2008.
19. White L, Terner C. E-health, phase two: the imperative to integrate process automation with communication automation for large clinical reference laboratories. Journal of healthcare information management: JHIM. 2001;15(3):295-305.
20. Castillo-Salgado C. Trends and directions of global public health surveillance. Epidemiologic reviews. 2010;32(1):93-109.
21. Black AD--C, J.-//-Pagliari, C.-//-Anandan, C.-//-Cresswell, K.-//-Bokun, T.-//-McKinstry, B.-//-Procter, R.-//-Majeed, A.-//-Sheikh, A. The impact of ehealth on the quality and safety of health care: A systematic overview. PLoS Medicine. 2011;8(1).
22. Ossebaard HC--VG-P, L. EHealth and quality in health care: Implementation time. International Journal for Quality in Health Care. 2016;28(3):415-9.
23. Geenhuizen MV, Faber S. eHealth adoption factors in medical hospitals: A focus on the Netherlands. 2015.
24. Vilans. Digitale vaardigheden in de zorg. 2019.
25. Digivaardig in de Zorg. Nut en noodzaak van het investeren in digitale vaardigheden in de zorg. 2020.

26. Noar SM, Harrington NG. eHealth applications: Promising strategies for behavior change: Routledge; 2012.
27. Sulaiman H--M, Asma-//-Ramli, Rohaini. Adoption of cloud-based e-health record through the technology, organization and environment perspective. 2018.
28. Xia F, Yang LT, Wang L, Vinel A. Internet of things. International journal of communication systems. 2012;25(9):1101.
29. Wortmann F, Flüchter K. Internet of things. Business & Information Systems Engineering. 2015;57(3):221-4.
30. Mitrasinovic S, Camacho E, Trivedi N, Logan J, Campbell C, Zilinyi R, et al. Clinical and surgical applications of smart glasses. Technology and Health Care. 2015;23(4):381-401.
31. Kotb MT, Haddara M, Kotb YT, editors. Back-propagation artificial neural network for ERP adoption cost estimation. International Conference on Enterprise Information Systems; 2011: Springer.
32. Wilson EV--B, S.-//-Lankton, N. K.-//-Ieee,. Current Trends in Patients' Adoption of Advanced E-Health Services. 43rd Hawaii International Conference on Systems Sciences Vols 1-5. Proceedings of the Annual Hawaii International Conference on System Sciences2010. p. 2384-+.
33. Tsiknakis M--K, A. Organizational factors affecting successful adoption of innovative eHealth services: A case study employing the FITT framework. International journal of medical informatics. 2009;78(1):39-52.
34. Cresswell K--S, A. Organizational issues in the implementation and adoption of health information technology innovations: an interpretative review. International journal of medical informatics. 2013;82(5):e73-86.
35. Swinkels ICS--H, M. W. J.-//-Schoenmakers, T. M.-//-Nijeweme-D'Hollosy, W. O.-//-Van Velsen, L.-//-Vermeulen, J.-//-Schoone-Harmsen, M.-//-Jansen, Yjfm-//-Van Schayck, O. C. P.-//-Friele, R.-//-de Witte, L. Lessons Learned From a Living Lab on the Broad Adoption of eHealth in Primary Health Care. Journal of medical Internet research. 2018;20(3).
36. Sulaiman H--M, A. I.-//-Ieee,. Factors affecting the adoption of integrated cloud-based e-health record in healthcare organizations: a case study of Jordan. Proceedings of the 2014 6th International Conference on Information Technology and Multimedia. International Conference on Information Technology & Multimedia2014. p. 102-7.
37. Razmak J--B, C. H.-//-Farhan, W. Development of a techno-humanist model for e-health adoption of innovative technology. International journal of medical informatics. 2018;120:62-76.
38. Lee J, Cain C, Young S, Chockley N, Burstin H. The adoption gap: Health information technology in small physician practices. Health Affairs. 2005;24(5):1364-6.
39. Organization WH. From innovation to implementation: eHealth in the WHO European region: World Health Organization. Regional Office for Europe; 2016.
40. Al-Qirim N. Strategic Ehealth Planning In Healthcare Organisations In New Zealand: A Telemedicine Perspective. BLED 2004 Proceedings. 2004:39.
41. Oliveira T, Fraga M. Literature review of information technology adoption models at firm level. 2011.
42. Gerritsen H. Adoption of Internet of Things in business: University of Twente; 2018.
43. Alkhwaldi A, Kamala MA. Why do users accept innovative technologies? A critical review of models and theories of technology acceptance in the information system literature. 2017.
44. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior Prentice-Hall Inc. Englewood Cliffs, NJ. 1980.
45. Ajzen I. The theory of planned behavior. Organizational behavior and human decision processes. 1991;50(2):179-211.
46. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: A comparison of two theoretical models. Management science. 1989;35(8):982-1003.
47. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS quarterly. 2003:425-78.
48. Rogers EM. Diffusion of innovations (5th ed.): New York: Free Press; 2003.
49. Rogers EM. The diffusion of innovations perspective. Taking care: Understanding and encouraging self-protective behavior. 1987:79-94.
50. Tornatzky LG, Fleischer M, Chakrabarti AK. Processes of technological innovation: Lexington books; 1990.
51. Gopalakrishnan S, Damanpour F. A review of innovation research in economics, sociology and technology management. Omega. 1997;25(1):15-28.
52. Keller JM. Motivational design of instruction. Instructional design theories and models: An overview of their current status. 1983;1(1983):383-434.
53. Ajzen I. From intentions to actions: A theory of planned behavior. Action control: Springer; 1985. p. 11-39.

54. Thompson RL, Higgins CA, Howell JM. Personal computing: Toward a conceptual model of utilization. MIS quarterly. 1991:125-43.
55. Bagozzi RP. The legacy of the technology acceptance model and a proposal for a paradigm shift. Journal of the association for information systems. 2007;8(4):3.
56. Venkatesh V, Thong JY, Xu X. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly. 2012:157-78.
57. Neufeld DJ, Dong L, Higgins C. Charismatic leadership and user acceptance of information technology. European Journal of Information Systems. 2007;16(4):494-510.
58. Chang I-C, Hwang H-G, Hung W-F, Li Y-C. Physicians' acceptance of pharmacokinetics-based clinical decision support systems. Expert systems with applications. 2007;33(2):296-303.
59. Mun YY, Jackson JD, Park JS, Probst JC. Understanding information technology acceptance by individual professionals: Toward an integrative view. Information & Management. 2006;43(3):350-63.
60. Toebes I. Implementation and effect analysis of video consultation in a Dutch hospital: University of Twente; 2020.
61. Karim NSA, Mohamed N. Organizational Readiness and its Contributing Factors to Adopt KM Processes: A Conceptual Model.
62. van Houwelingen CT, Barakat A, Best R, Boot WR, Charness N, Kort HS. Dutch nurses' willingness to use home telehealth: Implications for practice and education. Journal of Gerontological Nursing. 2015;41(4):47-56.
63. Ariens LF, Schussler-Raymakers FM, Frima C, Flinterman A, Hamminga E, Arents BW, et al. Barriers and facilitators to eHealth use in daily practice: perspectives of patients and professionals in dermatology. Journal of medical Internet research. 2017;19(9):e300.
64. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management science. 2000;46(2):186-204.
65. Warshaw PR. A new model for predicting behavioral intentions: An alternative to Fishbein. Journal of marketing research. 1980;17(2):153-72.
66. Faber S. Factors influencing eHealth adoption by Dutch hospitals: An empirical study. 2014.
67. Brown SA, Venkatesh V. A model of adoption of technology in the household: A baseline model test and extension incorporating household life cycle. Management Information Systems Quarterly. 2005;29(3):11.
68. Thong JY. An integrated model of information systems adoption in small businesses. Journal of management information systems. 1999;15(4):187-214.
69. Holbrook MB, Hirschman EC. The experiential aspects of consumption: Consumer fantasies, feelings, and fun. Journal of consumer research. 1982;9(2):132-40.
70. Limayem M, Hirt SG, Cheung CM. How habit limits the predictive power of intention: The case of information systems continuance. MIS quarterly. 2007:705-37.
71. Ajzen I, Fishbein M. Attitudes and the attitude-behavior relation: Reasoned and automatic processes. European review of social psychology. 2000;11(1):1-33.
72. Fazio RH. Multiple processes by which attitudes guide behavior: The MODE model as an integrative framework. Advances in experimental social psychology. 23: Elsevier; 1990. p. 75-109.
73. Iacovou CL, Benbasat I, Dexter AS. Electronic data interchange and small organizations: Adoption and impact of technology. MIS quarterly. 1995:465-85.
74. Premkumar G. A meta-analysis of research on information technology implementation in small business. Journal of organizational computing and electronic commerce. 2003;13(2):91-121.
75. Fichman RG. The diffusion and assimilation of information technology innovations. Framing the domains of IT management: Projecting the future through the past. 2000;105127:105-28.
76. Premkumar G, Roberts M. Adoption of new information technologies in rural small businesses. Omega. 1999;27(4):467-84.
77. Zahra SA, George G. Absorptive capacity: A review, reconceptualization, and extension. Academy of management review. 2002;27(2):185-203.
78. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. The milbank quarterly. 2004;82(4):581-629.
79. Taplay K, Jack SM, Baxter P, Eva K, Martin L. Organizational culture shapes the adoption and incorporation of simulation into nursing curricula: A grounded theory study. Nursing Research and Practice. 2014;2014.
80. Lee H, Choi B. Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination. Journal of management information systems. 2003;20(1):179-228.
81. De Long D. Building the knowledge-based organization: How culture drives knowledge behaviors. Centers for Business Innovation–Working Paper. 1997:1-29.
82. Eppler MJ, Sukowski O. Managing team knowledge: core processes, tools and enabling factors. European Management Journal. 2000;18(3):334-41.

83. Schein EH. Organizational culture and leadership (Jossey-Bass business & management series): Jossey Bass Incorporated; 2004.
84. Lau F. eHealth economic evaluation framework. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]: University of Victoria; 2017.
85. Brynjolfsson E, Yang S, editors. The intangible costs and benefits of computer investments: Evidence from the financial markets. Atlanta, Georgia: Proceedings of the International Conference on Information Systems; 1999.
86. Knoster T, editor Model for Manging Complex Change. Presentation at TISH Conference; 1991.
87. Keel G, Savage C, Rafiq M, Mazzocato P. Time-driven activity-based costing in health care: a systematic review of the literature. Health Policy. 2017;121(7):755-63.
88. Dejnega O. Method time driven activity based costing–literature review. Journal of Applied Economic Sciences (JAES). 2011;6(15):9-15.
89. Kaplan RS, Anderson SR. Time-driven activity-based costing. Available at SSRN 485443. 2003.
90. Halamka J, Aranow M, Ascenzo C, Bates DW, Berry K, Debor G, et al. E-Prescribing collaboration in Massachusetts: early experiences from regional prescribing projects. Journal of the American Medical Informatics Association. 2006;13(3):239-44.
91. Li J, Talaei-Khoei A, Seale H, Ray P, MacIntyre CR. Health care provider adoption of eHealth: systematic literature review. Interactive journal of medical research. 2013;2(1):e2468.
92. Kujala S, Heponiemi T, Hilama P. Clinical Leaders' Self-Perceived eHealth Competencies in the Implementation of New eHealth Services. Studies in health technology and informatics. 2019;264:1253-7.
93. Merrell RC, Doarn CR. m-Health. Mary Ann Liebert, Inc. 140 Huguenot Street, 3rd Floor New Rochelle, NY 10801 USA; 2014.
94. Smith L, editor Stakeholder analysis: a pivotal practice of successful projects. Project Management Institute Annual Seminars & Symposium; 2000.
95. Gardner JR, Rachlin R, Sweeny A. Handbook of strategic planning: John Wiley & Sons Incorporated; 1986.
96. Payroll P. Wat zijn de totale arbeidskosten van een werkgever?2019. Available from: https://www.pwnet.nl/arbeidsrecht/artikel/2019/10/wat-zijn-de-totale-arbeidskosten-van-een-werkgever-10131389.
97. Green J, Thorogood N. Qualitative methods for health research: sage; 2018.
98. Fornes-Romero G, Doñate-Martinez A, Garces-Ferrer J, Fredskild T, Hansen H, Traver-Salcedo V, et al. Digital and innovation skills in health care professionals in Europe. European Journal of Public Health. 2020;30(Supplement_5):ckaa166. 027.
99. Khilnani A, Schulz J, Robinson L. The COVID-19 pandemic: new concerns and connections between eHealth and digital inequalities. Journal of Information, Communication and Ethics in Society. 2020.
100. Díaz de León Castañeda C, Martínez Domínguez M. Factors Related to Internet Adoption and Its Use to Seek Health Information in Mexico. Health Communication. 2020:1-8.
101. Dwivedi YK, Rana NP, Chen H, Williams MD, editors. A Meta-analysis of the Unified Theory of Acceptance and Use of Technology (UTAUT). IFIP international working conference on governance and sustainability in information systems-managing the transfer and diffusion of it; 2011: Springer.
102. Dawson C. Practical research methods: A user-friendly guide to mastering research techniques and projects: how to books; 2002.
103. Lee E, Han S. Determinants of adoption of mobile health services. Online Information Review. 2015.
104. Khechine H, Lakhal S, Pascot D, Bytha A. UTAUT model for blended learning: The role of gender and age in the intention to use webinars. Interdisciplinary Journal of E-Learning and Learning Objects. 2014;10(1):33-52.
105. Pan S, Jordan-Marsh M. Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. Computers in human behavior. 2010;26(5):1111-9.
106. Venkatesh V, Brown SA, Maruping LM, Bala H. Predicting different conceptualizations of system use: the competing roles of behavioral intention, facilitating conditions, and behavioral expectation. MIS quarterly. 2008:483-502.
107. Hoque R, Sorwar G. Understanding factors influencing the adoption of mHealth by the elderly: An extension of the UTAUT model. International journal of medical informatics. 2017;101:75-84.
108. Alam MZ, Hu W, Barua Z. Using the UTAUT model to determine factors affecting acceptance and use of mobile health (mHealth) services in Bangladesh. Journal of Studies in Social Sciences. 2018;17(2).
109. DiGioia III AM, Greenhouse PK, Giarrusso ML, Kress JM. Determining the true cost to deliver total hip and knee arthroplasty over the full cycle of care: preparing for bundling and reference-based pricing. The Journal of arthroplasty. 2016;31(1):1-6.

110. Balakrishnan K, Goico B, Arjmand EM. Applying cost accounting to operating room staffing in otolaryngology: time-driven activity-based costing and outpatient adenotonsillectomy. Otolaryngology--Head and Neck Surgery. 2015;152(4):684-90.
111. De Grood C--R, A.-//-Kwon, Y.-//-Santana, M. J. Adoption of e-health technology by physicians: a scoping review. Journal of Multidisciplinary Healthcare. 2016;9.
112. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. BMC health services research. 2010;10(1):1-17.
113. Castillo VH, Martínez-García AI, Pulido J. A knowledge-based taxonomy of critical factors for adopting electronic health record systems by physicians: a systematic literature review. BMC medical informatics and decision making. 2010;10(1):1-17.
114. Detollenaere J, Christiaens W, Dossche D, Camberlin C, Lefèvre M, Devriese S. Barriers and facilitators for eHealth adoption by general practitioners in Belgium. Analysis based on the integrated allowance for GP practices. 2020.
115. Ludwick DA, Doucette J. Adopting electronic medical records in primary care: lessons learned from health information systems implementation experience in seven countries. International journal of medical informatics. 2009;78(1):22-31.
116. Police R, Foster T, Wong K. Adoption and use of health information technology in physician practice organisations: systematic review. Journal of Innovation in Health Informatics. 2010;18(4):245-58.
117. Coyle D, Doherty G, editors. Clinical evaluations and collaborative design: developing new technologies for mental healthcare interventions. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems; 2009.
118. Edwards R, Holland J. Reviewing challenges and the future for qualitative interviewing. International Journal of Social Research Methodology. 2020;23(5):581-92.

10. Supplementary

10.1 Constructs Conceptual Framework

Table S1. Operationalization of constructs used to measure factors that influence successful e-health adoption according to the conceptual model. Latent variables, that can be measured formative (F) or reflective (R), will be inferred by the scores from the observational variables. Items in black are originated from the source, blue items are translated from the original item and used in this research.

Latent variable	R/F	Observational variables (items)	Code	Sources
Performance expectancy	**R**	I find [EH] useful in my job. Ik vind [EH] nuttig in mijn dagelijkse werkzaamheden.	PE1	**(56)**
		Using [EH] increases my chances of achieving things that are important to me. Het gebruik van [EH] vergroot mijn kansen om dingen te bereiken die voor mijn werkzaamheden belangrijk zijn.	PE2	
		Using [EH] enables me to accomplish tasks more quickly. Het gebruik van [EH] helpt mij om taken sneller uit te voeren.	PE3	
		Using [EH] increases my productivity. Het gebruik van [EH] verhoogd mijn productiviteit.	PE4	
Effort expectancy	**R**	Learning to operate [EH] is easy for me. Het is gemakkelijk voor mij om [EH] te leren gebruiken.	EE1	**(56)**
		My interaction with [EH] is clear and understandable. Mijn interactie met [EH] is duidelijk en begrijpelijk.	EE2	
		I find the [EH] easy to use. Ik vind [EH] makkelijk te gebruiken.	EE3	
		It is easy for me to become skilful at using [EH]. Het is voor mij gemakkelijk om vaardig te worden in het gebruik van [EH].	EE4	
	R	People who are important to me think that I should use [EH].	SI1	**(56)**

Social influence		Mensen die voor mij belangrijk zijn, vinden dat ik [EH] moet gebruiken.		
		People who influence my behaviour think that I should use [EH]. Mensen die mijn gedrag beïnvloeden, vinden dat ik [EH] moet gebruiken.	SI2	
		People whose opinions that I value prefer that I use [EH].. Mensen waarvan ik hun mening waardeer, geven er de voorkeur aan dat ik [EH] gebruik.	SI3	
Facilitating conditions	**R**	I have the resources necessary to use [EH].. Ik heb de middelen die nodig zijn om [EH] te gebruiken.	FC1	**(56)**
		I have the knowledge necessary to use [EH]. Ik heb de kennis die nodig is om [EH] te gebruiken.	FC2	
		[EH] is compatible with other systems and technologies I use. In combinatie met andere technologieën die ik gebruik, werkt [EH] goed.	FC3	
		I can get help from others when I have difficulties using [EH]. Ik kan hulp van anderen krijgen als ik problemen heb met [EH].	FC4	
Hedonic motivation	**R**	Using [EH is fun. Het is leuk om [EH] te gebruiken.	HM1	**(56)**
		Using [EH] is enjoyable. Het is prettig [EH] te gebruiken.	HM2	
		Using [EH] is very entertaining. Het is erg vermakelijk om [EH] te gebruiken.	HM3	
Price Value	**R**	[EH] is reasonably priced. De prijs die voor [EH] wordt betaald vind ik schappelijk.	PV1	**(56)**
		[EH] is a good value for money. Er is een goede prijs-kwaliteitsverhouding voor [EH].	PV2	
		At the current price, [EH] provides a good value.	PV3	

		Voor de huidige prijs, biedt [EH] een goede waarde.		
Habit	**R**	The use of [EH] has become a habit for me. Het gebruik van [EH] is voor mij een gewoonte geworden.	HT1	**(56)**
		I am addicted to using [EH]. Ik ben verslaafd aan het gebruik van [EH].	HT2	
		I must use [EH]. Voor mijn gevoel moet ik [EH] gebruiken.	HT3	
		Using [EH] has become natural to me. Het gebruik van [EH] is voor mij vanzelfsprekend geworden.	HT4	
Behavioural Intention	**R**	I intend to use [EH] in the future. Ik ben van plan [EH] in de toekomst te blijven gebruiken.	BI1	**(56)**
		I will always try to use [EH] in my daily life. Ik zal altijd proberen om [EH] in het dagelijks te gebruiken.	BI2	
		I plan to continue to use [EH] frequently. Ik ben van plan [EH] regelmatig te blijven gebruiken.	BI3	
Use Behaviour	**R**	Usage frequency ranging from "never" to "many times per day".	UB	**(56)**
Centralisation	**R**	De structuur van mijn organisatie is in sterke mate gecentraliseerd.	CE_1	**(66)**
		Besluiten over het implementeren van nieuwe IT worden centraal genomen.	CE_2	
		In mijn organisatie kunnen medewerkers actie ondernemen zonder supervisor.	CE_3	**(61)**
		In mijn organisatie worden werknemers aangemoedigd om hun eigen beslissingen te nemen.	CE_4	
		In mijn organisatie hoeven medewerkers bij het maken van beslissingen niet te verwijzen naar iemand anders.	CE_5	
		In mijn organisatie hoeven medewerkers vóór het ondernemen van actie geen toestemming te vragen bij een supervisor.	CE_6	

		In mijn organisatie kunnen medewerkers beslissingen nemen zonder goedkeuring.	CE_7	
Organizational readiness	**F**	A higher-level formative construct consisting of two dimensions: 1) Technological readiness 2) Financial readiness. (see below)	OR	**(66)**
Technological readiness	**F**	A higher-level formative construct consisting of four dimensions: 1A) IT infrastructure, 1B) IT human resources (support), 1C) IT governance, 1D) IT security. 1E) IT support. (see below)	TR	**(66)**
IT infrastructure	**R**	De IT-infrastructuur in uw organisatie is toereikend voor eHealth.	IT_1	**(66)**
		Draadloos Internet is overal te allen tijde beschikbaar voor medewerkers binnen mijn organisatie.	IT_2	
		Draadloos internet is overal ten allen tijde beschikbaar voor patiënten binnen mijn organisatie.	IT_3	
		Mijn organisatie faciliteert het gebruik van Bring Your Own Device (BYOD) door de medisch professionals.	IT_4	
IT human resources (support)	**R**	Bij de implementatie van een e-health toepassing beschikt mijn organisatie over voldoende ondersteunend personeel.	HR_1	**(66)**
		Bij de implementatie van een e-health toepassing beschikt mijn organisatie over voldoende ondersteuning op het gebied van training.	HR_2	
		In mijn organisatie is een helpdesk aanwezig voor technische ondersteuning bij de implementatie en toepassing van e-health.	HR_3	
		Mijn organisatie biedt IT-ondersteuning ongeacht tijd en plaats.	SUP_1	**(61)**
		Mijn organisatie biedt IT-ondersteuning voor communicatie tussen medewerkers.	SUP_2	

		Mijn organisatie biedt IT-ondersteuning voor het zoeken naar en toegang krijgen tot noodzakelijke informatie.	SUP_3	
IT governance	**R**	IT Strategie is opgesteld en bekrachtigd door het bestuur	IG_1_t	**(66)**
		Er is een korte termijn (1 à 2 jaar) visie met betrekking tot IT-beleid opgesteld.	IG_2_t	
		Er is een lange termijn (5 jaar) visie met betrekking tot IT-beleid opgesteld.	IG_3	
IT security	**R**	Mijn organisatie maakt gebruik van DigiD.	SE_1	**(66)**
		Mijn organisatie voldoet aan alle eisen voor een Goed Beheerd Zorgsysteem	SE_2	
		Mijn organisatie voldoet aan alle eisen van de NEN7513 (2010).	SE_3	
		Mijn organisatie voldoet aan alle eisen van de NEN7510 (2011).	SE_4_t	
Financial Readiness	**R**	The IT budget of the healthcare organisation, using a logarithmic transformation to adjust for curvilinearity	FR	**(66)**
Top management support	**R**	Het management beloont personeel voor e-health innovatie en creativiteit.	MS_1	**(66)**
		Het management stimuleert sterk het gebruik van e-health.	MS_2	
		Het management stelt voldoende middelen (tijd en geld) beschikbaar voor e-health.	MS_3	
		Het bestuur heeft een visie ontwikkeld over e-health.	MS_4	
		Evaluatie tussen het management en medisch professionals over de effecten van e-health vindt plaats op regelmatige basis.	MS_5	
Absorptive capacity	**R**	Mijn organisatie is goed in staat nieuwe e-health toepassingen te identificeren.	AC_1	**(66)**
		Het zoeken naar nieuwe e-health mogelijkheden is een alledaagse bezigheid in mijn organisatie.	AC_2	
		Mijn organisatie bezoekt met enige regelmaat bijeenkomsten om nieuwe kennis over e-health te verwerven.	AC_3	
		Medewerkers worden regelmatig bijgeschoold en voorgelicht over nieuwe ontwikkelingen in e-health.	AC_4	

		In mijn organisatie is een goede communicatie tussen medewerkers en IT-professionals.	AC_5	
		Mijn organisatie kent goed georganiseerde communicatiekanalen voor het uitwisselen en delen van kennis en ideeën.	AC_6	
		Mijn organisatie is in staat nieuwe e-health kennis in te zetten voor het ontwikkelen van nieuwe (verbeterde) zorgdiensten.	AC_7	
		Mijn organisatie gaat voortdurend na hoe nieuwe IT-kennis beter benut kan worden.	AC_8	
Organizational culture	**F**	A higher-level formative construct consisting of three dimensions: 1) Collaboration, 2) Trust, 3) Learning	OC	**(61, 80)**
Collaboration	**R**	Our organizationa members are satisfied by the degree of collaboration. Medewerkers in mijn organisatie zijn tevreden over de mate van onderlinge samenwerking	COL_1	**(61, 80)**
		Our organizational members are supportive. Medewerkers in mijn organisatie ondersteunen elkaar.	COL_2	
		Our organizational members are helpful Medewerkers in mijn organisatie helpen elkaar.	COL_3	
		There is a willingness to collaborate across organizational units within our organization. Medewerkers zijn bereid om met verschillende teams binnen de organisatie samen te werken.	COL_4	
		There is a willingness to accept responsibility for failure In mijn organisatie is er bereidheid om verantwoordelijkheid te nemen voor falen.	COL_5	
Trust	**R**	Our company members are generally trustworthy.	TRU_1	**(61, 80)**

		Medewerkers in mijn organisatie zijn over het algemeen te vertrouwen.		
		Our company members have reciprocal faith in other members' intentions and behaviors. Medewerkers in mijn organisatie hebben wederzijds vertrouwen in de bedoelingen en het gedrag van anderen.	TRU_2	
		Our company members have reciprocal faith in others' ability Medewerkers in mijn organisatie hebben wederzijds vertrouwen in de bekwaamheid van anderen.	TRU_3	
		Our company members have reciprocal faith in others' decision toward organizational interests than individual interests. Medewerkers in mijn organisatie hebben wederzijds vertrouwen in het nemen van beslissingen waarbij organisatorische belangen zwaarder wegen dan individuele belangen.	TRU_4	
		Our company members have relationships based on reciprocal faith. De verhoudingen tussen medewerkers is gebaseerd op wederzijds vertrouwen.	TRU_5	
		Our company provides various formal training programs for performance of duties. Mijn organisatie biedt verschillende formele trainingsprogramma's voor het uitvoeren van mijn taken.	TRU_6	
Learning	**R**	Our company provides opportunities for informal individual development other than formal training such as work assignments and job rotations. Mijn organisatie biedt mogelijkheden voor informele individuele ontwikkeling.	LEA_1	**(61, 80)**
		Our company provides opportunities for informal individual development. Mijn organisatie biedt mogelijkheden voor informele individuele ontwikkeling.	LEA_2	

		Our company encourage people to attend seminars, symposia, and so on. Mijn organisatie moedigt werknemers aan om deel te nemen aan werk gerelateerde evenementen.	LEA_3	
		Our company provide various programs such as clubs and community gatherings. Mijn organisatie biedt verschillende activiteiten waarbij medewerkers samen komen.	LEA_4	
		Our company members are satisfied by the contents of job training or self-development programs. In mijn organisatie zijn medewerkers tevreden over de inhoud van trainingen en zelfontwikkelingsprogramma's.	LEA_5	
E-health adoption	**R**	Option between 8 stages: aware, interest, evaluation, adoption, adaptation, acceptance, routinization and infusion. Definition of these concepts are explained below:	Fase_Org	**(66)**
		Bewust: belangrijke besluitvormers zijn zich bewust van de innovatie, maar er zijn nog geen concrete stappen ondernomen. **Belang:** de organisatie zet zich in om actief meer te leren over de innovatie. **Evaluatie:** de organisatie is begonnen met evalueren, denkt na over eventuele inzet van de innovatie en is gestart met het opzetten van trials ('proefgebruik'). **Adoptie:** er wordt geïnvesteerd in middelen om ervoor te zorgen dat het product kan worden gebruikt door de werknemers zoals opleiding, educatie, ICT-ondersteuning etc. **Aanpassing:** de innovatie is ontwikkeld, geïnstalleerd en onderhouden en overal verkrijgbaar voor gebruik in de organisatie. **Acceptatie:** de innovatie wordt toegepast in dagelijkse werkzaamheden en werknemers zijn vastbesloten om de innovatie te gebruiken.		

		Routinisatie: het gebruik van de innovatie wordt aangemoedigd als een normale activiteit in de organisatie; de innovatie wordt niet langer gezien als iets ongewoons. **Assimilatie:** de innovatie wordt volledig geaccepteerd en gebruikt binnen de organisatie en is het nieuwe 'normaal' geworden.		

10.2 Semi-structured interview guide

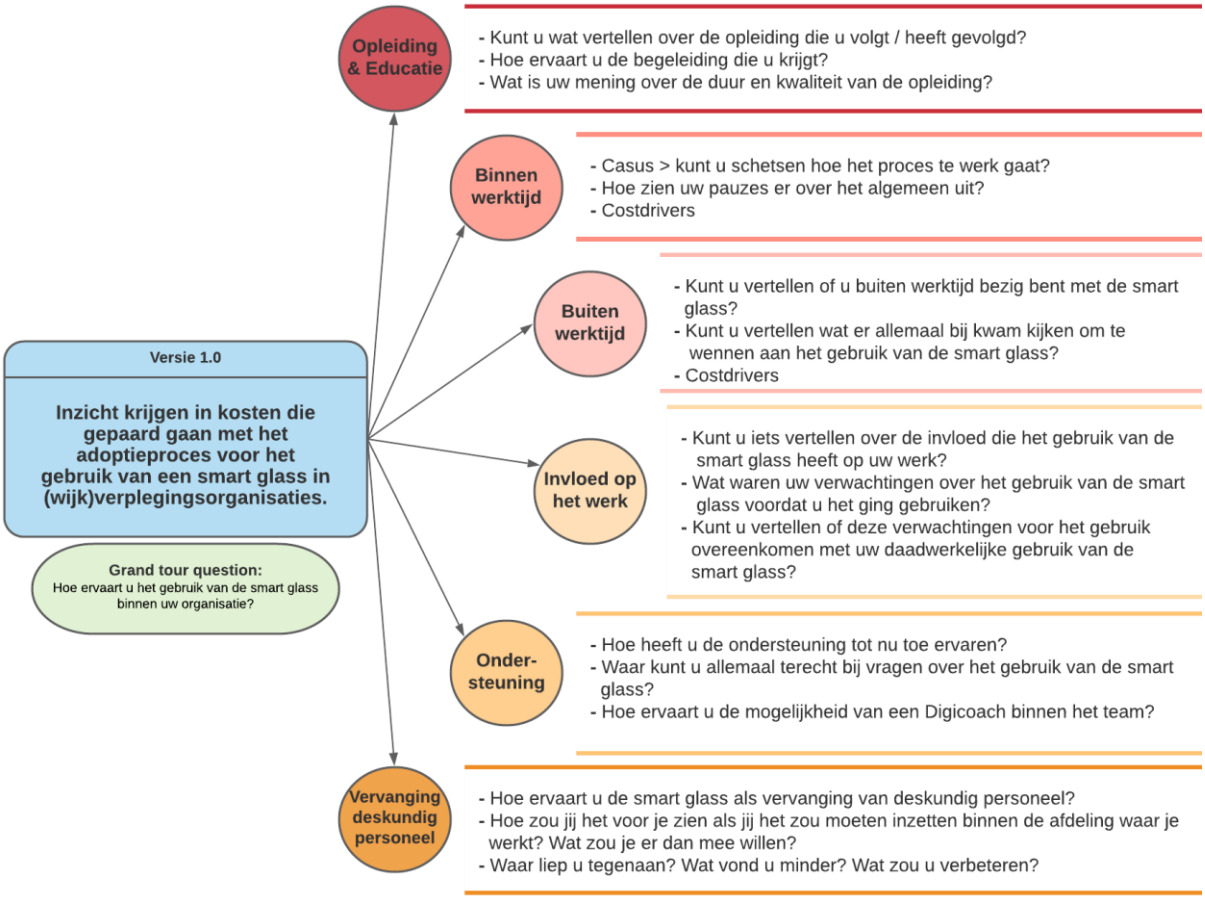


Figure S1. Semi-structured interview guide containing a grand tour question and six identified topics including example questions.

10.3 Specification of Adoption Costs

Table S2. Identified costs regarding the adoption of a Smart Glass in wound care in a Dutch nursing and homecare organization. These numbers are based on the identified costs during semi-structured interviews using the TDABC model (n=10). Note that these costs are only part of the total costs for the entire project!

Ongoing Costs (OC)

1. Hidden Adoption Costs (HAC)

	Total costs	**% Total**	**% HAC**
Education	€ 2.114,70	3.8%	19%
Evaluation	€ 404,30	0.7%	4%
Communication	€ 2.378,05	4.3%	22%
Coordination	€ 2.624,29	4.7%	27%
Gathering information	€ 641,37	1.2%	6%
Learning technique	€ 2.095,10	3.8%	22%
Support	€ 59,86	0.1%	1%
SUB – Total HAC	**€ 10.317,67**	**18,6%**	

2. Scheduled Project Costs

	Total costs	**% Total**
Scheduled project hours	€ 13.363,66	24%
SUB – Total OC	**€ 23.681,33**	**42,6%**

One-Time Direct Costs (OTDC)

1. Raw materials

	Total costs	**% Total**
Raw Material Costs	€ 20.107,96	36.2%

2. External support

	Total costs	**% Total**
E-health provider	€ 1.780,00	3.2%
Q-Consult Zorg	€ 10.000,00	18,0%
SUB – Total OTDC	**€ 31.887,96**	**57,4%**

TOTAL COSTS € 55.569,29

Table S3. Identified hours spent on the adoption process divided into time spent within- and outside working hours including their percentages within- and outside working hours.

	Total	Within working	% Within	Outside working	% Outside
Education	16,00	16,00	3,45%	0,00	0%
Evaluation	6,00	6,00	1,29%	0,00	0%
Communication	42,50	42,50	9,16%	0,00	0%
Coordination	60,25	53,25	11,48%	7,00	47,5%
Gathering Information	14,50	14,00	3,02%	0,50	3,4%
Learning Technique	38,08	30,83	6,65%	7,25	49,1%
Support	1,42	1,42	0,31%	0,00	0%
Scheduled hours	300,00	300,00	64,66%	0,00	0%
• Project manager	160,00	140,00		0,00	
• Wound expert	140,00	160,00		0,00	
TOTAAL	**478,75**	**464,00**	**100,00%**	**14,75**	**100%**

Table S4. Identified costs for each stakeholder involved in the adoption process of the Smart Glass in a Dutch nursing and homecare organization. Time spending identified during the interviews is divided by the number of participants from that stakeholder group (3 nurses intramurally; 2 nurses extramurally; 2 wound experts). Next, these costs per person are multiplied by the number of persons involved in the project (5 nurses intramurally; 8 nurses extramurally; 2 wound experts).

	Collected data	Costs / person	Costs / team	%
Nurse (intramurally)	€ 1.610,86	€ 536,95	€ 2.684,76	9,6%
Nurse (extramurally)	€ 1.153,72	€ 576,86	€ 4.614,89	16,5%
Wound expert	€ 11.256,79	€ 5.628,39	€ 11.256,79	40,2%
Project Manager	€ 6.728,08	€ 6.728,08	€ 6.728,08	24,0%
Innovation Manager	€ 2.368,00	€ 2.368,00	€ 2.368,00	8,5%
Functional Application	€ 136,05	€ 136,05	€ 136,05	0,5%
Regional Manager	€ 193,14	€ 193,14	€ 193,14	0,7%
Total			**€ 27.981,71**	
Total (caregivers only)			**€ 11.828,36**	