

Handling the ‘Lemonade Principle’: Leveraging environmental contingencies in the development of effective eHealth tools

Research report

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Preface

It happens to everyone. Something unexpected happens, something that changes everything. The way you look at life, or the ideas you have. The manoeuvrability needed to cope with unexpected circumstances and adjust one's perspective intrigues me, both regarding business and private. Being self-employed in healthcare, I have noticed that responding to unexpected circumstances requires a high degree of manoeuvrability and expertise by caregivers. They are in direct contact with the patient and should decide, using their rationale and intuition, which action is required to save or improve a patient's life.

The development of eHealth tools is of a less acute and primary nature, but nevertheless has powerful potential to positively influence the quality of life of people worldwide. There are several motives that underlie the development of an eHealth technology, and the developer's viability and levels of interaction with users vary considerably. What makes an eHealth tool successful? And to what extent did the developers make use of unexpected circumstances? In my opinion, the lemonade principle as a behavioural dimension of the effectuation theory (Sarasvathy, 2001) provides a beautiful concept to handle these questions within the business domain.

Personally, I also encountered some lemons during my thesis journey. Managing a young family, continuing my own business and following a part-time study posed significant challenges. Although I persevered, there were several people who helped me 'make lemonade' out of this process. First, Matthijs, who has undoubtedly supported my scientific ambitions and gave me the floor for the last two years. Or, actually, for the last 7,5 years. Thomas Blekman, who enthusiastically introduced a theory that fully appealed to my gut feeling, and Juup Essers, who, in the cave of business, teaches students about ethical dilemmas in the current causal system and fed me the idea of a fresh, rebellious sound in my graduation research. And finally, of course, all the participants in this study who wanted to spend time and energy on reflecting upon their development process, without having any idea what this study would lead to. Thank you all; I hope that this research will offer a new perspective and that the 'lemonade' will flow for you.

Joyce van der Niet

Abstract

Keywords: eHealth, development, design, implementation, effectuation, leveraging contingencies, uncertainty, lemonade principle, innovation, innovation journey.

Background

Many eHealth technologies fail to achieve meaningful patient care outcomes (Damschroder et al, 2009). A significant reason for this lies in the “positivistic” philosophical assumptions underlying these innovations, which relies on the belief that there is an external reality that can be objectively predicted and measured (Greenhalgh and Swinglehurst, 2011). Effectuation (Sarasvathy, 2001) is a way of thinking in opposition to causation-based models and contributes to the process of opportunity recognition and value creation. An important behavioural principle of effectuation is leveraging environmental contingencies, referred to as the ‘lemonade principle’ (Blekman, 2013). This principle can be of great importance during the development processes of eHealth tools when considering the elusiveness of success in the eHealth market.

Objective

This dissertation aims to make an explorative contribution in the areas of effectuation theory and eHealth practice by focussing on the management of the lemonade principle during the development process, and its possible contribution to increase the success rate of eHealth technologies.

Methods

20 case studies of eHealth technologies were included by purposeful sampling. These studies aimed at helping patients to manage a certain condition or preventively helping people to remain healthy using eHealth tools, and these tools have the potential to be effective regarding user adoption and acceptance. Interview sessions were applied with professionals involved in the development of eHealth tools to map the ‘innovation journey’ of each eHealth tool. The retrieved data were linked to the constructs of Brettel et al (2012). The outcomes were used to relate the contributions of the lemonade principle towards the different phases of the development of eHealth technologies, following the CeHRes roadmap (Gemert-Pijnen et al, 2011).

Results

This study reveals that leveraging uncertainties can contribute to performance, user acceptance, satisfaction and widespread adoption, a solid infrastructure and resources for implementation. Interaction with the market and end users from the beginning is crucial for successful development. Interdisciplinary collaboration with parties in the field of value creation and infrastructure is important in the run-up to the production phase. This requires a careful balance between guarding the vision of the product and creating common value with stakeholders during product development.

Conclusions

The lemonade principle can contribute to the development of eHealth tools in several ways, by empowering the developers to turn the unexpected into the valuable and profitable, during the early stages of the innovation journey of eHealth tools.

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1. Introduction

This chapter introduces the research subject. In the first paragraph, the motivation for the subject will be outlined. In the second paragraph, the problem statement will be introduced. The third paragraph provides the problem statement and the research questions. The final paragraph presents the research objectives.

1.1 Motivation

There is currently a proliferation of new eHealth technologies (Krijgsman et al., 2016). Over the next two years, the Dutch government will invest more than €130 million in the development of new health-related tools, interventions and decision aids (Kamerbrief VWS, 2016). These new eHealth tools promise to dramatically improve healthcare and prevent the escalation of problems, thus significantly reducing healthcare costs. However, many interventions found to be effective in health-related studies have failed to achieve meaningful patient care outcomes (Damschroder et al, 2009).

This evaluation problem is not only, as is often stated, due to difficulty in the implementation of eHealth (Greenhalgh and Swinglehurst, 2011). A much more significant reason lies in the philosophical assumptions underlying these innovations. These eHealth tools are largely based on a “positivist” view, which relies on the belief that there is an external reality that can be objectively predicted and measured (Greenhalgh and Swinglehurst, 2011). Decision making is often based on causal reasoning, trials commence too early (Greenhalgh et al., 2014), and insufficient attention is paid to product development, placing user experience further down the knowledge hierarchy of scientific research (Knaapen, 2014). This results in the realisation of small effects and unsuccessful implementations (May et al., 2009). Baker et al. (2005) argued that to understand entrepreneurial behaviour, a constructivist approach to environments is more fruitful than an objectivist viewpoint.

Effectuation (Sarasvathy, 2001) is a way of thinking that is opposite to causation-based models. It contributes to the process of opportunity recognition and value creation. An important behavioural principle of effectuation is leveraging environmental contingencies, also referred to as the ‘lemonade principle’ (Blekman, 2013). This principle could be of great importance regarding the elusiveness of success in the eHealth market. Little research has been performed into the specific contribution of effectuation to different phases of the development processes involved in innovations. However, this could be of importance, as coping with unforeseen circumstances during the different phases of the development process through using effectual behaviour may increase the success rate of innovations in general and eHealth tools in particular. This dissertation aims to make an explorative contribution in this area by focussing on the management of the lemonade principle during the development process, and its possible contribution to increase the success rate of eHealth tools. The social urgency for eHealth tools to succeed is evident, given current and predicted healthcare costs. It is of great importance to fulfil the promise of eHealth to dramatically improve healthcare and significantly improve patient quality of life.

1.2 Introduction to the problem statement

1.2.1 Introducing the current challenges in eHealth development

eHealth will become a system-changing development in healthcare in this century (Catwell and Sheikh, 2009). The most widely-accepted definition of eHealth tools is *“the use of new information and communication technologies and particularly internet technology to support and improve health and healthcare”* (Eng, 2001). The current study focusses on eHealth tools that aim to help patients manage a certain condition or to preventively help people stay healthy.

Black et al. (2011) argued that a large gap exists between the promised and proven benefits of eHealth technologies. The authors stated that there is no robust evidence for these benefits, although these benefits are often claimed in the introduction of the tools. When one considers eHealth technologies as start-ups, the main reasons for failure include a lack of market need, lack of a healthy financial structure, an unsuitable team, a product lacking value, the lack of a business model, a lack of marketing, and ignoring the needs of customers (CB insights, 2014). These failures, when attributed to start-ups, seem to match the problems that many eHealth technologies currently face, particularly concerning tools being developed within the context of health research.

Significant attention has been turned in the scientific literature to the obstacles in the implementation of evidence-based eHealth tools that arise from health research. Greenhalgh (2011) made a major contribution to this field by investigating the problem of the underlying philosophical assumptions of these innovations. She argued that the foundation of health research is based on the causal decision-making models undertaken by positivist researchers, and that the dominant knowledge hierarchy in healthcare research places objective and numerical knowledge above the interest of user experience (Greenhalgh and Swinglehurst, 2011). Their findings are supported by Gemert-Pijnen et al. (2011), which additionally stated that the current developers of eHealth tools often ignore the interactions between technology, users and environment. Gemert-Pijnen et al. (2011) and Greenhalgh and Swinglehurst (2011) both proposed a more ‘holistic’ approach, which integrates qualitative and interpretative research methods into a user-centred approach towards the development of healthcare technologies.

Greenhalgh (2011) stated that it is time for health researchers, journal editors, trainers and practitioners to recognize the need for new methodologies, ontologies, epistemologies and new definitions of what is of value and how value can be jointly established regarding the development of eHealth technologies. However, one should be careful to not enter into an incommensurability debate on this subject (Essers, 1999).

As Essers (1999) stated, quoting the words of Kuhn (1970) regarding incommensurability: *“When paradigms enter, as they must, into a debate about paradigm choice, their role is necessarily circular. Each group uses its own paradigm to argue in that paradigm’s defence”* (p.94).

1.2.2 Introducing effectuation theory and the principle of leveraging contingencies
With the abovementioned tension of the conflict paradigm in mind, the following theory may provide a cheerful contrast to counterbalance the reigning paradigm and offer a new perspective of the development of eHealth tools.

Effectuation (Sarasvathy, 2001) offers a different way of understanding entrepreneurial behaviour, providing a contrasting mind-set to 'causation', a term used by Sarasvathy to appoint the more rational decision-making models.

Sarasvathy (2001) states, that "*when an individual uses effectual logic, he or she will begin with a given set of means, focus on affordable loss, emphasize strategic alliances, exploit contingencies, and seek to control an unpredictable future*" (p. 245).

Thus, in contrast to causation, effectuation represent an approach that relies on the impact of individual creation and not on prediction (Read et al., 2009). Perry et al. (2012) argue that only a few researchers have attempted to test the effectuation theory empirically. They are surprised about this gap because research on effectuation can potentially make a significant contribution to the entrepreneurship theory (Perry et al., 2012). However, as effectuation represents a paradigmatic shift in entrepreneurial behaviour in a wide sense, its contribution does not merely need to be limited to the entrepreneurship literature.

Brettel et al. (2011) shifted the focus of effectuation theory from the entrepreneurial context to Research & Development. Their findings indicate that effectual dimensions offer ways to deal with innovative projects and to rethink internal processes in favour of a more co-creational innovation approach (Brettel et al., 2012). However, this research was carried out at the expense of a more detailed analysis of each dimension. Therefore, the authors suggested additional in-depth analyses of each dimension in follow-up studies (Brettel et al., 2012).

The lemonade principle, focused on leveraging unforeseen circumstances, forms an important dimension of effectuation (Blekman, 2013). Rosenberg (1998) distinguishes three key uncertainties related to innovations: 1) the inability to predict the speed of innovation among competitors 2) the inability to predict synergies among innovations and 3) uncertainty about possible changes in customer demand. It is to be expected that the needed behaviour to deal with these uncertainties play a significant role in the development of effective eHealth tools and that the lemonade principle might offer a positive contribution to this field. The research performed by Brettel et al. (2011) revealed that creating space for the unexpected promotes the successful results of an innovation. Yet, the lemonade principle has not previously been examined regarding its contribution to eHealth technologies and the relation it has to the different phases of these developments.

In this study, the specific contribution of the lemonade principle as a behavioural dimension of effectuation is mapped and related to the development process of effective eHealth tools. It aims to reveal a new perspective of the development processes of eHealth tools in a constructive manner, so that the horizon of understanding for all those involved in eHealth can be broadened and the effectiveness of eHealth tools can be enhanced.

1.3 Statement of the problem and research questions

The problem statement addressed in this study is:

What is the specific contribution of the lemonade principle, as a behavioural dimension of effectuation, to the development processes of effective eHealth tools?

To answer this question, the following questions also need to be answered:

- What are (effective) eHealth tools?
- What are innovation processes in general and the development processes of eHealth tools in particular?
- What is the effectuation theory in general and the lemonade principle in particular?
- Which contributions can be expected from the lemonade principle to the development process of effective eHealth tools?
- Which contributions can be expected from the lemonade principle to the effectiveness of eHealth tools?
- What is the conclusion of these findings for future research and for stakeholders who aim to improve the effectiveness of eHealth tools?

1.4 Research objectives

The objectives of this research are threefold. First, to contribute to the development of the theory of effectuation by providing insight into the contribution of the lemonade principle as a behavioural dimension of effectuation related to the development processes of innovations in general and eHealth technologies in particular.

Perry et al. (2012) argued that only a few researchers have attempted to empirically test the effectuation theory. By understanding the contribution of the effectual lemonade principle related to the development processes of eHealth tools, this research can contribute to filling this gap. In addition, this research aims to offer a new approach to the current development processes of eHealth tools. As Greenhalgh and Swinglehurst (2011) described, the current development of eHealth technologies is largely related to a positivist research approach. Since the effectuation theory (Saravathy, 2001) clearly reflects a different, entrepreneurial mind-set, stakeholders involved in the traditional settings of health research in which eHealth tools are being developed are challenged to rethink their vision and approach.

Finally, and in addition to the previous point, this research aims to provide insights into realizing effective eHealth tools for organizations that are being confronted with barriers. These organizations can benefit from knowledge about the possible contributions of effectuation related to the development of eHealth tools.

2. Theory

This chapter is structured around the theoretical subtopics of the research subject. First, the definition of eHealth tools and the determination of its effectiveness will be outlined. Secondly, the theory of effectuation in general, the specific principle of leveraging environmental contingencies and relevant criticisms of the effectuation theory will be reviewed. After this review, the chapter continues by discussing in detail the expected contributions of the principle of leveraging environmental contingencies to the development of effective eHealth tools. The final section describes the conceptual model resulting from these expectations.

2.1 The definition of effective eHealth tools

In this section, the following sub-question will be answered:

- **What are (effective) eHealth tools?**

Keywords: *eHealth, definitions, effectiveness, impact, evaluation, indicators, criteria, domains.*

2.1.1 The definition of eHealth tools

Since 2001, the term ‘eHealth’ has come into use (Pagliari et al., 2005). There are various definitions of eHealth that vary among stakeholders, functions, context, purpose and technology purpose.

Pagliari et al. (2005) described that most definitions highlight the communicative aspects of eHealth and the specific use of network technologies, especially the internet. According to the authors, this distinguishes eHealth from other information systems. Furthermore, they emphasised that while some definitions focus more on caregivers or patients, most tools are being developed for a wide range of stakeholders.

A globally-accepted definition of eHealth was given by Thomas Eng (2001). Here, eHealth was defined as “*the use of new information and communication technologies and particularly internet technology to support and improve health and healthcare.*”

Eysenbach (2001) made a valuable contribution to the definition of eHealth by emphasizing that eHealth encompasses more than the technical aspects alone. He defined eHealth as:

“*An emerging field in the intersection of medical informatics, public health, and business, referring to health services and information delivered or enhanced through the internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state of mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve healthcare locally, regionally, and worldwide by using information and communication technology.*”

Furthermore, Eysenbach (2001) introduced the following “10 Es” that characterise the concept of eHealth:

1. Efficiency

The promise of eHealth to increase cost-efficiency by enhanced communication possibilities, patient involvement and avoidance of duplicative or unnecessary actions.

2. Enhancing quality

The promise of eHealth to improve quality, for example by bettering the infrastructure that guides patients to the best quality providers.

3. Evidence based

Proven effectiveness and efficiency. As mentioned earlier, this is a critical issue.

4. Empowerment

Increased access to records, information and treatment for patients enables better informed choices by patients.

5. Encouragement

Shared decision making between patients and health professionals.

6. Education

Both professionals (medical education) and consumers (health education, tailored information) can be educated by eHealth.

7. Enabling

Lowers the barriers of information exchange and communication.

8. Extending

Extends the scope of healthcare beyond its conventional boundaries.

9. Ethics

New forms of patient-physician interaction pose new challenges and threats to ethical issues, such as privacy and equity issues.

10. Equity

The promise to make healthcare more equitable, although there is an existing threat that eHealth will widen the gaps between people who are unskilled in their use or unable to gain access to computers or devices.

Several categorisations can be used regarding eHealth technologies. In this study, the basis for categorization is outlined along the following three dimensions, as reported by Krijgsman and Klein Wolterink (2012): Care process, users and technology.

Care process

There are many different processes within healthcare in which ICT is used. Therefore, it is appropriate to organize the different functions of eHealth tools regarding the care process. The following applications of eHealth can be distinguished:

- e-public health: Education and prevention;
- e-care: Primary care process in cure and care; and
- e-care support: Administrative affairs, meetings, planning, record keeping.

As this study focusses on eHealth tools that result from health research and are aimed at helping patients to manage a certain condition or preventively helping people to stay healthy, the following applications are included in this research:

- ✓ e-public health: Education and prevention; and
- ✓ e-care: Primary care process in cure and care.

Users

eHealth tools vary greatly with respect to the different users. The following user applications were distinguished by Krijgsman and Klein Wolterink (2012) with regards to target user groups. eHealth applications for:

- Healthcare providers within their own working context;
- Communication between caregiver and patient/client;
- Patients within their home situation;
- Communication between patients;
- Communication between patients and others than healthcare providers;
- Communication between healthcare providers and others than healthcare providers or patients; and
- Communication between healthcare professionals.

Given the focus of this study, the following user applications are included:

- ✓ Communication between caregiver and patient/client;
- ✓ Patients within their home situation;
- ✓ Communication between patients; and
- ✓ Communication between patients and others than healthcare providers.

Technology

The following table (Table 1; Krijgsman, 2012) offers an overview of technologies and functions regarding eHealth.

Table 1. Overview of technologies and functions on eHealth (Krijgsman, 2012)

| Technology | Function |
|--|---|
| Web applications and portals | Patient portals or education portals |
| Mobile apps | Apps for both physicians (e.g., registration) and patients (e.g., diary) |
| Electronic patient records and personal health records | Medical administration for health professionals |
| Health sensors and wearable devices | Collection of vital results (e.g., blood pressure and coagulation value) |
| Video conference | To support or replace consults between physicians and patients or to support peer consultation |
| Domotics | Application of electronics for automation at home (e.g., fall detection) |
| Robotics | Software-driven machines that can replace certain tasks in cure (e.g., invasive surgery) and care (e.g., support housekeeping) medicine |
| Medical integration networks | Exchanging medical/medication information |
| General integration networks | To exchange orders of medical instruments |
| Business intelligence and big data | Analysing structured and unstructured information for decision support (medical intelligence and big data) |

| | |
|-----------------------|--|
| Serious gaming | Playful exercises for certain treatments such as physiotherapy or dementia |
|-----------------------|--|

This study will focus on the eHealth tools that have resulted from health research and that are aimed at helping patients and healthcare professionals to manage a certain condition or preventively help people to stay healthy. Therefore, the following technologies had potential to be included in this study:

- ✓ Web applications and portals;
- ✓ Mobile apps;
- ✓ Serious gaming;
- ✓ Domotics;
- ✓ Robotics;
- ✓ Health sensors and wearable devices.

2.1.2 The determination of effectiveness of eHealth tools

There is considerable interest in the potential solutions of eHealth to improve the quality and safety of healthcare; however, a large gap exists between the promised and proven benefits of eHealth technologies (Black et al., 2011).

Black et al. (2011) stated that although cost-effectiveness and health improvements are often claimed at the launch of eHealth tools, no robust evidence exists for these effects. In addition, Greenhalgh and Swinglehurst (2011) warned that differences in the underlying philosophical assumptions can lead to opposing criteria for this desired evidence.

Different indicators are used in scientific research to determine the quality effectiveness of eHealth tools. In a systematic review by Black et al. (2011), the following indicators were used: Resource utilization, indicated care, patient outcomes, cost savings and time savings.

Examples of indicators aimed at improving the use of eHealth technologies include

user acceptance, user satisfaction and the adoption or implementation of eHealth tools (Gemert-Pijnen, 2011). Furthermore, indicators have been prepared to evaluate the success of eHealth. Van der Meijden et al. (2003) referred to the six dimensions of success defined by DeLone and McLean (1992), namely system, service quality, information quality, user acceptance, and individual and organizational effects.

Hebert (2001) referred to the quality care structure reported by Donabedian (1988): Structure, process and outcome (Gemert-Pijnen, 2011). Since there is neither consensus nor robust evidence in the literature regarding a fixed set of indicators to determine the (generic) effectiveness of eHealth tools, the current study focusses on pragmatic measures in determining the effectiveness of eHealth tools through assessing user adoption of the tool (quantitative) plus user acceptance and appreciation (qualitative).

2.2 Development processes of eHealth tools

In this section, the development processes of eHealth tools will be outlined, thereby answering the following sub-question:

- **What are innovation processes in general and development processes of eHealth tools in particular?**

Keywords: *Innovation, innovation processes, funnels, development, development processes, user innovation, producer innovation, eHealth development processes, eHealth innovation.*

2.2.1 Innovation processes in general

Definitions of innovation

Organizations need to innovate in order to respond to changing circumstances in the market environment and to take advantage of the opportunities created by technology (Baregheh et al, 2009).

King & Anderson (2002: p. 3) come to a following definition: "*Innovation is a non-routine change and renewal for the environment in which it becomes introduced (individual, group, organization), based on an idea and deliberately targeted on certain benefits (earnings, sales, satisfaction, safety, etc.).*"

Baregheh et al (2009) define innovation as: "*a multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.*"

Classical views on innovation and entrepreneurship are stated by Schumpeter (1934) and Kirzner (1973). In Schumpeter's view (1934), the entrepreneur is an innovator and leader who realizes "creative destruction" by outbalancing markets, introducing new combinations and concepts. In Kirzner's view the entrepreneur is a borrower who passively identifies opportunities and takes advantage of them with price adjustments, balancing the economic system.

According to Drucker (1985), innovations provide organizations solutions for the problems they encounter when striving for a solid competitive position. He defines innovation as the processes of improving capabilities and utilities.

Types of innovation

Innovations vary in nature, type, social contexts, stages, means and aims (Baregheh et al, 2009). Schumpeter (1934) distinguishes innovations of new products, new production methods, new sources of supply, new markets, and new ways to organize. Current dominant types of innovation are disruptive, radical innovation on the one hand (representing the view of Schumpeter) where something completely different is introduced, and incremental innovation on the other hand (presenting the view of Kirzner and Drucker), where existing methods are improved.

Some innovations are purely technologically driven (technology push), some are market driven (market pull). Innovations can be initiated by providers (producer innovation), but are increasingly initiated by users (user innovation).

Innovation processes

Each kind of innovation knows its own development process and dynamics. Traditional NPD (New Product Development) processes focus on a prescribed approach, whereby the end user is only asked for feedback in the final phase, as shown in Figure 1.

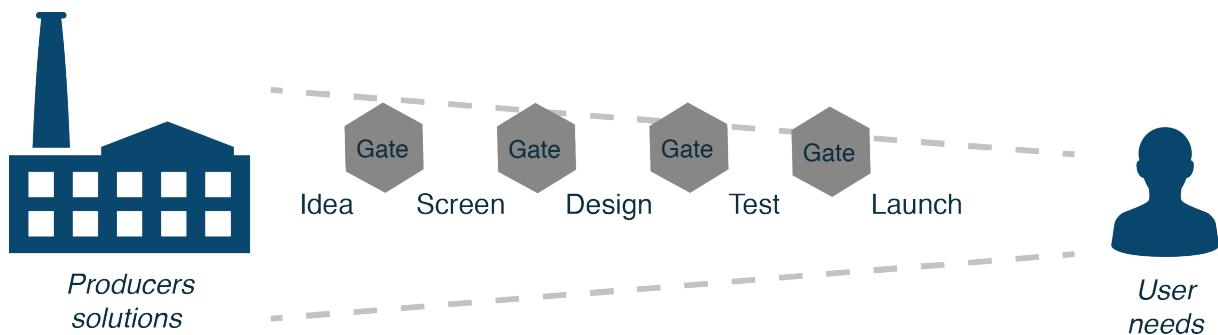


Figure 1. A traditional NPD funnel (Cooper, 2014).

A new alternative to this traditional way of developing is the Triple A system (Cooper, 2014), which stands for adaptive, agile and acceleration. The idea behind this principle is that the product is quickly introduced to the customer, even if it only has 50% functionality. It gradually evolves in close cooperation with the client and other stakeholders. Parts of this development system are sprints and scrums, which allow the fast moving from milestone to milestone without unnecessary activities in the development process. This new idea aims to accelerate the development process, by working in a multidisciplinary team and shortening the time-to-market (Cooper, 2014), as shown in Figure 2.

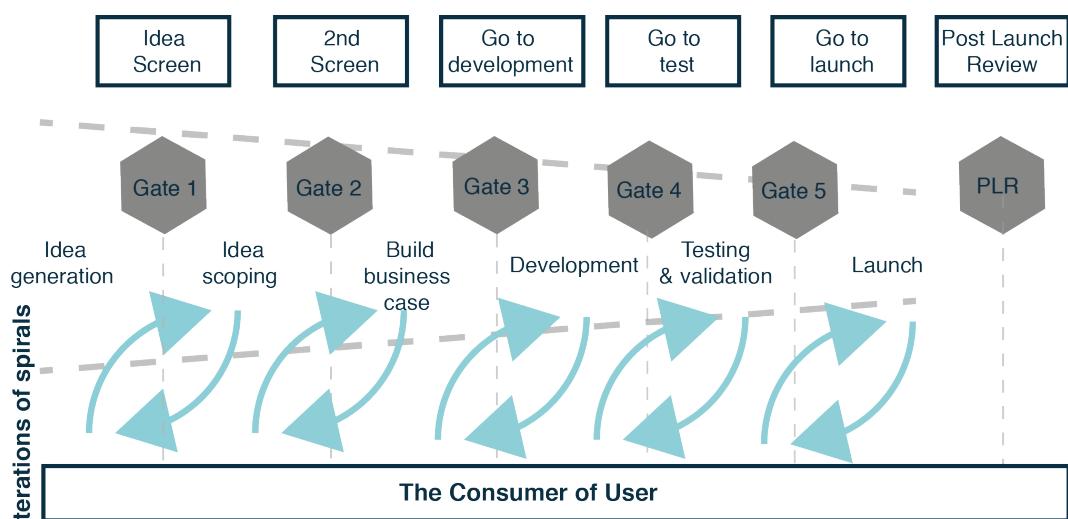


Figure 2. New NPD processes: Triple A system (Cooper, 2014).

Thus, new NPD processes are iterative and are in continuous interaction with the end users. This approach promotes experimentation, and encourages the development team to make frequent, quick and cheap mistakes (Isaacson, 2011).

User-centered design

Emerging innovation processes and design theories form user-centered design (UCD) and user experience (UX). User-centered design (UCD) stands for design processes in which the (end) users influence the design (Abras et al., 2004).

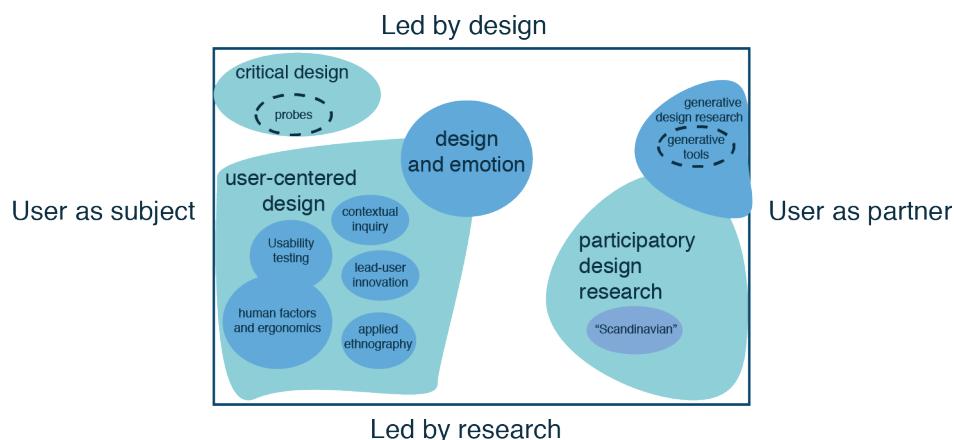


Figure 3. The current landscape of human-centered design in the development of products and services (Sanders & Stappers, 2008).

Within the field of user-centered design, co-creation and co-design are trending terms, which are often confused with each other (Sanders & Stappers, 2008). The authors state that co-creation refers to an act of collective creativity and that co-design is more focused on collective creativity throughout the design process. Co-design thus constitutes a specific example of co-creation.

2.2.2 Development processes of eHealth tools

Many eHealth technologies are unsuccessful in realizing sustainable innovations in healthcare practices. When health research forms the basis of eHealth technologies, research funds are allocated from universities for the development of a missing intervention for a specific audience or are related to a trending policy topic.

Researchers develop and test a health technology and carry out a randomized controlled trial (RCT) of the effect. Catwell and Sheikh (2009) argued that RCTs alone are too limited to include all contextual considerations and that these positivistic research approaches are often less suitable to prove the impact of eHealth tools in a complex environment.

Product development 'funnels' that are associated with the current development of eHealth tools within health research are characterised by a prescribed approach in which users are only asked for feedback in the final stage of the product development cycle (Figure 4).



Figure 4. Traditional development funnel within health research

Gemert-Pijnen et al. (2011) stated that an important factor contributing to failure is that the current developers of eHealth technologies are ignoring the underlying dependencies between technology, human interaction and social environment. In addition, Catwell and Sheikh (2009) suggested that developers must have a thorough understanding of user needs, experiences and beliefs, and should define what the eHealth technology can offer in this regard. Although the importance of a multidisciplinary approach to the development of eHealth tools is emphasized in many studies, only a few authors have integrated this into frameworks for research and development (Gemert-Pijnen et al., 2011). The frameworks that have integrated this are based on human technology interaction models, health services and innovation theories.

According to Greenhalgh and Swinglehurst (2011), user experience (UX) and user value (UV) can make a valuable contribution to the successful development of eHealth tools. Esser et al. (2009) proposed a user-oriented design approach towards eHealth by taking the interaction between the patient and healthcare provider as a starting point. Gemert-Pijnen et al. (2011) integrated the user-centred perspective into a holistic design approach, named the CeHRes roadmap (Figure 5).

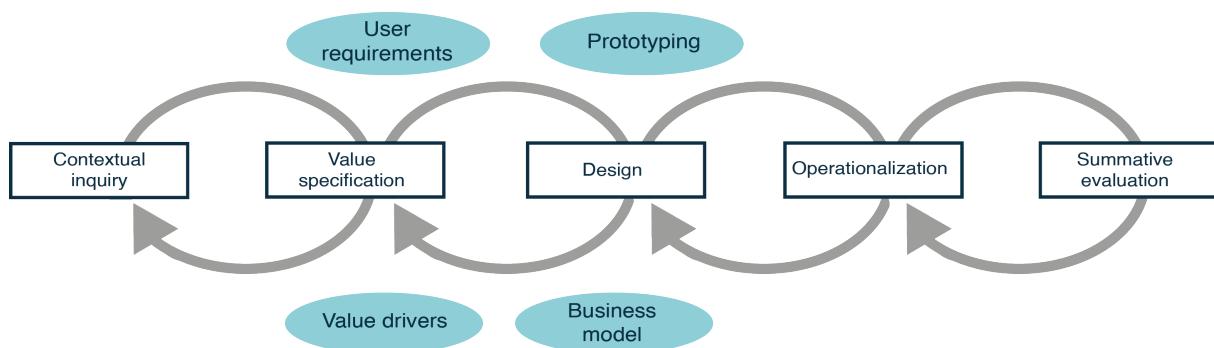


Figure 5. The CeHRes roadmap (Gemert-Pijnen et al., 2011)

In this research, the CeHRes roadmap (Gemert-Pijnen et al, 2011) will be used as a grid to map the specific contribution of leveraging contingencies throughout the different phases of the development process.

By introducing the CeHRes roadmap, Gemert-Pijnen et al. (2011) forwarded the following assumptions about the development of eHealth tools:

- **Multidisciplinary project management**
Collaboration between those responsible for the technology and those who will use it to ensure that the tool meets the needs and concerns of end users and other stakeholders.
- **Contextual inquiry**
Collecting implicit and explicit information from the initial users and the environment in which the tool will be used. A contextual inquiry is also proposed by stakeholders other than users, through scenarios that inform about the political, social, clinical contexts wherein the tool will act.
- **Value specification**
Recognition and quantification of the economic, medical and social values of users and stakeholders. This brings forth the most appreciated solution.
- **Design**
Building prototypes based on values and user conditions. Mock-ups, storyboards and paper prototypes are developed and regularly and iteratively tested with the intended end users. The end users are invited to provide feedback on whether the tool is based on their expectations and ways of thinking and working.
- **Operationalization**
The final introduction and adoption of the tool in practice.
- **Summative evaluation**
The evaluation of the impact of the tool in terms of clinical, organizational and behavioural effects. The evaluation measures outcomes at different levels: The scope of a tool and the effects on performance criteria for quality assurance.

2.3 The theory of effectuation

In this section, the theory of effectuation in general, the lemonade principle in particular and criticisms regarding effectuation theory will be outlined. In this way, the following sub-question will be answered:

- What is the effectuation theory in general and the lemonade principle in particular?

Keywords: *Effectuation, Sarasvathy, effectuation principles, criticism on effectuation, growth mindset, lemonade principle, leveraging environmental contingencies.*

2.3.1 The theory of effectuation

“The concept of effectuation is as subtle as it is profound. On the one hand, it challenges long held beliefs about the nature of cause and effect in social science. On the other hand, it generates a host of new insights about social phenomena” (Sarasvathy, 2008).

Effectuation allows goals to emerge contingently over time from the varied ambitions of the founders and the stakeholders with whom they interact (Sarasvathy, 2008). In the context of research and development, effectual logic is emphasized in the earlier stages of venture creation, characterized by greater levels of uncertainty. Sarasvathy (2001) developed five behavioural principles that relate to effectuation. These principles are summarized in the following table (Sarasvathy and Dew, 2005):

Table 2: The basic principles of effectual thought. Sarasvathy and Dew (2005)

| | |
|--|--|
| View of the future | Design. The future is contingent on actions by willful agents. |
| Givens | Means provide the basis for decisions and new opportunities. 3 subconstructs: - What I know - Who I am - Whom I know. |
| Attitude towards others | Partnership. Build your market together with customers, suppliers and even prospective competitors. |
| Predisposition toward risk | Affordable Loss. Calculate downside potential and risk no more than you can afford to lose. |
| Predisposition toward contingencies | Leverage Contingency. Surprises can be positive. Leverage them into new opportunities. |
| Underlying logic | To the extent that we can control the future, we don't need to predict it. |

As Table 2 shows, the five principles of effectuation include:

Table 2 shows, the five principles of negotiation include:

1. Beginning with a set of given means (Bird-in-Hand);
2. Focusing on affordable loss (Affordable loss);
3. Leveraging environmental contingencies (Lemonade);
4. Emphasizing strategic partnership and pre-commitments (Crazy Quilt); and
5. Seeking to control an unpredictable future (Pilot in the plane).

Principle 1: Beginning with a set of given means (Bird-in-Hand)

The 'Bird-in-Hand' principle is based on designing possible effects using a particular set of means. Effectuators hereby start with determining their identity (who they are), their knowledge (what they know) and their network (whom they know), instead of what the goal is they want to achieve. Together, these means form a basis to determine the resources (Sarasvathy, 2008). Causation takes a certain effect as given and concentrates on the way to cause this effect. Effectuation takes a group accidentally available resources as given and then looks at the best choice of effects that can be achieved therewith (Blekman, 2013).

Principle 2: Focusing on affordable loss (Affordable loss)

The second principle of effectuation is affordable loss. The idea underpinning this principle is not investing more than one wants to risk. Effectuation begins with a determination of how much the effectuator is willing to lose, and leverages limited means in creative ways to generate new ends as well as new means. This is in contrast to the causation model, which focusses on maximizing returns by selecting optimal strategies (Blekman, 2013). By using affordable loss instead of predicting future benefits, the effectuator reduces his/her dependence on predictions. The affordable loss can be calculated by the financial condition and commitment of the effectuator, based on the worst-case scenario (Sarasvathy, 2008).

Principle 3: Leveraging environmental contingencies (Lemonade)

The third principle forms the focal point of this study: The lemonade principle, derived from the saying, 'When life gives you lemons, make lemonade' (Blekman, 2013). This involves leveraging unexpected events in an uncertain environment into new opportunities (Blekman, 2013). This principle differs greatly from causal models; these models seek to either avoid the unexpected or to achieve established goals in spite of contingencies. The lemonade principle forms a crucial principle for effectuation. This can be explained by the setting of goals. Goals are often loosely applied by effectuators. By means of leveraging the unexpected, these goals can be changed when unexpected events occur. In this way, uncertainty is a resource and a process rather than a disadvantage (Sarasvathy, 2008).

Principle 4: Emphasizing strategic alliances and pre-commitments (Crazy Quilt)

The crazy-quilt principle emphasizes alliances and pre-commitments from stakeholders as a way to reduce and/or eliminate uncertainty and establish entry barriers (Sarasvathy, 2008). Stakeholders are not chosen on the basis of preselected ventures or venture goals. Rather, stakeholders are invited to make commitments and to co-create the enterprise or innovation. This in contrast to the causal models, in which partners are selected through strictly-defined competencies for a defined purpose (Blekman, 2013).

Principle 5: Seeking to control an unpredictable future (Pilot in the plane)

The pilot-in-the-plane principle is based on co-creating the future with circumstances you can control and with the partners you chose. Effectuation hereby focuses on the controllable aspects of an unpredictable future; if you can control the future, you do not need to predict it (Sarasvathy, 2008). This in contrast to the causation model, which focuses on the predictable aspects of an uncertain future; if you can predict the

future, you can control it. As may arise from this principle, it is especially useful in areas in which human action is the predominant factor for shaping the future. As Sarasvathy (2008) stated, the pilot in the plane is often the opening to unexpected opportunities.

2.3.2 Criticism on effectuation

In this section, criticisms of the theory of effectuation will be discussed.

The current criticisms present in the literature maintain that the affordable loss principle is not significantly related to new venture performance (Read et al., 2009). The authors argued that it is important to conduct further research regarding how to measure this principle in relation to expected returns. Another comment has been that pre-commitments are relevant for both effectuation and causation processes, and that it is therefore not a distinctive principle between effectuation and causation (Chandler et al., 2011).

Furthermore, Kraaijenbrink (2012) argued that the comparison between causation and effectuation is a simplification. He advocated a more productive approach by independently examining the six dimensions shown in Table 3.

Table 3: Comparison of the causation and effectuation model (Kraaijenbrink, 2012)

| Dimension | Causation model | Effectuation model |
|--------------------------------------|--------------------------------------|---|
| Starting point | Ends are given | Means are given |
| Assumptions on future | Predictability means controllability | Controllability reduces need to predict |
| Predisposition towards risk | Expected return | Affordable loss |
| Appropriate for | Existing products and markets | New products and markets |
| Attitude toward outside firms | Competition | Cooperation |
| Type of model | Linear | Cyclical |

A final critique, as argued by Brettel et al. (2010), is that control can be actively built using effectual elements, such as commencing the process based on individual means and competences. This contradicts the existing framework, which deals with uncertainty by recommending quick adaption to unforeseen circumstances and developments. This latter critique formed an interesting issue for the current study, since leveraging contingencies is the focal point of the research subject addressed here.

2.3.3 The subject of environmental contingencies in detail

Kline and Rosenberg (1986) emphasize the importance of managing uncertainties in implementing innovations, since according to them, innovations are inherently uncertain. They state that the greater the change is that is introduced, the greater the uncertainty is, not only in terms of technical performance, but also the response of the market environment and the ability of the organization itself to exploit the innovation. In addition, Rosenberg (1998) emphasizes the impossibility of anticipating the future impact of innovations (Dew & Sarasvathy, 2007). This immediately reveals the relevance of managing uncertainty in realising innovations, such as eHealth technologies. Rosenberg (1998) distinguishes three key uncertainties related to innovations: 1) the inability to predict the speed of innovation among competitors 2) the inability to predict synergies among innovations and 3) uncertainty about possible changes in customer demand.

Some technologies grow unforeseen into general tools with an enormous range of users (Dew & Sarasvathy, 2007); however, often the technologies intended to have a huge impact, fail. This has been the case for many eHealth technologies, as described in the previous sections.

Baker et al. (2005) found that the concept of bricolage (Lévi Strauss, 1966), namely doing what is at hand, explained much of the phenomenon of small entrepreneurs who could create something from scratch by exploiting physical, social or institutional inputs that were ignored or rejected by other firms. They argued that to understand entrepreneurial behaviour, a constructivist approach to resource environments is more fruitful than an objectivist viewpoint. Causal models almost always seek either to avoid the unexpected or to achieve predetermined goals in spite of contingencies. Effectuation concerns exploiting those contingencies (Sarasvathy, 2008).

The concept of shared quality

Furthermore, Dew and Sarasvathy (2007) stressed the concept of shared quality uncertainty, introduced by Lupton (2005). This concept contains three categories of shared uncertainty, shared by all those who are active in a market. Uncertainty about the emergence of a good, the origins of a good and the future consequences of a good. If these categories are projected onto eHealth development, the first implies that neither the innovator nor the user know exactly what the worth of the tool is. The second implies that neither the innovator nor the user knows the origin of the tool nor the pressing need for the tool, and the third may imply that neither the innovator nor the user knows the future impact of the eHealth technology.

Issues in the epistemology of novelty

From these uncertainties, Dew and Sarasvathy (2007) attempted to determine the differential impact of innovations on different stakeholders. They also turned their attention to what philosophers had already coined the “frame problem” (McCarthy & Hayes, 1969).

The question of the (according to philosophers, fundamental) epistemological frame problem is "*Whether it is possible, in principle, to limit the scope of the reasoning required to derive the consequences of an action*" (Stanford Encyclopaedia of Philosophy, 2004).

Dew & Sarasvathy (2007) suggest three effectual solutions to manage the uncertain impacts of innovations on stakeholders;

- A pre-commitment framework

Individuals benefit from having fewer options, especially if some options were somehow made entirely unavailable (less is more);

- A contractarian framework

Map all possible positive and negative consequences from the perspective of each stakeholder involved in an innovation;

- An entrepreneurial framework

A stakeholder-dependent solution based on pre-commitment.

According to Dew and Sarasvathy (2007), the entrepreneurial solution to the differential stakeholder impact of innovations provides useful design principles for making better worlds, even if we may not know and cannot predict what those would be.

This research focusses further on the specific contribution of managing uncertainty and leveraging environmental contingencies within this entrepreneurial framework, related to the development processes of effective eHealth tools.

2.4 Expected contributions of the lemonade principle

In this section, the expected contributions of the effectual principle of leveraging contingencies will be outlined, thereby partly answering the following sub-question:

- **Which contributions can be expected from the lemonade principle to the developmental process of effective eHealth tools?**

Keywords: *Contribution effectuation to innovation, contribution lemonade principle, development processes, effective eHealth tools.*

The lemonade principle forms an important dimension of effectuation (Blekman, 2013). Sarasvathy (2008) considered causal problems as problems of decision and effectual problems as problems of design. In other words, causal logic helps to choose, effectual logic helps to construct. Therefore, it is to be expected that the behaviour required to deal with these uncertainties plays a significant role in the development of effective eHealth tools, and that the effectual behavioural principle of leveraging contingencies may offer a positive contribution to this field. However, the principle of leveraging contingencies has not previously been examined regarding its contribution to innovations in general and eHealth technologies in particular.

2.5 Conceptual model

The following visualization (Figure 6) provides a preliminary design of the conceptual model, in which the specific contribution of leveraging environmental contingencies as a behavioural principle of effectuation will be related to the development process of effective eHealth tools.

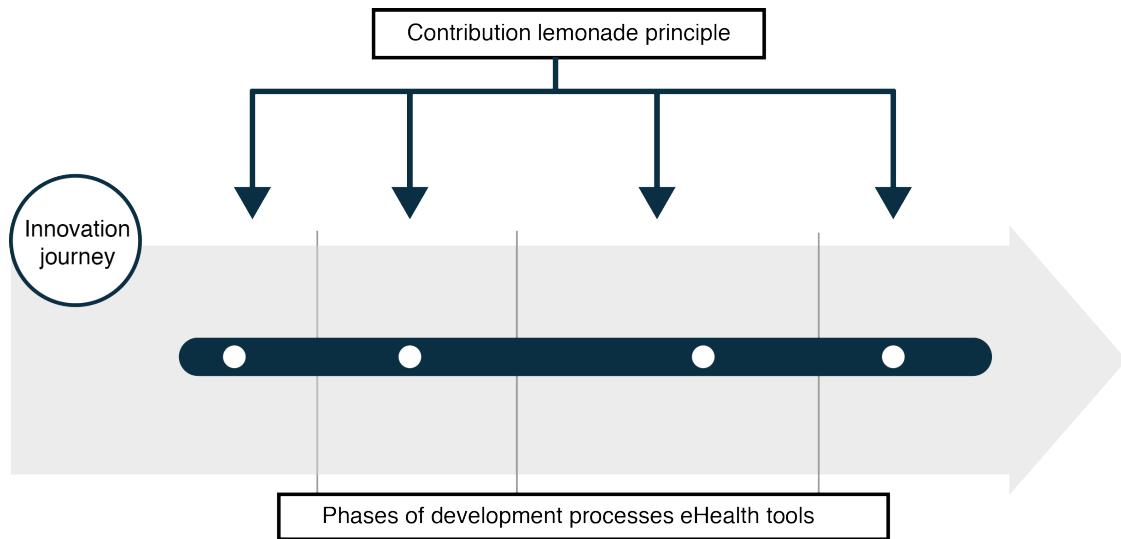


Figure 6. Conceptual model of the current study.

3. Research design

This chapter explains the methodology behind this research. In the first section, the research methods and approach will be outlined. In the second section, the instruments used will be described. The final section will outline the data description. No previous research was found that has mapped the specific contribution of effectuation related to development processes. As the problem statement largely consists of exploratory phrases (how does effectuation contribute, regarding different phases), this research was carried out using a qualitative approach.

Qualitative research was conducted into the contributions of effectuation in general and the lemonade principle in particular. This provided deeper insight into how these contributions can be interpreted and when these contributions occur in the development process of eHealth tools.

3.1 Core constructs of the research

In Figure 7, the research onion of Saunders et al., (2013) is shown, displaying the core constructs of the methodology applied here.

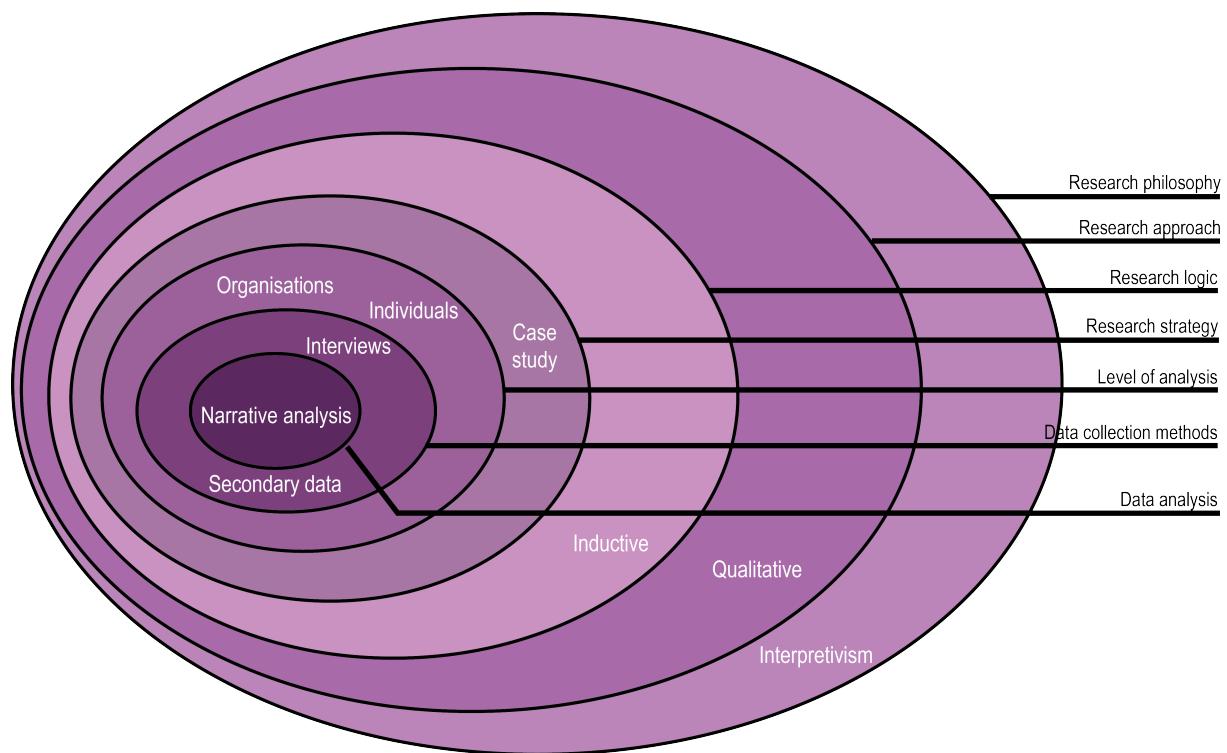


Figure 7. Research onion Source: interpretation of Saunders et al., 2013.

3.2 Research philosophy

This investigation followed the philosophy of social constructionism and interpretivism by focussing on human interest and the way in which people create value. Explanations aimed to increase general understanding regarding how leveraging contingencies contributes to the effectiveness of eHealth tools by gathering rich, holistic data from the ideas involved (Easterby-Smith, Thorpe & Jackson, 2012).

3.3 Research approach

Given the nature of the research subject and the research philosophy, a qualitative research approach was used. Maso and Smaling (1990) identified four aspects that characterize qualitative research:

- Object of the study: This is focused on definitions, experiences or constitutions. It not only focusses on meanings that people ascribe to their reality, but also on the unconscious ways in which meanings are created.
- Study design: This assumes a cyclic or interactive process, in which data collection and analysis alternate and influence each other. The data collected via participant interviews and the results of the literature review interact with the new information obtained during the research.
- Data collection: This is open, flexible, and deliberately chosen not to be strictly regulated. In all forms of data collection used here (interviews and literature review), an open approach is used to stimulate a rich and broad perspective.
- Analysis: The collected data form a natural language. This involves an interpretative process in which collected data are compared with other data collected, in which each data set is interpreted in the light of the whole and using which views are being formed regarding the whole in the light of individual data (Maso & Smaling, 1990). The entire data analysis will be completed in a continuous process.

3.4 Research logic

Inductive logic research is consistent with the qualitative research approach.

Saunders et al. (2013) described the following aspects of inductive research, which are applicable to the current study:

- Creating understanding of the meanings people attach to events/processes;
- Detailed insight into the research context;
- Collect qualitative data;
- More flexible structure to permit changes in the research focus during the research;
- Awareness that the researcher is part of the research process; and
- Less need to generalize (this is however desirable as a follow-up after completion of the exploratory research).

3.5. Research strategy: rational reconstruction and case study

According to Richardson (2006), rational reconstruction can be interpreted as follows: A method to expose the rationality of concepts, theories, views and reasoning, which are partly implicitly or intuitively formulated. The reasons behind choosing a rational reconstruction strategy were to emphasize the meaning of certain concepts that are related to the development of eHealth tools and the effectuation principle.

Furthermore, this research strategy focused on the elements of the case study. The elements of a case study, according to Wester, Smaling and Mulder (2000), are:

- Focus on meaning by the participants;
- A deep, holistic understanding of the situation;
- Idiographic rather than generalizing interest;
- Focus on processes rather than outcomes;

- The unique context instead of isolated variables;
- Exploration instead of testing; and
- Open data collection and analysis procedures.

The case studies contained several eHealth tools that are (being) developed by both health researchers and commercial developers. Paragraph 3.7 further outlines the sample selection.

3.6 Level of analyses

In this study, the following levels of analysis were used:

Individuals

This study was aimed at a composition of individuals of an organization/development team. It was important to specify the experiences professionals involved in the development of eHealth tools, so that similarities running through the various experiences can eventually be captured and mapped in the different phases of the development processes.

Organizations

The results, which were mutually collected, analysed and pooled on a case study level.

3.7 Access to data

By purposeful sampling (current and new network), 20 eHealth cases were selected and acquired that meet the following selection criteria:

eHealth tools that are aimed at helping patients to manage a certain condition or preventively helping people to stay healthy, have the potential to be effective regarding user adoption (quantitative) and user acceptance (qualitative), and which include the following applications:

Domain applications

- ✓ e-public health: Education and prevention; and
- ✓ e-care: Primary care process in cure and care.

User applications

- ✓ Communication between caregiver and patient/client;
- ✓ For patients within their home situation;
- ✓ Communication between patients; and
- ✓ Communication between patients and others than healthcare providers.

Technologies

- ✓ Web applications and portals;
- ✓ Mobile apps;
- ✓ Robotics;
- ✓ Domotics;
- ✓ Serious gaming
- ✓ Health sensors and wearable devices.

3.8 Data collection methods and conduct of fieldwork

Journey mapping sessions

In this investigation, interview sessions were applied to map the 'innovation journey' of each eHealth tool. Participants invited for these sessions were professionals involved in the development of eHealth tools including founders/initiators, developers/researchers and CEOs. For the semi-structured interview sessions, a topic guide (Appendix 2) and case study format (Appendix 3). Participants were asked to assess their perception of the development process and to pick out the contingencies they had experienced through their own narrative style.

Secondary data

In addition, it was necessary to utilize secondary sources by means of desk research. The secondary data were used for a literature review and for the preselection and enrichment of the case studies, by assessing the user acceptance and user adoption of the selected eHealth tools.

3.9 Data analyses

The data collected from the interview sessions were translated to a process mapping method. The data were analysed based on a framework approach. Within the framework approach, the aim is to order the data to facilitate interpretation. The interpretation occurred in a theme-based manner (Ritchie et al, 2013).

To validate the application of the lemonade principle, the findings per case study were pro-actively linked to the constructs performed by Brettel et al (2012) as shown in Appendix 4. In addition, other observed effectuation principles were passively linked to the constructs performed by Brettel et al (2012). The following table (Table 4) shows a summary of the research design implemented here.

Table 4: Application of the research design template (Easterby Smith et al., 2012)

| Elements of research design/approach | An exploratory approach towards effectuation |
|--------------------------------------|--|
| Rationale | Gap: Contributions of lemonade principle to development processes of innovations in general and eHealth tools in particular |
| Research aims | How does the lemonade principle as a behavioural principle of effectuation contribute to the effectiveness of eHealth tools? |
| Data collection | Qualitative: Cases, interview sessions, secondary data |
| Sampling | Purposive sampling Qualitative: N=20 |
| Access | Current/new network |
| Unit of Analysis | Organisation |
| Analysis | Qualitative: Framework analyses |
| Practicalities | Interview sessions with professionals, involved with the development of eHealth tools |
| Theory | Explaining the contribution of the effectual lemonade principle to different phases of development processes |

4. Case studies

This chapter describes the preliminary findings of this study. The first section describes the included case studies of segments, interviewees, technologies and users. The second section describes the key findings of this study, related to the phases of the development processes by which the eHealth tools have been developed.

4.1 Included case studies

This section describes the nature and characteristics of the 20 included case studies by highlighting the eHealth domains, sectors, interviewees, technologies and user groups.

eHealth domains

Within this study, two areas of eHealth applications were included:

- ✓ e-public health: Education and prevention; and
- ✓ e-care: Primary care process in cure and care.

The following figure (Figure 8) shows the spread of the case studies in these two domains. The e-care domain was the most represented, with 13 cases.

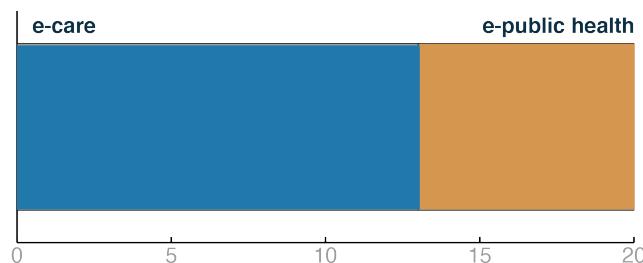


Figure 8. Spread of case studies on the eHealth domains.

Health care sectors

Figure 9 shows the spread of the case studies across the healthcare sectors. This shows that mental health is the most represented, followed by oncology and public health. Mental disability care was represented in two case studies. The other sectors are equally represented by one case study each.

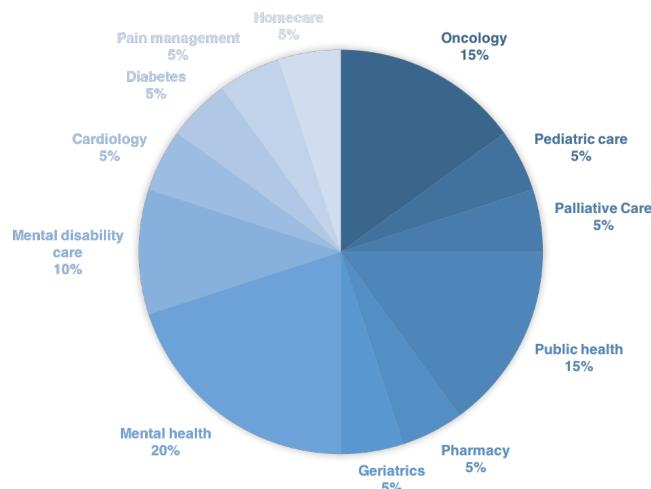


Figure 9. Spread of case studies across health care sectors.

Interviewees' backgrounds

For this study, several professionals were interviewed. Figure 10 illustrates the representation of the interviewees' backgrounds. The CEO and founders were the most represented, followed by product/product managers. Interaction designers and researchers were equally represented. A business development director and head of digital department also participated. Only one IT developer participated, because the actual IT development was usually carried out by a subcontractor.

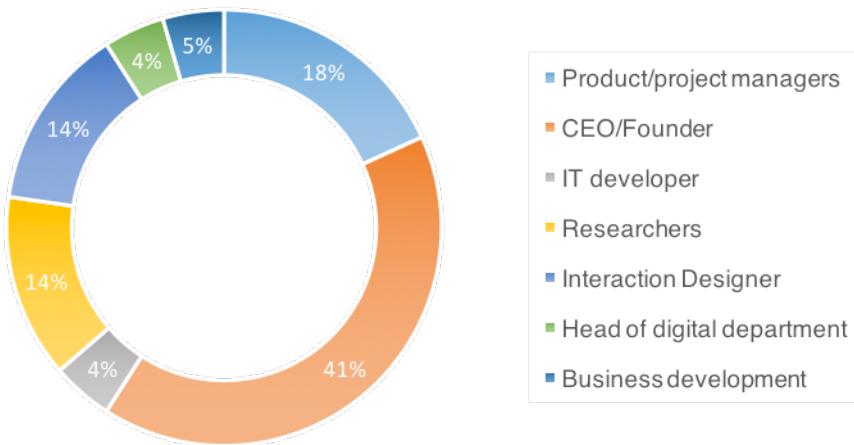


Figure 10. Representation of the backgrounds of interviewees.

Spread of technologies

Figure 11 shows the different technologies that were represented in this research. The most dominant technologies were web applications and portals, followed by serious gaming. Mobile apps and wearable devices were equally represented. Robotics was represented by one case study only.

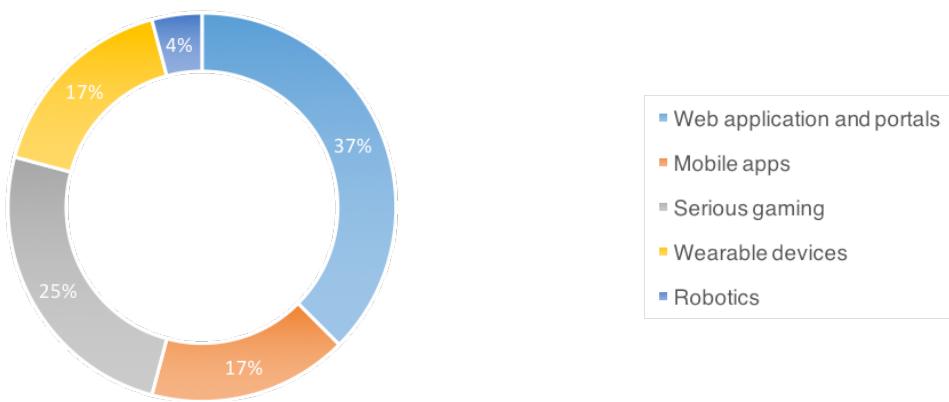


Figure 11. Representation of different technologies.

User groups

The eHealth tools included in this study were developed for highly diverse user groups (Figure 12). The most presented user group in this study were people with mental health problems, followed by generic patients. Within the group of people with mental health problems, several subgroups were involved, including those who suffer from psychoses and auditory hallucinations, for example.

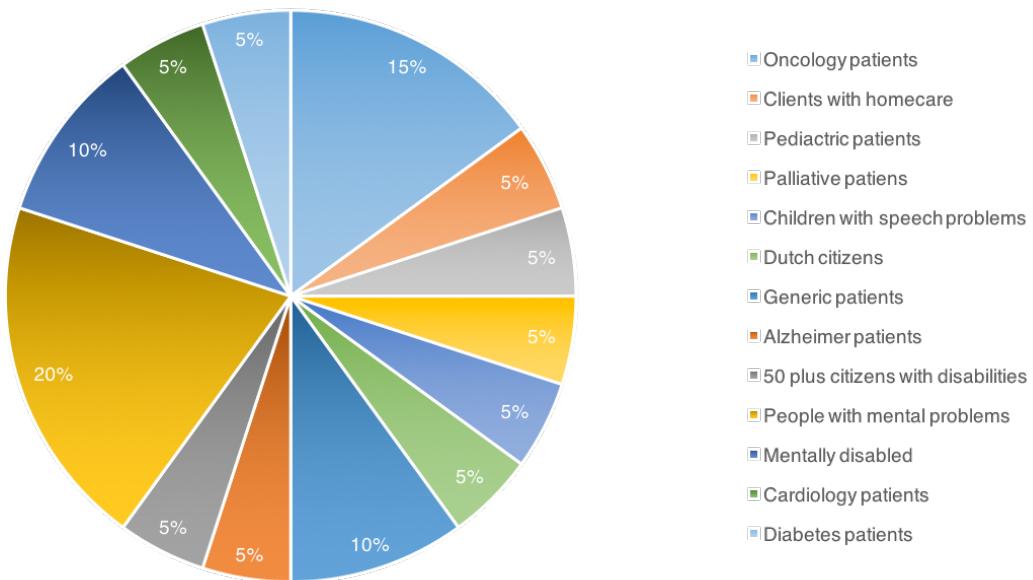


Figure 12. Representation of user groups.

Overview of included case studies

The following Table (Table 5) provides an overview of the included case studies, the function of the tool and the used technology (extracted from Appendix 5). The green highlighted case studies were found to be successful in both user acceptance and user adoption. The dark green shaded case studies were very successful regarding user adoption. For the remaining cases the success was not yet clear.

Table 5: Overview of included case studies

| Nr | Case study | Function | Technology |
|----|------------------------|-----------------------------------|--|
| 1 | Cancer Aftercare Guide | Self-management | Web application and portals |
| 2 | Project Network | Self-help managing social network | Mobile apps |
| 3 | Therapieland | Blended therapy | Web application and portals |
| 4 | Temstem | Reducing auditory hallucinations | Mobile apps |
| 5 | Active Plus | Physical exercise | Web application and portals |
| 6 | Palliarts | Decision support | Mobile apps |
| 7 | Accendowave | Pain management | Wearable devices |
| 8 | OWise | Empowerment and self-management | Mobile apps |
| 9 | Mirro | Self-help and decision support | Web application and portals |
| 10 | MyWepp | Physical exercise | Wearable devices/Web application and portals |
| 11 | KLIK | Monitoring quality of life | Web application and portals |
| 12 | C Platform | Information and decision support | Web application and portals |
| 13 | Philips Healthsuite | Monitoring vital functions | Wearable devices/Web application and portals |
| 14 | Lekker Puh | Speech therapy | Serious gaming |
| 15 | Medi&Seintje | Medication adherence | Serious gaming |
| 16 | InterviewR | User information | Serious gaming |
| 17 | GG-DJ | Real-time population monitoring | Serious gaming |
| 18 | Hartwacht | Monitoring vital functions | Wearable devices |
| 19 | Sexylexy | Empowerment and sexual education | Serious gaming |
| 20 | Tinybots | Empowerment and social support | Robotics |

4.2 Findings case studies

This chapter describes the key findings of this study, related to the phases of the development processes by which the eHealth tools have been developed: The innovation journeys. In this chapter, the main research question will be answered:

- **What is the specific contribution of the lemonade principle, as a behavioural dimension of effectuation, to the development processes of effective eHealth tools?**

The first section will describe the phases of development that are found throughout the case studies and the clustering of these phases to map the findings of the research. The second section will describe the lemonade principle and the identified themes per innovation journey phase. The third section will answer the research question by describing the specific contribution of the lemonade principle to the development processes and to the effectiveness eHealth tools.

4.2.1 Phases of development: the innovation journeys

During the interview sessions, the phases of development were openly requested. Table 6 shows the various development processes that were addressed within the involved case studies. To identify, compare and map the specific contributions of the lemonade principle throughout the development process, the different phases were merged and clustered within the four main phases of the CeHRes roadmap (Gemert-Pijnen et al, 2011) using thematic analysis. Not at all distinguished stages of the CeHRes roadmap findings were found. Therefore, the five phases of the Cehres roadmap have been clustered into four main stages. The color-coding of the phases in Table 6 and the accompanying legend shows the labelling of these clusters. The first clustered phase concerns contextual inquiry and value specification. In the second phase, the conceptual ideas were translated into a design and a prototype was tested. During the third phase, the product was operationalized and introduced into the market. The fourth, final phase provides a summative evaluation and ongoing tool development. The findings of the research are clustered into these phases of development.

Table 6: Overview of the innovation journey phases per case study (extracted from the case studies as attached in Appendix 5)

| Nr | Case study | Phases of innovation journey | | | | | |
|----|------------------------|--|---|--------------------------------------|---|---|---|
| 1 | Cancer Aftercare Guide | Needs assessment | Performance objectives | Selection intervention methods | Producing and pretesting | Adoption and implementation | Evaluation (not started yet) |
| 2 | Project Network | Context research | First paper prototype /testing | Digital prototype | Implementation | Ongoing development | |
| 3 | Therapieland | Vision development | Start project Therapieland | New market and collaboration XIOSS | Implementation | Monitoring, evaluation and ongoing development | |
| 4 | Temstem | Context research | First paper prototype /testing | Digital prototype | Implementation | Ongoing development | |
| 5 | Active Plus | Needs assessment | Performance objectives | Selection intervention methods | Producing and pretesting | Adoption and implementation | Evaluation (not started yet) |
| 6 | Palliarts | Start advisory board | Pitch VGZ Grant | App development | Fill CMS with content, training | Launch, implementation | Monitoring, evaluation and ongoing development |
| 7 | Accendowave | Vision development and data research | Algorithm development | Technology prototype development | Industry stakeholder solution development | Pilot release and ongoing technology enhancements | Upscaling |
| 8 | OWise | Market exploration | Development first and second prototype. | Initial testing | Launch OWise in The Netherlands | Innovation call England | Launch OWise in UK. |
| 9 | Mirro | Launch of initiative | Establishment of working groups | Official establishment of foundation | Development and testing of eHealth modules | Launch of first eHealth modules, introduction of decision assistant | Introduction business model, and licenses for GP's. |
| 10 | MyWepp | Establishment of Brevidius | Development ABC TV, video on demand | Vision development with stakeholders | Development of services for the mentally disabled | Introduction of MyWepp | |
| 11 | KLIK | Scientific research | Development analogue version | Development stand-alone website | Broader implementation | Implementation and business model development | |
| 12 | C Platform | Vision development and decision making | Content and software development | Focus on KPI's and marketing | Launch | Exploitation | |
| 13 | Philips Healthsuite | Vision development and collaboration | Health Suite lab sessions | Prototyping | Testing | Implementation | |
| 14 | Lekker Puh | Exploration game development | Prototype | Empirical research/RCT | Ongoing development | Impact case | Launch |
| 15 | Medi&Seintje | Moonshot session | Prototype | Empirical research/RCT | Ongoing development | Impact case | Launch |
| 16 | InterviewR | Moonshot session | Prototype | Empirical research/RCT | Ongoing development | Impact case | Launch |
| 17 | GG-DJ | Moonshot session | Prototype | Empirical research/RCT | Ongoing development | Impact case | Launch |

| | | | | | | | |
|----|-----------|----------------------------------|---|---------------------------|---------------------------|---------------------|--|
| 18 | Hartwacht | Development cVitals by Focuscura | Moonshot vision and pre-commitment partners | Business case/impact case | Launch and implementation | | |
| 19 | Sexylexy | Context research | First paper prototype /testing | Digital prototype | Implementation | Ongoing development | |
| 20 | Tinybots | | | | | | |

Phase 1: Contextual inquiry & value specification

Phase 2: Design

Phase 3: Operationalization

Phase 4: Summative evaluation

4.2.2 The lemonade principle per innovation journey phase

Phase 1: Contextual inquiry and value specification

Table 8 shows the lemons and lemonade principles that were identified in the first phase of the innovation journey, regarding the contextual inquiry and value specification (extracted from the data overview in Appendix 1).

Table 8: Case study findings regarding the lemonade principle in phase 1 of the innovation journey.

| Case study findings | Phase 1: contextual inquiry and value specification |
|--------------------------------------|--|
| Nr. 1: Cancer Aftercare Guide | |
| Lemons | Whilst setting up the needs assessment it appeared to be difficult to recruit participants for the focus groups. |
| Lemonade principle | The additional investment and attention to involve healthcare providers and patients. |
| Nr. 2: Project Network | |
| Lemons | The need for social restructure was not experienced by the social network of mental vulnerable people, but by the vulnerable people themselves. |
| Lemonade principle | Project Network shifted its attention to vulnerable people. |
| Nr. 3: Therapieland | |
| Lemons | Prevention proved to be a difficult market. |
| Lemonade principle | Through thorough knowledge of the market and regional and national policies, Therapieland transformed this into an opportunity to enter the GP/GGZ market. |
| Nr. 6: Palliarts | |
| Lemons | Prize from the VGZ proved not to be funding, but rather project hours. |
| Lemonade principle | By showing perseverance and faith in the concept by the initiator, VGZ eventually acknowledged that it had not been sufficiently clear and offered to invest in the development of the app. |
| Nr. 10: MyWepp | |
| Lemons | With the advent of Youtube, the business model for ABC TV was lost. |
| Lemonade principle | Brevidius co-created a new vision and approach to the market need of the mentally disabled. |
| Nr. 12: C Platform | |
| Lemons | Harvesting information appeared not to be an option. |
| Lemonade principle | The team decided to develop authoritative content. |
| Nr. 13: Philips Healthsuite | |
| Lemons | Patient are not only interested in the data generated, but also in the interaction with their network, both professional and personal. |
| Lemonade principle | Philips will develop an environment in which the patient can take ownership of his own data and share this data with his personal and professional network. |
| Nr. 14: Lekker Puh! | |
| Lemonade principle | By building a prototype quickly, the lemonade principle is already handled in the design of the development process of GFHE. |
| Nr. 15: Medi&Seintje | |
| Lemonade principle | Cope with uncertainty is guaranteed in GFHE's development process. The insights that were gained during the prototype testing, were immediately converted into opportunities for the product during the development phase. |
| Nr. 16: InterviewR | |
| Lemons | Healthcare had proved a barbarous field, when innovations in care do not give rise to substitution, innovation is expensive. |
| Lemonade principle | GFHE shifted the focus from fighting sickness to restoring and promoting happiness and wellbeing. |
| Nr. 19: Sexy Lexy | |
| Lemons | 1) When evaluating the tool, clients said they would use it, but only for fun, because they already know everything. 2) The user group feels that is being told that they better not get |

| | |
|---------------------------|--|
| | involved with sex, while all they want to do are normal things. |
| Lemonade principle | The developers used this insight in the positioning of the product and attempted to remove the taboo surrounding this subject. |

Involving participants and intermediaries

In the first phase, a lemon was found by the developers of the Cancer Aftercare Guide in the recruitment of participants for the needs assessment. Whilst setting up the assessment, it was found to be difficult to recruit participants for the focus groups. The developers responded to this lemon by making an additional investment in involving healthcare providers and patients for the needs assessment and the upcoming studies.

Targeting the correct user group

By conducting thorough context research during the first phase, false assumptions about the user group were identified. For example, Project Network first focused on the social network of people with psychosis. During the context research, it was discovered that the social network did not require support, but rather that the people who experienced psychosis did. Thus, their assumption about their target group could be adjusted accordingly.

Scanning the market environment

Lemons in the market environment were also identified the first development phase. This was the case with Therapieland, who foresaw an interesting market in self-help and prevention. They created the perfect platform to address this, only to find during the first phase that this market did not provide a sufficient basis for a healthy business model. They then shifted their attention to the General Practitioners and to the GGZ (psychological care). This was eventually realised to be fortuitous timing, as legislation had recently been signed into law that provided funding for innovation in this area of care. The same applied to Games for Health Europa (GFHE), for whom healthcare proved a barbarous field. With the development of InterviewR, GFHE shifted the focus from fighting sickness to restoring and promoting happiness and wellbeing.

Adjusting the product concept

Other lemons were found in the first phase regarding correcting incorrect assumptions about the feasibility and desirability of the product concept. This was the case for the C-platform, where the original idea involved only harvesting information from different sources. After further investigation during this stage, this idea was deemed unfeasible, both substantively and technically. Due to the early discovery of this lemon, the team could respond in a timely manner and was able to transform this vision into a new, successful approach. In the case study of Philips Health Suite, the diabetes mellitus patients that were involved in a co-creation session indicated that they were not only interested in the data, but also in the interaction with their networks, both professional and personal. Through this early insight, Philips was able to make this need part of their overall solution.

Sufficient funding and business model tension

Lemons in the field of funding and business models we also found in the first phase.

PalliArts discovered during this stage that the prize they had won from a call for health insurer innovations did not include funding, but rather only project hours. By PalliArts persevering and maintaining their belief in the concept, the health insurer eventually acknowledged that it had not been sufficiently clear and offered to invest in the development of the app. In the case of MyWepp, the loss of a healthy business model for an earlier product resulted in a new vision, aimed at developing new offers specifically for mentally disabled, later to become MyWepp services.

Early insights in product use

Discovered lemons in the first phase meant that they were not so sour, as they were identified in a timely manner and could lead to the further successful development of the eHealth tool. Several cases showed that when there was room for unexpected insights to be obtained during the first phase, there was more control in the process and opportunities could be exploited. For example, various cases followed the principles of user-centred design (Temstem, Project Network, Sexy Lexy, GG-DJ, InterviewR, Lekker Puh!, Medi&Seintje), design processes in which the (end) users influenced the design (Abras et al., 2004) at an early stage. In these design processes, thorough context research was performed during the first phase and a prototype was quickly submitted to the user group. These (often surprising) insights were immediately used in further development, which significantly increased the value of the tool. Figure 13 visually highlights examples of the lemons and lemonade principle found in the first phase of the innovation journey.

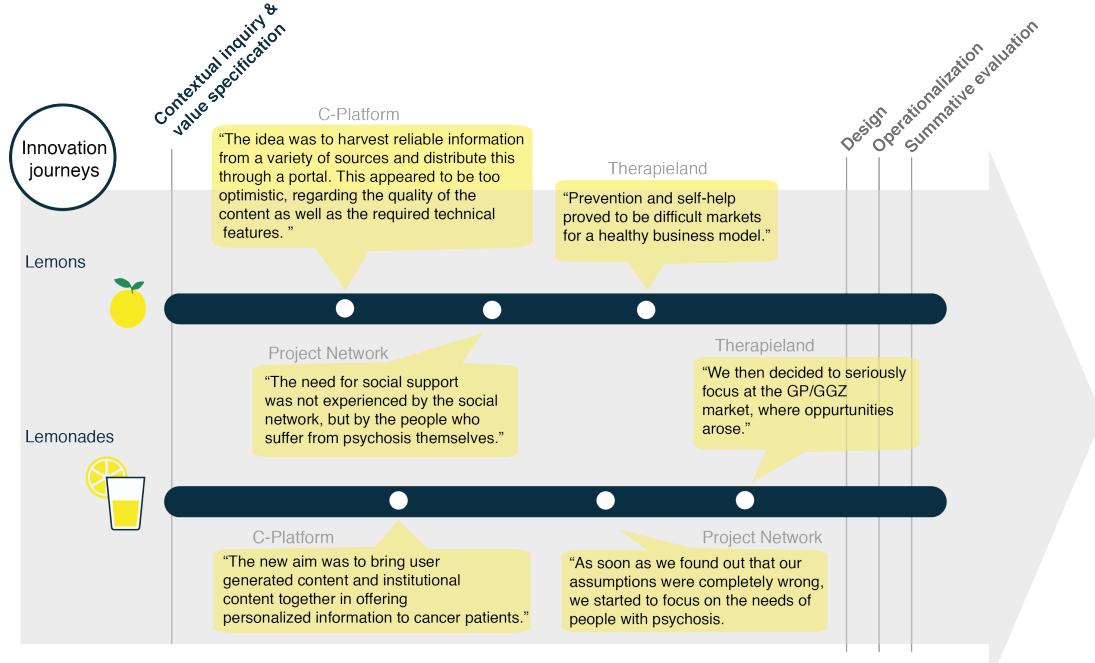


Figure 13. Visual examples of the lemons and lemonade principle in the first phase of the innovation journey.

In summary, a variety of lemons were found in the first phase of the innovation journey, such as the involvement of participants and intermediaries for performing needs research, the unexpected response from user groups and insights into the market and product concept. Lemons were also found regarding funding and business models, and early insights emerged regarding (future) product use.

Phase 2: Design

Table 9 shows the lemons and lemonade principles that were identified during the design phase of the innovation journey (extracted from the data overview in Appendix 1).

Table 9: Case study findings regarding the lemonade principle in phase 2 of the innovation journey.

| Case study findings | Phase 2 Design |
|--------------------------------------|--|
| Nr. 1: Cancer Aftercare Guide | |
| Lemons | The effect was only significant in the first 6 months after treatment. |
| Nr. 2: Project Network | |
| Lemons | 1) The closer you become to someone, the more contact you will have, turned out to be an incorrect assumption. 2) Blurring people did not produce the effect intended by the developers. 3) Reporting turned out to be an intervention itself. |
| Lemonade principle | 1) Users now indicate themselves how often they intend to speak someone. 2) Instead of blurring, the developers introduced a traffic light system. 3) The reporting part is incorporated in the tool. |
| Nr. 4: Temstem | |
| Lemons | 1) Cognitive ability of users was limited. 2) Name Voice Control was misunderstood. 3) Temstem was used differently than thought. |
| Lemonade principle | 1) Adjustment of playing level 2) Change of name |
| Nr. 5: Active Plus | |
| Lemons | Pretests showed that Active Plus had modest usability and relatively high appreciation. |
| Lemonade principle | The team worked further on usability. |
| Nr. 6: Palliarts | |
| Lemons | App builder did not meet expectations. |
| Lemonade principle | The team decided to terminate the collaboration and started a successful collaboration with another app builder. |
| Nr. 7: Accendowave | |
| Lemons | Time and length to market were longer than expected: seven to eight years. |
| Lemonade principle | The team persevered, as their mission to reduce pain was an important part of their drive. |
| Nr. 12: C-Platform | |
| Lemons | 1) Creating content together with these different stakeholders was not an option. 2) The political playing field and decision-making process was very complex. |
| Lemonade principle | An independent content team was build, that worked beyond the edges of the organization. |
| Nr. 14: Lekker Puh! | |
| Lemons | A current uncertainty is whether the application can provide the expected effectiveness. |
| Nr. 18: Hartwacht | |
| Lemons | The time-to-market was longer than expected, in particular to proceed the processes with the health insurer. |
| Lemonade principle | By focusing and keeping faith in the product, eventually progress was made. |
| Nr. 20: Tinybots | |
| Lemons | The production of the specific components and interdependencies in production was more complex than thought. |
| Lemonade principle | The production process has been adapted for the next batch. |

Surprises in product use

Early testing led to early insights, as was the case with Temstem. Temstem (a tool for people who experience auditory hallucinations) tested a paper prototype with users, which led to surprising insights. The language games that intended to reduce voices proved to be too difficult for the users to play. Due to the influence of the voices and medications the participants used, their cognitive ability had significantly decreased. This insight allowed the developers to adjust the game in time for the development of the digital version of the product. In addition, the initial tool name, 'Voice Control,' proved to lead to confusion among users. One user thought that he could control the tool with his voice, leading to confusion. This insight led the developers to immediately change the name to Temstem. A similar insight was experienced by Project Network, a social network tool for people who experience psychoses. The assumptions the developers had about the effects of the design were immediately corrected while testing a paper prototype. The core concept was that visually blurring people in your network should motivate you to get in touch. This did not produce the effect intended by the developers. Additional needs were also observed. For example, reporting turned out to be an intervention in itself. This function has now been incorporated into the tool.

Uncertainty about effectiveness

In this phase, many tools were further tested for effectiveness and usability. The effect study of the Cancer Aftercare Guide showed that the effect of the tool was only significant during the initial six months after treatment. This provided insights into the benefits of the product and the required positioning. For Active Plus, a test study showed that the utility was limited, but that appreciation for the tool was high. As a result, the team could continue to work on usability. In the case of Lekker Puh!, uncertainty was experienced whether the application could provide the expected effectiveness.

Collaboration and the time to market

This phase depended on whether the collaboration would contribute to the development by intensifying development or taking a proper distance; both responses were found in the case studies during this phase. At C Platform, three parties intensely collaborated. This proved to be a difficult cooperation, as each party strongly advocated its own interests. The idea of developing the content tripartite was voiced; however, this was an impossible exercise. The organizations then decided to build an independent team addressing this. This proved to be a good decision, which secured the progress of content development. In the case of PalliArts, the app builder that was selected was unable to meet requirements. The team therefore decided to terminate the collaboration and commenced a successful collaboration with another app builder.

AccendoWave (a pain management tool) was required to overcome an unexpectedly long time to market, which eventually lasted eight years. By starting a collaboration with Samsung and AT&T and intensifying the partnership with hospitals, they secured a solid technical and substantive infrastructure. Tinybots (who developed the social robot 'Tessa' for Alzheimer patients) found that the production of specific components and interdependencies between these components in production was

more complex than originally thought. They therefore adapted the production process for the next batch. In the case of Hartwacht, the time to market was also longer than expected, particularly regarding making progress with the health insurer processes. However, the tripartite collaboration offered a large amount of added value to all parties and was eventually deemed worth the wait.

Figure 14 visually highlights examples of the lemons and lemonade principle found in the design phase of the innovation journey.

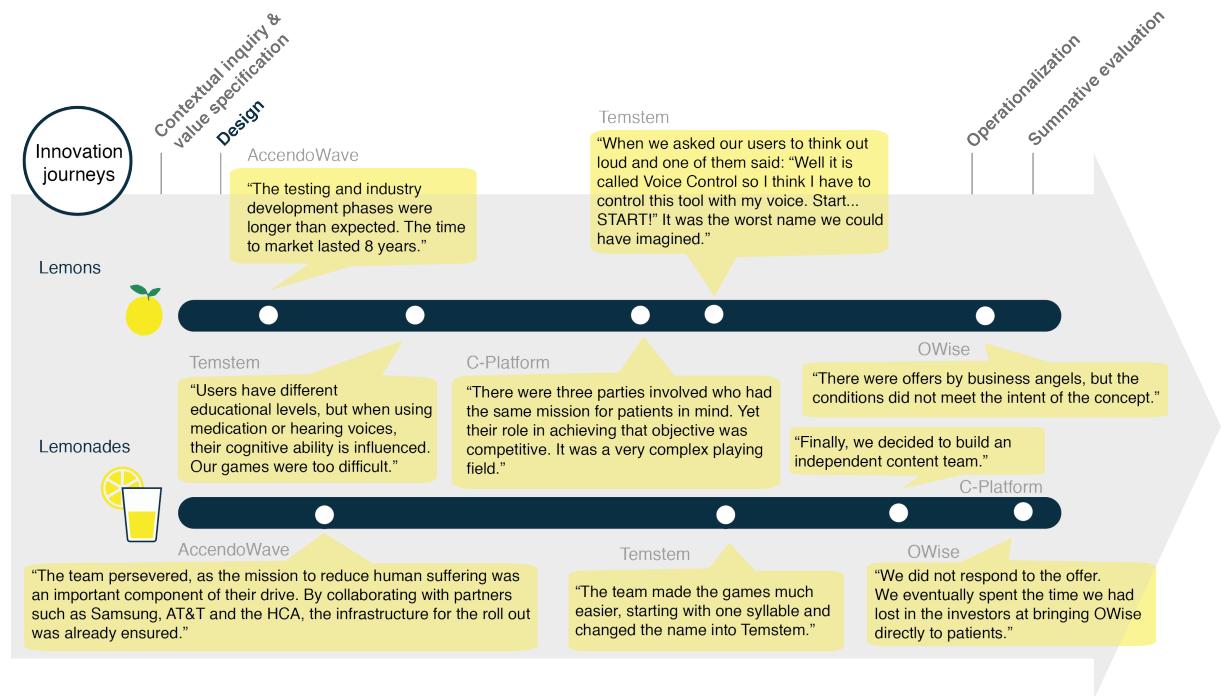


Figure 14. Visual examples of the lemons and lemonade principle in the design phase of the innovation journey.

In summary, the main themes of the lemons found in the design phase were surprises in product use, product effectiveness, collaboration dynamics with partners and the time to market.

Phase 3: Operationalization

Table 10 shows the lemons and lemonade principles that were identified during the third phase of the innovation journey: the operationalization phase (extracted from the data overview in Appendix 1).

Table 10: Case study findings regarding the lemonade principle in phase 3 of the innovation journey.

| Case study findings | Phase 3 Operationalization |
|--------------------------------------|---|
| Nr. 1: Cancer Aftercare Guide | |
| Lemons | The team voiced differing expectations regarding tool implementation. Since this was an online intervention, the team expected it to run itself. |
| Lemonade principle | Collaboration with IKNL for implementation support. |
| Nr. 2: Project Network | |
| Lemons | Implementation requires more attention. |
| Lemonade principle | A toolbox is developed with communication materials for professionals. |
| Nr. 3: Therapieland | |
| Lemons | 1) The rollout proved harder than initially thought. 2) Not everyone supported innovation unreservedly 3) In the education of psychologists, blended care does not exist as a method. |
| Lemonade principle | 1 & 2) A professional and tailor made implementation strategy was developed. 2) A Master eHealth was developed in collaboration with Leeuwarden University |
| Nr. 4: Temstem | |
| Lemons | 1) The importance of evidence-based tools was unforeseen. 2) Implementation required more attention than thought. |
| Lemonade principle | These insights have been included in development of later tools. |
| Nr. 5: Active Plus | |
| Lemons | Originally aimed at a healthy population aged over 50 years, but the market demanded a different target group. |
| Lemonade principle | The team converted this demand into a market opportunity. |
| Nr. 6: Palliarts | |
| Lemons | Exerted pressure from partner to expand the target group to nurses. |
| Lemonade principle | Initiator persevered and convinced partner to remain focused on initial user group. |
| Nr. 8: OWise | |
| Lemons | 1) The Netherlands proved to be a difficult market. 2) Instead of surgeons, oncologists and hospital pharmacists were better suited as initial stakeholders. 3) Offers were received from business angels, but the conditions did not meet the intent of the concept. |
| Lemonade principle | 1) PX Healthcare seized the chance to enter the market in England. 2) The role of these new stakeholders will be further assessed. 3) The time that was lost to the investors, was eventually gained when bringing OWise directly to patients. |
| Nr. 9: Mirro | |
| Lemons | 1) Impact of introduction decision assistant was different than expected, the implementation strategy caused resistance and led to unmotivated use. 2) Decision assistant did not fit the practice of GP's |
| Lemonade principle | 1) In contrast, the latter intuitive approach used in the development of the online self-help modules clearly contributed to the acceptance of Mirro. |
| Nr. 10: MyWepp | |
| Lemons | 1) Lack of demand for MyWepp products in senior market. 2) Unwillingness to pay formed an unexpected obstacle. |
| Lemonade principle | 1) MyWepp ceased its approach and remained focused on the mentally disabled. 2) MyWepp started working with living areas, handling a bottom-up approach rather than a top-down approach, so that groups can make their own choices regarding budget and instantly receive offers of customized products. |
| Nr. 11: KLIK | |
| Lemons | 1) There was no one size fits all possible, every group of users had its own needs. 2) Unwillingness to pay came as a surprise when the business model was introduced 3) Not invented here syndrome by care givers |

| | |
|---------------------------------|--|
| | 4) The less support the more commitment |
| Lemonade principle | 1 & 2) The team learned how to realize pre-commitment to the business model and to the implementation by offering customized solution. |
| Nr. 15: Medi&Seintje | |
| Lemons | Access to technology is not yet evident for (end) users. |
| Lemonade principle | The developers learned that the key to success is to stimulate call to action. |
| Nr. 20: Tinybots | |
| Lemons | The implementation and use of a robot within healthcare organizations proved to be difficult. Robotics are completely new and need to be carefully introduced to caregivers. |
| Lemonade principle | 1) The idea is to previously scan if a healthcare organization has the right conditions to support a robotic innovation. 2) More attention is given to marketing and communication materials about the product. |

In almost all case studies, implementation was reported as difficult and complex. Several developers underestimated the complexity of the implementation due to the digital nature of eHealth (Cancer Aftercare Guide, Therapieland, Active Plus). It was stressed that the Netherlands has a fragmented infrastructure with too many conflicting interests (OWise), that various and complex care processes exist (KLIK, Mirro), and that there is an ambiguous attitude by healthcare professionals towards the implementation of eHealth (Therapieland, Mirro, TemStem, KLIK, Tinybots, Medi&Seintje).

Motives for product acceptance

One disappointment voiced by several developers in this study was that not everyone cheers for innovation, either care professionals or end users. This ambiguous attitude towards eHealth may have been caused by several factors, such as the 'not invented here syndrome,' the fear of replacement, the lack of willingness to invest time or money, or simply the lack of skills to work with eHealth. The interviewees considered it especially important to understand why they were unable to proceed straight to innovation. They then converted these lemons into opportunities by developing implementation strategies (Therapieland/KLIK/Project Network/Tinybots/Hartwacht), offering tailor-made solutions to fit the work processes of healthcare providers (Therapieland, KLIK, Project Network, Active Plus, MyWepp), developing marketing and communication materials (Project Network, Tinybots), and implementing a more direct user approach (Therapieland, Mirro, MyWepp). A master's degree in eHealth was also developed in collaboration with a university, with the aim of educating care professionals in the development and use of eHealth tools (Therapieland).

Challenging market conditions

In several cases, market conditions in the operational phase were unfavourable. An unwillingness to pay for the tool was faced by many tools during the implementation phase (Therapieland, MyWepp, KLIK). By shifting their attention to more fruitful markets and user groups, the developers were able to adjust their business models in time. For example, Active Plus was originally aimed at a healthy population aged over 50 years; however, the market demanded a different target group. Active Plus converted this demand into a market opportunity. During the operational phase of PalliArts, pressure was exerted by a collaborating partner to expand the target group to nurses. As this would have compromised the core concept, the initiator convinced the partner to stay with the initial target group.

Successful implementations

A perfect example of a successful implementation is PalliArts, the initiators of which carefully prepared the implementation with explicit attention to usability, support and ownership. In addition, Accendowave, Owise, InterviewR, Therapieland both achieved solid rollouts through strong infrastructure partnerships. These findings support the arguments of Adner (2006), who stressed the importance of an innovation ecosystem in the realization of innovations. Finally, C-Platform and Mirro were successfully launched through (online) campaigning.

Figure 15 visually highlights examples of the lemons and lemonade principle found in the operationalization phase of the innovation journey.

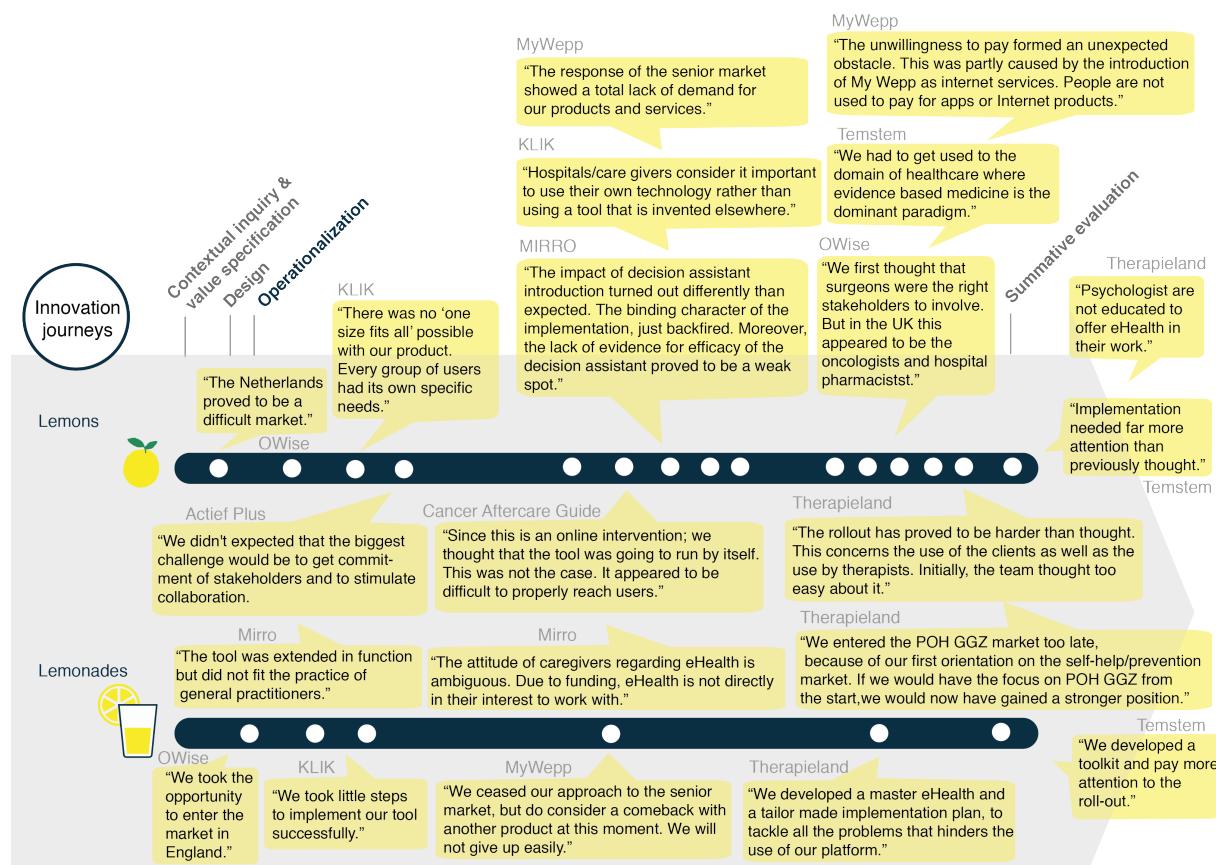


Figure 15. Visual examples of the lemons and lemonade principle in the operationalization phase of the innovation journey.

In summary, the majority of the lemons were identified during the operationalization phase. The largest theme that emerged was (motives for) product acceptance, followed by challenging market conditions and a lack of willingness to pay for the product. Successful implementation was realized in several cases by creating pre-commitment with (infrastructure) partners.

Phase 4: Summative evaluation

Although some case studies are currently in the phase of summative evaluation, no lemons and lemonades have been found in this phase (as shown in Appendix 1).

4.2.3 The specific contribution of the lemonade principle to the development of effective eHealth tools

In this section, the following sub-questions will be answered:

- **Which contributions can be expected from the lemonade principle to the development process of effective eHealth tools?**
- **Which contributions can be expected from the lemonade principle to the effectiveness of eHealth tools?**

First, the fields of contribution from the lemonade principle will be highlighted per innovation journey phase. Thereafter, the specific contributions by the lemonade principle to the development of effective eHealth tools in general will be outlined. Finally, these contributions will be related to the (expected) effectiveness of eHealth tools.

Contributions per innovation journey phase

The following table (Table 11) presents the contributions of the lemonade principle that were identified per innovation journey phase (extracted from the data overview in Appendix 1). These fields were labelled by use of thematic analyses.

Table 11: identified contributions of the lemonade principle per innovation journey phase

| Contributions phase 1 | Contribution phase 2 | Contribution phase 3 |
|--|---|---|
| Timely adjustment of product concept (4) Timely adjustment to right market (3) Timely adjustment of user group (2) Stakeholder involvement Sufficient funding for development Adjustment of positioning Adjustment of product acceptance | Realization of product development (5) Adjustment of product concept (2) Early improvement of product use | Increase of product acceptance (8) Infrastructure for implementation (7) Refinement of implementation strategy (3) Increase of product use (3) Adjustment of user group (2) Preservation of initial user group Adjustment to the right market Remaining independent in funding Adjustment of product concept Refinement of positioning |

In the first phase, the lemonade principle contributed to create earlier insight into and adjustment of assumptions about the product concept, market and user group. Furthermore, the lemonade principle contributed to future product acceptance and product use, the required positioning and stakeholder involvement. In the second phase, the contributions shifted to organizational conditions and collaborations to realise successful product development. In addition, contributions were made to the adjustment of the product concept and improvement of product use.

The contributions in the third phase mainly focused on the increase of product acceptance and the creation of a solid infrastructure for implementation. The lemonade principle further contributed during this phase to the usability of the product and refinement of the implementation strategy through awareness of an appropriate introduction, development of tailor-made solutions and reaching the appropriate stakeholders.

Furthermore, the lemonade principle contributes during the operationalization phase through tailoring the tool to the correct user group and market (although this should preferably occur during the earlier phases). Finally, the lemonade principle contributed to the adjustment or creation of a healthy business model, the adjustment of a product concept and the refinement of positioning.

Contributions to effectiveness of eHealth tools

The abovementioned contributions are linked to the earlier-mentioned effect indicators described by Gemert-Pijnen et al. (2011), which cover user acceptance and satisfaction, widespread adoption, performance, and infrastructure and resources. Table 12 shows how the contributions per phase relate to these effects indicators.

Table 12: contributions per innovation journey phase related to the effect indicators of Gemert-Pijnen et al. (2011)

| Contribution Phase 1 | Contribution Phase 2 | Contribution Phase 3 | Effect indicators |
|---|--|--|----------------------------------|
| Timely adjustment of product concept and user group, Product acceptance | Adjustment of product concept | Refinement product concept, implementation, user group, increase of product acceptance | User acceptance and satisfaction |
| Adjusting the positioning | | Refinement implementation Strategy, positioning | Widespread adoption |
| Adjustment of market, Stakeholder involvement Sufficient funding for development | | Adjustment market, infrastructure for implementation Sufficient funding for development | Infrastructure and resources |
| Adjustment of usability | Realizing product development, adjusting product use | Adjustment of usability | Performance |

Finally, Figure 16 shows the contribution model in which the answer to the main research question is visualised:

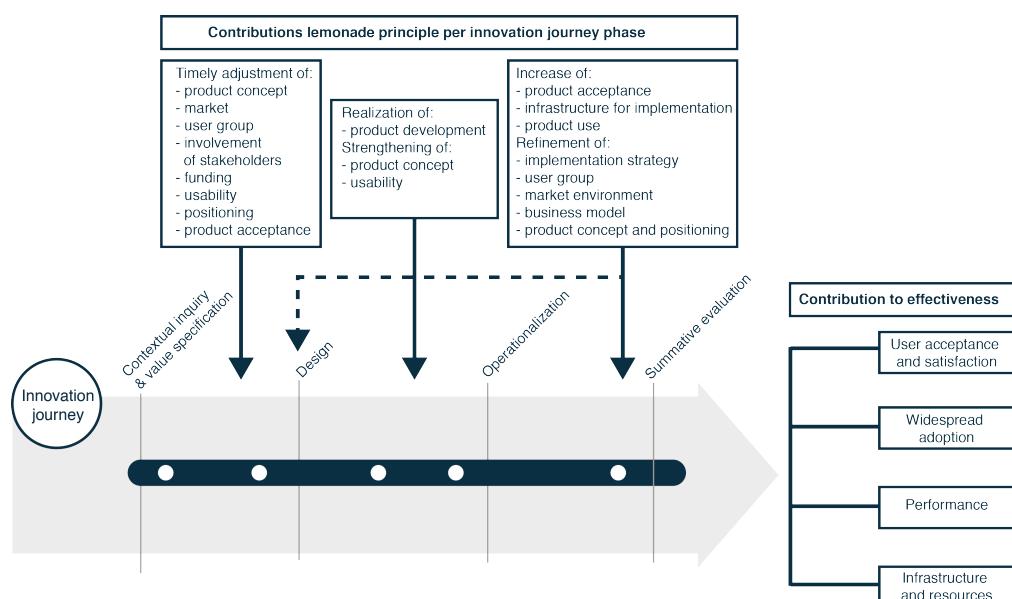


Figure 16. Contribution model lemonade principle

4.2.4 Additional observations of effectuation principles

In this section, the additional effectual principles that were found are described. Although not the primary focus of this research, additional data regarding other effectuation principles were included during the interview sessions. These findings were linked to the measurement constructs by Brettel et al. (2012), as shown in Appendix 4. Table 13 shows the additional effectual principles that were identified during this study (extracted from Appendix 5).

Table 13: Case study findings of additional effectual principles

| Case study findings of additional effectual principles | Crazy Quilt | Affordable loss | Bird-in-Hand | Pilot in the plane |
|--|-------------|-----------------|--------------|--------------------|
| Cancer Aftercare Guide | x | | | |
| Project Network | x | | x | |
| Therapieland | x | x | x | |
| Temstem | x | | | |
| Active Plus | x | | x | |
| Palliarts | x | | x | x |
| Accendowave | x | | x | x |
| OWise | x | x | x | x |
| Mirro | x | | | |
| MyWepp | x | | x | x |
| KLIK | x | | x | |
| C Platform | x | | x | x |
| Philips Healthsuite | x | | x | |
| Lekker Puh | x | | x | |
| Medi&Seintje | x | | x | |
| InterviewR | x | | x | |
| GG-DJ | x | | x | |
| Hartwacht | x | | x | x |
| Sexy Lexy | x | | x | |
| Tinybots | x | | | |

What is immediately apparent in the overview is that within the most successful cases (highlighted in dark green), multiple effectuation principles were applied during the innovation journey, with a dominant combination of the crazy quilt, bird-in-hand, and pilot-in-the-plane principles. All case studies touched upon the crazy quilt principle. Various collaborations were created during the innovation journey, such as stakeholder pre-commitment, end-user co-creation and infrastructure collaborations, which often had no crystallized pathways. Many developers paid careful attention to the resources and skills available to develop the eHealth tool, by using the means provided as starting point for the project. The pilot-in-the-plane principle was observed in cases in which vision and perseverance were shown to successfully develop the tool. Few cases touched upon the affordable loss principle, which states that by approving budgets on the basis of considerations of acceptable losses, businesses thereby remain as independent as possible. More information on the additional observed principles is shown in the case studies in Appendix 5.

5. Conclusion

Finally, the central research question can now be answered.

- **What is the specific contribution of the lemonade principle, as a behavioural dimension of effectuation, to the development processes of effective eHealth tools?**

This study reveals that leveraging uncertainties, especially in the initial development phase, can contribute to increase performance, user acceptance, satisfaction and widespread adoption, a solid infrastructure and resources for implementation.

Interaction with the market and end users from the beginning is crucial for successful tool development. Interdisciplinary collaboration with parties in the field of value creation and infrastructure are important contributions in the run-up to the development phase. This requires a careful balance between guarding the vision of the product and creating common value with the stakeholders during product development.

The eHealth market is currently experiencing a growth phase. Many micro-initiatives exist; however, little scaling up has been performed. This study shows that the developer's approach and behaviour regarding uncertainties can play a crucial role in increasing the impact and effectiveness of eHealth tools. This powerful effectual 'DNA' helps to boost scaling by bringing vision and perseverance.

In conclusion, the lemonade principle can contribute to the development of eHealth in several ways, by empowering the developers to turn the unexpected into the valuable and profitable, during the early stages of an innovation journey.

This study casts a new perspective on the development process in a constructive manner, so that the horizon of understanding for all those involved in eHealth can be broadened, contingencies can be leveraged and the effectiveness of eHealth tools can be enhanced.

6. Discussion

In this section, the final sub-question of the research question will be answered.

- **What are the implications of these findings for future research and for stakeholders who aim to improve the effectiveness of eHealth tools?**

The first section describes the implications of these findings for future research. The second section describes the practical implications for stakeholders who desire to improve the effectiveness of eHealth tools. The final section describes suggestions for follow-up research.

6.1 Theoretical implications

This investigation was an initial, explorative study of the contribution of the lemonade principle to the effectiveness of eHealth tools. It covered a broad field of themes to obtain insight into the contributions of the lemonade principle to the development processes of eHealth technologies. To be able to generalize the findings of this research, a quantitative follow-up study is suggested.

Deploying uncertainty as a resource at the start of the innovation journey

A lesson learned by the interviewees throughout the innovation journey was that implementation must be taken into account in earlier phases of the development processes, which corresponds with the findings of Gemert-Pijnen et al. (2011). The phases of each innovation journey were openly requested and subsequently clustered using a framework approach. Therefore, the relationship between the contributions and the specific phases per case study may not have been sufficiently explored. More detailed research is required regarding the effects of shifting the attention of the lemonade principle to earlier stages of the innovation journey.

Vision and perseverance as key characteristics

Potential was seen via intensifying the discussion of the demonstrated importance of vision and perseverance in this research, through investigating more effectuation-related measures (Sarasvathy, 2008). This was related to the pilot-in-the-plane principle, through identifying and relating individual effectual behaviour to the ultimate effectiveness of an eHealth tool.

User-centred design vs evidence-based medicine (EBM)

The case studies included in this investigation were developed using different motives and dynamics. The paradigms that lay behind these included user-centred design and EBM. The challenge as outlined in the problem statement was to not enter a commensurability debate on this matter (Essers, 1999), but rather to examine possible connections. Just as effectuation and causation can complement each other in realizing an innovation (Sarasvathy, 2008), user-centred design and EBM can be brought closer together to enhance the impact of eHealth tools. Multiple case studies in this study made use of a combined approach, based on both human-centred design and EBM. Through the parallel development of product refinement and the execution of an RCT, they ensured that the EBM approach did not compromise user-centred design.

Future studies could elucidate the balance required between effectuation and causation during the development of eHealth technologies.

Coping with uncertainty and the degree of innovativeness

In this study, no distinction was made between “acknowledging the unexpected” and “overcoming the unexpected,” which according to Brettel et al. (2012) relate to the degree of innovativeness of a project. Building on the propositions by Kline and Rosenberg (1986), who stated that “the greater the change, the greater the uncertainty,” it may be interesting to further investigate the degree of innovativeness of a technology in relation to the handling of the lemonade principle.

The three key uncertainties distinguished by Rosenberg (1998) that relate to innovations were all touched upon during this study, with a focus on the (in)correct assumptions concerning customer demand. Nevertheless, the forms of uncertainty that occurred require further research to be able to significantly contribute to the theories regarding uncertainty.

Bricolage and the realization of effective eHealth tools

A potential interesting research angle would be to take the concept of bricolage (Lévi Strauss, 1966), doing what is at hand, to the context of eHealth development, in order to further investigate (in addition to that performed by Baker et al., 2005), whether small entrepreneurs are more successful in delivering effective eHealth tools than corporate firms.

Effectual solutions to manage uncertain impacts

Pre-commitment was frequently addressed as a prerequisite for successful development. Therefore, it may be interesting to further investigate the possible contributions of the three effectual solutions (pre-commitment, contractor, entrepreneurial agency) by Dew and Sarasvathy (2007) to manage the uncertain impacts of innovations on stakeholders within the context of eHealth development.

6.2 Practical implications

A practical aim of this research was to provide insights into realizing effective eHealth tools for organizations that are being confronted with barriers.

As stated earlier, the dominant knowledge hierarchy in healthcare places objective and numerical knowledge above the user experience (Greenhalgh and Swinglehurst, 2011). However, researchers and professionals within healthcare are increasingly stressing the importance of the interaction between technology, human interaction and the social environment (Gemert-Pijnen et al., 2011).

Without doubting the necessity of evidence-based tools, the findings of this research imply that equal attention is required regarding exploratory viability during the innovation journey. As this study shows, coping with unforeseen circumstances during the early phases of the development process through using effectual behaviour increases the success of eHealth tools.

As indicated by Gemert-Pijnen et al. (2011), the development approach of eHealth technologies should be multidisciplinary in nature, preferably at an early stage. Various skills are needed to explore the market and to map the user needs, to empathically design the product, and to acquire technical knowledge about the feasibility of the product, business knowledge about a suitable business model, and knowledge about marketing and communication. In addition, it is important for future developers to continually and carefully guard and match the vision of the product and the user needs. Finally, literal stamina may be required if processes occur more slowly than initially expected.

To apply the lemonade principle in practice, the following interviewee lessons and experiences can be considered, as shown in Figure 17:

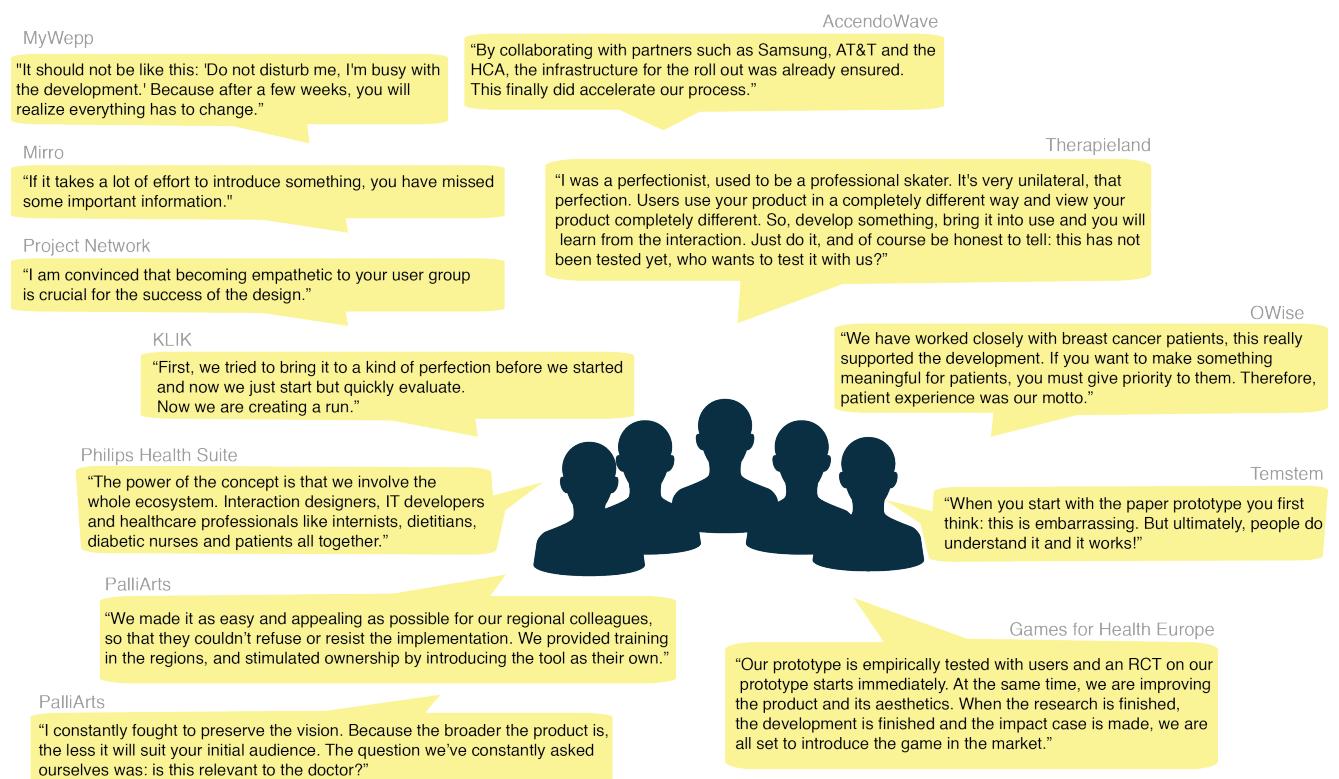


Figure 17. Interviewee lessons and experiences.

By sharing insights into 20 innovation journeys within eHealth practice, together with a theoretical framework concerning the contribution of the lemonade principle to the development processes of effective eHealth tools, it is hoped that organizations can benefit from this knowledge by increasing the uptake and effectiveness of eHealth tools.

6.3 Follow-up research

This investigation was an initial, explorative study of the contribution of the lemonade principle to the effectiveness of eHealth tools. To generalize the findings of this research, a quantitative follow-up study is required.

The contribution fields described here related to other theories regarding human centred design, innovation theories and technology design. Future research should attempt to link effectuation to these adjacent theories. During this study, it became apparent that the effectiveness of eHealth tools cannot be determined using a one-dimensional model. In addition, not all case studies have completed their innovation journey; therefore, it would be interesting to conduct a longitudinal investigation into the contributions of effectual behaviour to the ultimate effectiveness of eHealth tools.

Furthermore, it would be interesting to follow champion developers with different backgrounds through their development journey, to more fully understand their entrepreneurial and innovative behaviour. Given the demonstrated importance of perseverance and vision in this study, it is recommended that future studies link effectual behaviour in general, or the pilot-in-the-plane principle in particular, to leadership within healthcare.

The findings of this research contribute to fill the gap in empirically testing the effectuation theory, by understanding the contribution of the effectual lemonade principle related to the development processes of eHealth tools. Regarding the significant linkage between the application of the lemonade principle with other effectuation principles, many opportunities exist to further investigate and build a contribution model for effectuation in relation to eHealth development, preferably in the tradition of the experiments involving expert entrepreneurs performed by Sarasvathy (2008).

This research opens doors to follow-up research that could further substantiate the findings of this study and shift attention to adjacent theories and practices.

7. Limitations

7.1 Limitations of the research process

Although the interview sessions were conducted with great care, the results of this study may have been influenced by the following limitations:

- This was a retrospective investigation, in which developers and founders shared and mapped their experiences with the development process. It is possible that they assessed their experiences differently afterwards;
- The interviews were considered as a co-production between the interviewer and the interviewee;
- Some interview sessions involved several interviewees, which could have influenced the dynamics of the interviews;
- Two interviews were conducted at the HIMSS conference in Orlando (AccendoWave/Philips Health suite). This setting may have had an impact on the course and depth of the interview;
- The nature of case studies differed, making some case studies less elaborate than others;
- It was difficult to determine the effectiveness of eHealth tools due to a lack of unambiguous indicators. Ultimately, follow-up research using strong indicators is required;
- Since the interview sessions were conducted in Dutch, the quotes may not provide an accurate view of the words used, although all care was taken in translation.

7.2 Reflection on the process

As a student researcher, I am aware of the interactions that might have influenced the interview results during the interview sessions:

- Although in my experience the interviewees were honest and open about the barriers they encountered in the development process, a social desirability bias might have occurred, involving over-reporting of good behaviour or under-reporting of 'bad' behaviour;
- Since this research concerned implicit information about the handling of the lemonade principles and there were no extensive explicit measurement constructs available, my interpretation of certain events and actions during the innovation journeys possibly influenced the outcomes;
- Although I have tried to exploratory collect the experiences of developers, the tendency to shift the attention to significant issues concerning the lemonade principle might occurred during the research process;
- Finally, due to the number of case studies, the interpretation process was time and labour intensive, which may have jeopardized the depth of the analysis.

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Attended congresses & seminars

- eHealth Seminar, January 16th 2017
- ICT&Health Experience, January 16th 2017
- HIMSS Conference & Exhibition in Orlando, USA, February 19-23 2017
- Conference eGGZ Centre: the implementation of innovations, February 16th 2017
- Zorg & ICT exhibition, March 14th 2017
- Sessie Bridging the G@P - effectuating our future health April 11th 2017

Appendix 1. Overview key findings case studies

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Qualitative success |
|--------------------------------------|--|--|--|---------------------|---------------------|
| Nr. 1: Cancer Aftercare Guide | | | | ? | ? |
| Lemons | Whilst setting up the needs assessment it appeared to be difficult to recruit participants for the focus groups. | The effect was only significant in the first 6 months after treatment. | The team voiced differing expectations regarding tool implementation. Since this was an online intervention, the team expected it to run itself. | | |
| Lemonade principle | The additional investment and attention to involve healthcare providers and users. | | Collaboration with IKNL for implementation support. | | |
| Fields of contribution(s) | User group and stakeholder involvement | | Infrastructure for implementation. | | |
| Nr. 2: Project Network | | | | V | ? |
| Lemons | The need for social restructure was not experienced by the social network of mental vulnerable people, but by the vulnerable people themselves. | 1) The closer you become to someone, the more contact you will have, turned out to be an incorrect assumption. 2) Blurring people did not produce the effect intended by the developers. 3) Reporting turned out to be an intervention itself. | Implementation requires more attention. | | |
| Lemonade principle | Project Network shifted its attention to vulnerable people. | 1) Users now indicate themselves how often they intend to speak someone. 2) Instead of blurring, the developers introduced a traffic light system. 3) The reporting part is incorporated in the tool. | A toolbox is developed with communication materials for professionals. | | |
| Fields of contribution(s) | Timely adjustment of user group. | Timely adjustment of product concept. | Refinement of implementation and positioning | | |
| Nr. 3: Therapieland | | | | V | V |
| Lemons | Prevention proved to be a difficult market for a healthy business model. | | 1) The rollout proved harder than initially thought. 2) Not everyone supported innovation unreservedly 3) In the education of psychologists, blended care does not exist as a method. | | |
| Lemonade principle | Through thorough knowledge of the market and regional and national policies, Therapieland transformed this into an opportunity to enter the GP/GGZ market. | | 1) A professional implementation strategy was developed. 2) A Master eHealth was developed in collaboration with Leeuwarden University. 3) By collaborating with KSYOS, it became possible for Therapieland to scale up. | | |

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Quantitative success |
|---------------------------|---|---|---|---------------------|----------------------|
| Fields of contribution(s) | Timely adjustment to right market. | | Increase of product acceptance and product use | | |
| Nr. 4: Temstem | | | | V | ? |
| Lemons | | 1) Cognitive ability of users was limited. 2) Name Voice Control was misunderstood. 3) Temstem was used differently than thought. | 1) The importance of evidence-based tools was unforeseen. 2) Implementation required more attention than thought. | | |
| Lemonade principle | | 1) Adjustment of playing level 2) Change of name | These insights have been included in development of later tools. | | |
| Fields of contribution(s) | | Early improvement of product concept. | | | |
| Nr. 5: Active Plus | | | | V | V |
| Lemons | | Pretests showed that Active Plus had modest usability and relatively high appreciation. | 1) Originally aimed at a healthy population aged over 50 years, but the market demanded a different target group. 2) A different research approach was needed, because of the constant assessment of user needs. | | |
| Lemonade principle | | The team worked further on usability. | 1) The team converted this demand into a market opportunity. 2) The team shifted their attention to more qualitative research approaches. | | |
| Fields of contribution(s) | | Early improvement of product use. | Adjustment of user group and project objectives. | | |
| Nr. 6: Palliarts | | | | V | V |
| Lemons | Prize from the VGZ proved not to be funding, but rather project hours. | App builder did not meet expectations. | 1) Partner IKNL exerted pressure to expand the target group to nurses. | | |
| Lemonade principle | By showing perseverance and faith in the concept by the initiator, VGZ eventually acknowledged that it had not been sufficiently clear and offered to invest in the development of the app. | The team decided to terminate the collaboration and started a successful collaboration with another app builder. | 1) Initiator persevered and convinced IKNL to remain focused on initial user group. 2) With the support of all regional networks, it was possible to launch a successful product that exceeded all expectations regarding use. | | |
| Fields of contribution(s) | Realization of sufficient funding for development. | Realization of the development by collaboration | Preservation of initial user group, infrastructure for implementation | | |
| Nr. 7: AccendoWave | | | | V | V |
| Lemons | | Time and length to market were longer than expected: seven to eight years. | | | |
| Lemonade principle | | The team persevered, as their mission to reduce pain was an important part of their drive. By collaborating with partners such as Samsung, AT&T and the HCA, the infrastructure for implementation was ensured. | | | |

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Qualitative success |
|---------------------------|---|--|---|---------------------|---------------------|
| Fields of contribution(s) | | Fruitful collaboration for product development | Solid infrastructure for implementation | | |
| Nr. 8: OWise | | | | V | V |
| Lemons | | | 1) The Netherlands proved to be a difficult market. 2) Instead of surgeons, oncologists and hospital pharmacists were better suited as initial stakeholders. 3) Offers were received from business angels, but the conditions did not meet the intent of the concept. | | |
| Lemonade principle | | | 1) PX Healthcare seized the chance to enter the market in England. 2) The role of these new stakeholders will be further assessed. 3) The time that was lost to the investors, was eventually gained when bringing OWise directly to patients. | | |
| Fields of contribution(s) | | | 1) Adjustment to the right market. 2) Approaching the right stakeholders for implementation. 3) Remaining independent in funding. | | |
| Nr. 9: Mirro | | | | - | V |
| Lemons | | | 1) Impact of introduction decision assistant was different than expected, the implementation strategy caused resistance and led to unmotivated use. 2) Decision assistant did not fit the practice of GP's | | |
| Lemonade principle | | | 1) In contrast, the latter intuitive approach used in the development of the online self-help modules clearly contributed to the acceptance of Mirro. | | |
| Fields of contribution(s) | | | Increase of user acceptance (self-help modules) | | |
| Nr. 10: MyWepp | | | | V | V |
| Lemons | With the advent of Youtube, the business model for ABC TV was lost. | | 1) Lack of demand for MyWepp products in senior market. 2) Unwillingness to pay formed an unexpected obstacle. | | |

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Qualitative success |
|-------------------------------------|--|---|---|---------------------|---------------------|
| Lemonade principle | MyWepp co-created a new vision and approach to the market need of the mentally disabled. | | 1) MyWepp ceased its approach and remained focused on the mentally disabled. 2) MyWepp started working with living areas, handling a bottom-up approach rather than a top-down approach, so that groups can make their own choices regarding budget and instantly receive offers of customized products. | | |
| Fields of contribution(s) | Timely adjustment of right market | | Adjustment of user group, stakeholder approach, and increase of product acceptance | | |
| Nr. 11: KLIK | | | | | V V |
| Lemons | | | 1) There was no one size fits all possible, every group of users had its own needs. 2) Unwillingness to pay came as a surprise when the business model was introduced 3) Not invented here syndrome by care givers 4) the less support the more commitment | | |
| Lemonade principle | | | 1) Small steps were taken to be able to successfully implement the tool. 2 & 3) The team learned how to realize pre-commitment to the business model and to the implementation by offering customized solution. | . | . |
| Fields of contribution(s) | | | Adjustment of product, increase of product acceptance and product use. | | |
| Nr. 12: C Platform | | | | | V V |
| Lemons | Harvesting information appeared not to be an option. | 1) Creating content together with these different stakeholders was not an option. 2) The political playing field and decision-making process was very complex. | | | |
| Lemonade principle | The team decided to develop authoritative content. | 1) An independent content team was build. 2) The development team kept their distance and worked beyond the edges of the organization. | | | |
| Fields of contribution(s) | Timely adjustment of product concept | Realizing progress in product development | | | |
| Nr. 13: Philips Health suite | | | | | ? ? |
| Lemons | Patient are not only interested in the data generated, but also in the interaction with their network, both professional and personal. | | | | |

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Qualitative success |
|---------------------------------|--|--|--|---------------------|---------------------|
| Lemonade principle | Patient are not only interested in the data generated, but also in the interaction with their network, both professional and personal. | | | | |
| Fields of contribution(s) | Adjustment of product concept | | | | |
| Nr. 14: Lekker Puh! | | | | ? | ? |
| Lemons | | A current uncertainty is whether the application can provide the expected effectiveness. | | | |
| Lemonade principle | By building a prototype quickly, the lemonade principle is already handled in the design of the development process of GFHE. | | | | |
| | | | | | |
| Fields of contribution(s) | Early adjustment of product concept | | | | |
| Nr. 15: Medi&Seintje | | | | ? | ? |
| Lemons | | | Access to technology is not yet evident for (end) users. | | |
| Lemonade principle | | | The developers learned that the key to success is to stimulate call to action. | | |
| Fields of contribution(s) | | | Increase of product acceptance, implementation | | |
| Nr. 16: InterviewR | | | | V | V |
| Lemons | Care had proved a barbarous field, when innovations in care do not give rise to substitution, innovation is expensive. | | | | |
| Lemonade principle | GFHE shifted the focus from fighting sickness to restoring and promoting happiness and wellbeing. | | | | |
| Fields of contribution(s) | Adjustment of market / user group. | | | | |
| Nr. 17: GG-DJ | | | | V | V |
| Lemons | | | | | |

| Case study findings | Phase 1 Contextual inquiry & value specification | Phase 2 Design | Phase 3 Operationalization | Qualitative success | Qualitative success |
|---------------------------|---|--|--|---------------------|---------------------|
| Lemonade principle | Cope with uncertainty is guaranteed in GFHE's development process. The insights that were gained during the prototype testing, were immediately converted into opportunities for the product during the development phase. | | Parallel to the research phase, GFHE improves the product and its aesthetics. When the research is finished, the development is finished and the product is ready for launch. | | |
| Fields of contribution(s) | Timely adjustment of product concept. | | Increase of product acceptance and effective implementation | | |
| Nr. 18: Hartwacht | | | | | V V |
| Lemons | | The time-to-market was longer than expected, in particular to proceed the processes with the health insurer. | 1) They had overestimated caregivers when it came to eHealth use. 2) The product acceptance was difficult. | | |
| Lemonade principle | | By focusing and keeping faith in the product, eventually progress was made. | 1 & 2) FocusCura developed the service holistically, not solving a piece of a problem but offering a total solution. | | |
| Fields of contribution(s) | | Realization of product development | Product use and acceptance | | |
| Nr. 19: Sexy Lexy | | | | | ? ? |
| Lemons | 1) When evaluating the tool, clients said they would use it, but only for fun, because they already know everything. 2) The user group feels that is being told that they better not get involved with sex, while all they want to do are normal things. | | The organizations who were responsible for the tool decided to pause further development. | | |
| Lemonade principle | The developers used this insight in the positioning of the product and attempted to remove the taboo surrounding this subject. | - | Currently, Reframing Studio considers develop Sexy Lexy further themselves. | | |
| Fields of contribution(s) | Adjustment of positioning/product acceptance | | Collaboration, implementation | | |
| Nr. 20: Tinybots | | | | | ? ? |
| Lemons | | The production of the specific components and interdependencies in production was more complex than thought. | The implementation and use of a robot within healthcare organizations proved to be difficult. Robotics are completely new and need to be carefully introduced to caregivers. | | |
| Lemonade principle | | The production process has been adapted for the next batch. | 1) The idea is to previously scan if a healthcare organization has the right conditions to support a robotic innovation. 2) More attention is given to marketing and communication materials about the product. | | |
| Fields of contribution(s) | | Realization of product development, production | Increase of product acceptance, effective implementation | | |

Appendix 2. Topic guide interview sessions

Name tool:

Organisation:

Interviewees:

Technology category:

Function:

Users:

User number:

Care process:

Tool description:

Motive for the development of the tool

What was the motive for developing the tool?

Involved stakeholders

Who was involved with the development of the tool, why and in what way?

Phases of the development process

What where the phases of the development proces?

Evolution of the tool

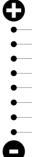
Is the product that you now provide essentially the same as originally conceptualized? Is it substantially different than first imagined?

Unforeseen circumstances

Where there unforeseen/unexpected barriers/opportunities that arose during the specific phases of the development process? What was the response to these circumstances? What was the result of this response (where these unforeseen circumstances leveraged?)

Additional observation of effectuation principles

Appendix 3. Case study format interview sessions

| TOOL | | | | |
|---------------------------------------|---|--|--|---|
| <p>Naam Doelgroep Segment</p> |  | | |  |
| CONTEXT | | | | |
| STAKEHOLDERS INVOLVEMENT | | | | |
| | | | | |
| TOUCHPOINTS/ MILESTONES | | | | |
| (UNFORESEEN) BARRIERS | | | | |
| (UNFORESEEN) OPPORTUNITIES | | | | |
| RESULTS | | | | |

Appendix 4. Consulted measurement constructs

Measurement constructs of effectuation principles, Brettel et al (2012)

Dimension 1: Preference for means vs. goals (Bird in Hand)

1. Our R&D project was specified on the basis of given means/resources
2. The target of our R&D project was vaguely defined in the beginning
3. Given means/resources have been the starting point for the project
4. The process converged towards a project target on the basis of given means/resources
5. Rather given means than concisely given project targets have been the starting point for our project
1. The project specification was predominantly based on given resources
2. Given means have significantly impacted on the framework of our R&D project

Dimension 2: Preference for affordable loss vs. expected returns (Affordable loss)

1. Considerations about potential losses were decisive for the selection of the R&D option
2. Project budgets were approved on the basis of considerations about acceptable losses
3. The selection of the R&D-option was mostly based on a minimization of risks and costs
4. We mainly considered the potential risk of the project
5. Decisions on capital expenditures were primarily based on potential risks of losses

Dimension 3: Preference for partnerships vs. competitive market analysis (Crazy Quilt)

1. We tried to reduce risks of the R&D project through internal or external partnerships and agreements
2. We jointly decided with our partners/stakeholders on the basis of our competences
3. Our focus was rather on the reduction of risks by approaching potential partners and customers
4. In order to reduce risks, we started partnerships and received pre-commitments

Dimension 4: Preference for acknowledge vs. overcome the unexpected (Lemonade principle)

1. We always tried to integrate surprising results and findings during the R&D process — even though this was not necessarily in line with the original project target
2. Our R&D process was flexible enough to be adjusted to new findings
3. New R&D findings influenced the project target
4. The project planning was carried out in small steps during the project implementation
5. Despite of potential delays in project execution we were flexible and took advantage of opportunities as they arose
6. We allowed the project to evolve as opportunities emerged — even though the opportunities have not been in line with the original project target
7. Potential setbacks or external threats were used as advantageous as possible

Appendix 5: Case studies

CASE STUDY NR 1: CANCER AFTERCARE GUIDE

Organization: Open University, Department of Health Psychology

Interviewee(s): Lilian Lechner. Professor in Health Psychology

Technology category: Web application and portals

Segment: Oncology

Function: Self-management

Users: Cancer patients

User adoption: 231 participants effect study

User acceptance: positive effect study

Care process:

- ✓ e-public health: Education and prevention;
- ✓ e-care: Primary care process in cure and care

Additional data sources: Willems, R. A., Bolman, C. A., Mesters, I., Kanera, I. M., Beaulen, A. A., & Lechner, L. (2015). The Kanker Nazorg Wijzer (Cancer Aftercare Guide) protocol: the systematic development of a web-based computer tailored intervention providing psychosocial and lifestyle support for cancer survivors. *BMC cancer*, 15(1), 580.

TOOL DESCRIPTION

The Cancer Aftercare Guide is an online information and support program for cancer survivors. The program is focused on recovering from cancer. It is implemented by the Open University in collaboration with the University of Maastricht. The project is funded by the Dutch Cancer Society.

MOTIVE FOR DEVELOPMENT

After primary treatment, many cancer survivors experience psychosocial, physical, and lifestyle challenges. To address these issues, the Open University developed a web-based computer-tailored intervention, the Cancer Aftercare Guide, which aims at providing psychosocial and lifestyle support for cancer survivors.

INVOLVED STAKEHOLDERS

- Open University
- University of Maastricht
- Dutch Cancer Society
- IKNL: Quality institute for oncological research and practice
- IT developers
- Hospitals
- Cancer survivors

PHASES OF THE DEVELOPMENT PROCESS

For the development of the Cancer Aftercare Guide, the steps described in the Intervention Mapping (IM) protocol were followed:

- A needs assessment of the study population,

- Specification of performance objectives and cross-referencing these with relevant determinants to change objectives,
- Selecting theory-informed intervention methods and practical applications to alter the determinants of the health behaviour,
- Producing and pretesting program materials,
- Planning program adoption and implementation, and
- Planning for evaluation.

EVOLUTION OF THE TOOL

A needs assessment was performed, consisting of a literature study, focus group interviews, and a survey to obtain further insight into cancer survivors' health issues. This resulted in the identification of seven problem areas, which were then addressed in the intervention: Cancer-related fatigue, return to work, anxiety and depression, social relationships and intimacy, physical activity, diet, and smoking. To address these areas, the principles of problem-solving therapy and cognitive behavioural therapy were employed. At the start of the intervention, participants complete a screening questionnaire. Based on the answers provided, participants receive tailored advice regarding which of these areas deserve their attention. Participants were recruited from November 2013 through June 2014 by hospital staff from 21 hospitals in the Netherlands. Patients were selected either during follow-up visits to the hospital or from reviews of patient files. The effectiveness of the intervention was tested in a randomized controlled trial consisting of an intervention group ($n = 231$) and a waiting list control group ($n = 231$), with a baseline measurement and follow-up measurements at 3, 6, and 12 months. Use of the Intervention Mapping protocol resulted in a theory and evidence-based intervention providing tailored advice to cancer survivors concerning how to cope with psychosocial and lifestyle issues after primary treatment.

LEMONS DURING THE INNOVATION JOURNEY

- While designing the needs assessment, it appeared to be difficult to recruit participants for the focus groups. Therefore, the development team made an additional investment to involve healthcare providers and hospitals, with the later impact study in mind.
- A proven effect on fatigue, depression, exercise, nutrition and quality of life was observed. The researchers saw that the quality of life of the experimental group increased to a greater degree and faster than that of the control group in the first half year. A surprising observation was that the effect was only significant in the initial 6 months after treatment. After this period, there was a catch-up effect by the control group. The most important effect seen was earlier recovery when using the Cancer Aftercare Guide.
- The team voiced differing expectations regarding tool implementation. Since this tool is an online intervention, the team expected it to run itself. This was not the case. It also appeared to be difficult to adequately reach users. Therefore, the team initiated a collaboration with the IKNL. According to Lechner, the correct intermediaries and sustainable funding are crucial for effective implementation.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to be adjusted to new findings
(additional investment to recruit participants)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Crazy Quilt:

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (collaboration IKNL)

QUOTES

"We only benefit by conducting good research. We have no interest in the earnings."
"One of the major challenges when it comes to eHealth is how to attract and keep the users."

"It is important to know your strengths. Researchers are not implementers. Therefore, you must let the intervention go at some point. Even if it feels like it is your baby."

"You don't want to enter a process where the content is changed in such way that it is no longer effective and that the quality of the intervention is no longer secured."

"It's never finished. You must continue to learn and innovate."

"To be honest, we thought, 'It's an eHealth intervention, it will run by itself.'

Implementation is difficult. And versatile. Each case has its own dynamics. It is important to know the field."

CASE STUDY NR 2: PROJECT NETWORK

Organization: Parnassia Group & Reframing Studio

Interviewee(s): Beatrijs Voornemans, Interaction Designer

Technology category: Mobile apps

Segment: Mental Health

Function: Self-help

Users: Young people with mental health issues

User adoption: currently used by clients of Parnassia group

User acceptance: positive user evaluation

Care process:

- ✓ e-public health: Education and prevention

Additional data sources: www.werkenaanjenetwerk.nl, consulted on March 15, 2017

TOOL DESCRIPTION

Project Network helps users to manage and strengthen relationships by offering a tool that allows people to actively boost their network. The design of Project Network is based on four mechanisms:

1. Actively working on your network,
2. Increase the frequency of contacts,
3. Improve the quality of contacts, and
4. Learn about friendship.

MOTIVE FOR DEVELOPMENT

The Dutch mental healthcare system is currently in transition. The sector is facing economical and demographical challenges, and the standard paradigms of diagnosis and treatment are also being questioned. New insights into this subject, a different approach towards service users and the possibilities of new technologies are demanding for new and inventive solutions. In the project 'Recovering from Psychosis through Design,' designers work closely with therapists, field experts, service users and scientists to discover how design can shed new light on the domain of mental health care. Project Network is one outcome of the 'Recovering from Psychosis through Design' project. Project Network is an app that helps young people to maintain and strengthen their social network when they are for example recovering from mental health issues.

INVOLVED STAKEHOLDERS

Project Network is a co-production of the Parnassia Group and Reframing Studio.

The Parnassia Group is a mental health institution that helps people to become more resilient.

- Parnassia Group
- Reframing Studio
- App developer Springs

PHASES OF THE DEVELOPMENT PROCESS

- Context research
- First paper prototype
- Digital prototype

- Implementation
- Ongoing development

EVOLUTION OF THE TOOL

The initial idea for Project Network was a self-destructing clock for the social network of someone who has a psychosis. If you are not contacting a person with a psychosis as a mother or friend, your clock will destruct at a certain time, leaving you no longer able to use it on your phone. If you make contact again, the clock will again become functional. For Project Network, Beatrijs conducted many interviews with people who experience psychosis, their parents, family and friends. This was an intense experience with many challenges; however, it was very valuable as many rich perspectives that were collected. Through these stories, it was realized that their assumptions were incorrect regarding the unwillingness of the social network to contact the person who experiences a psychosis. The social network was willing to make contact, but did not know how to do it. It was the one experiencing the psychosis who found it difficult. They needed to get to know and discover themselves again. They often did irrational things during a period of psychosis. Only after recovering from a psychotic episode did they come to realize what they had done. With this information, the designers of the Reframing Studio realized that it would be more advantageous to develop a solution for those who experience a psychosis themselves than for their social network.

The contextual research became increasingly extensive. Attention was shifted to the value of friendship, and how difficult it is to ask for help in some situations. Beatrijs and her colleagues then identified that they should motivate people themselves to reach out to their social network. They realized that the concept is not only relevant to people with psychosis. Anybody who is mentally vulnerable should be able to obtain support in managing and strengthening their social network.

The initial idea was that the closer you are to someone (inner circle), the more often you require contact with this person. According to the paradigm of the self-destroying clock, social contacts would otherwise slowly (visually) fade away.

Reframing Studio built a prototype and commenced testing. Ten to 20 people participated in the test. It was difficult to automatically track contact frequency, using for example WhatsApp or Facebook data. Therefore, the participants were asked to report the number of people with whom they had contact, how often and who took the initiative. These data were passed on to the trainee. This trainee manually altered certain contacts to be blurrier or brighter.

The outcome of the test was that the participants felt an increased sense of ownership regarding their social network and became aware of strong and weak relationships. A surprising insight was that the reporting formed part of the intervention itself; people became aware of the status of their relationships. Thus, this was important to retain this as a function. Another insight was that contact frequency with people in the inner circle is not per se higher. Through this insight, a new method was introduced, namely allowing users to indicate how often they hoped or intended to speak to someone in their social network. The tips and know-how that were sent by the trainee also here appeared to be valuable. This content has now been adopted into the app as 'First Aid at Contact.'

The blurring effect of people who were not contacted was experienced by the users as a clear and easy-to-interpret indication. Again, this was an unexpected insight. The developers expected that the clients would act immediately if someone became faded; however, this was not the case. The developers finally decided to instead design a traffic light system using green, orange and red indicators.

The team first named this tool 'project network' as a working title; however, it developed into a real project tool, for temporary use. Beatrijs used the metaphor of a physical therapist: You will not attend the clinic forever, as your therapist teaches you to properly use your muscles. Likewise, Project Network teaches you to properly manage your social network. The concept commenced in the form of a clock that would fall apart if you did not contact your social network; it ended as a complete networking tool. The Project Network app is openly available. To increase its impact, the team must pay further attention to implementation and communication. They are currently entering this phase.

LEMONS DURING THE INNOVATION JOURNEY

- The need for social restructuring was not experienced by the social network of mentally vulnerable people, but by the vulnerable people themselves. Therefore, Project Network now focusses on this group.
- The reporting part of the test turned out to be an intervention itself. The tips and tricks offered were also positively received. Therefore, these elements were incorporated into the tool.
- That the closer you become to someone, the more contact you will have, turned out to be an incorrect assumption. Users can now themselves indicate how often they hope or intend to speak to someone in their social network.
- Blurring people in the network did not produce the effect intended by the developers. Therefore, the developers introduced a traffic light system.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (explicit attention for contextual research and early prototype testing)
- ✓ The R&D process was flexible enough to be adjusted to new findings (incorporation of new elements in the tool)
- ✓ New R&D findings influenced the project target (change of product concept/use)
- ✓ The project planning was carried out in small steps during the project implementation
- ✓ The developers allowed the project to evolve as opportunities emerged — even though the opportunities have not been in line with the original project target (change of user group)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird-in-Hand:

- ✓ The target of the R&D project was vaguely defined in the beginning (providing network support) ;

Crazy Quilt:

- ✓ The developers jointly decided with our partners/stakeholders on the basis of our competences (co-creation between content experts of Parnassia Group and design experts of Reframing Studio).

QUOTES

"Special insight was that reporting was already an intervention. As a result, people became aware of the status of their relationships. So, we learned that this was important to retain as a function."

"You do not want users to need Project Network forever. They should use it as a check-up. Just as a visit to a physical therapist: You will not go there forever. It teaches you to use your muscles properly. Project Network teaches you to manage your social network properly."

"It started as a clock that would fall apart if you did not contact your social network, it ended up as a complete networking tool."

CASE STUDY NR 3: THERAPIELAND

Organization: Therapieland

Interviewee(s): Jarno Meijer, CEO Therapieland

Technology category: Web application and portals

Segment: Mental Health

Function: Blended Therapy

Users: Patients with mental health issues

User adoption: 86.581 users

User acceptance: positive user evaluation

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data sources: www.therapieland.nl, consulted on March 30, 2017

TOOL DESCRIPTION

Therapieland is an eMental Health platform with evidence-based modules that are designed for mental health complaints, disorders and methodologies.

MOTIVE FOR DEVELOPMENT

One of the shareholders of Therapieland owns a primary mental health practice. In 2007, he had the idea to provide information in a different way by offering accessible online information and modules and the option to choose your own therapist. Unfortunately, no funding was available at that time, so the concept was not executed. Later, the shareholder met with the director of a healthcare institution who also wanted to renew healthcare. Together, they developed the 'Therapieland project.' After six months, they began to hire employees. They had faith in the idea that this would be the future of healthcare by organizing care around eHealth instead of organizing eHealth around care.

INVOLVED STAKEHOLDERS

- Psychologists, psychotherapy practice
- General Practitioners, 'POH/GGZ', GP/GGZ practices
- KSYOS TeleMedisch Centrum
- Mental health clients
- University of Leeuwarden

PHASES OF THE DEVELOPMENT PROCESS

- Vision development
- Start project Therapieland
- New market and collaboration KSYOS Telemedisch Centrum
- Implementation
- Monitoring, evaluation and ongoing development

EVOLUTION OF THE TOOL

Therapieland's initial focus was on prevention and self-help. However, it was noticed that people were not willing to pay for an eHealth tool, when it concerns mental health support. The team learned that self-help is harder to finance and involves higher marketing costs to reach the correct people. Business healthcare was also difficult, as prevention was at that time not seen as especially interesting. From a

certain moment, national policy began to move in a direction advantageous to Therapieland. The team decided to seriously focus on the GP/GGZ market, where opportunities arose. They parked the self-help concept, as they realized that it is necessary to enter the right market at the right time. The core concept of the product remained the same; access to mental health knowledge and expertise through online exercises. Within the areas of GPs and the GGZ, there are several categories in which Therapieland is active: Complaint-based, disorder-oriented methodologies. In GP practices, their focus is more complaint-oriented; in GGZ practices, it is more disorder-oriented.

Therapieland works with psychologists in a demand-driven way. They have built a large and diverse customer base, and they brainstorm what is needed together with customers. The expertise of Therapieland is that they offer therapeutic content in an inspiring way, so that it is more likely that the clients will increasingly make use of it. An example of co-creation is the ADD program, developed by ADD clients themselves. They also created their own animations and videos.

The team always analyses the user group, but cannot always involve them in development, due to the complexity of the diagnosis. However, it is always tested in practice with the users. There is also an expert group involved with POHs and psychologists. Everything that is being developed is submitted to the expert group for assessment.

The team initially underestimated the complexities involved in implementation. Gradually, they became more professional in their approach to the implementation. After the product is 'sold,' the team discusses the goals, expectations, pitfalls and current agreements with the organization. A joint implementation plan is then created. Typically, they start with an initial training, in which the vision is expressed (benefits to the therapists and clients) and instructions are given. At the end of this session, goals are set regarding what the organisation wants to achieve in four to six weeks. Shortly thereafter, a second training session is planned. After the second training session, the user is often quite adept; however, the product still requires continuous attention. A quarterly report is sent by the trainers (psychologists) to monitor product use.

The remaining challenges for Therapieland include:

- Customer retention: Program use remains exciting, although the attrition rate is high;
- Improve products to increase success;
- To hold a solid financial position;
- To compete successfully, the competition is solid and always poses a threat;
- Entrance to international markets.

LEMONS DURING THE INNOVATION JOURNEY

- Prevention proved to be a difficult market in which to develop a healthy business model. Therapieland transformed this into an opportunity to enter the GP/GGZ market.

- The rollout proved harder than initially thought. This concerned use by the clients as well as by the therapists. Initially, the team underestimated the difficulty of the rollout. Through this lemon, they learned to set up a professional implementation strategy.
- Unexpectedly, not everyone supported innovation unreservedly. Some enjoyed their routines and there was often a fear for replacement. The team responded to this fear by using a personal approach.
- In the education of psychologists, blended care does not exist as a method. Psychologists are not trained to offer eHealth as a part of their work. Therefore, Therapieland developed a Master eHealth in collaboration with the Leeuwarden University. During this course, psychologists develop modules for Therapieland themselves, providing a win-win situation.
- Therapieland entered the POH GGZ market too late, because of the first orientation on the self-help/prevention market and business healthcare. If they had focused on POH GGZ from the beginning, they would now have a stronger position. Fortunately, they are now able to pay attention to other markets. Jarno considers thorough knowledge of the market and regional and national policies to be a major factor for success, because when one knows what is happening, one can adjust the business model used.
- The strength of Therapieland's business model is that there is a financial incentive for the GPs who desire to work with eHealth. In this way, value is created for multiple parties.
- Another important factor for success for Therapieland is the collaboration with KSYOS TeleMedisch Centrum, which boasts 60% of GPs as customers. They sell Therapieland's product, Tele-GGZ. Six thousand specialists are connected to this platform. This collaboration has made it possible for Therapieland to scale up in recent years.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (adjustment of market)
- ✓ The R&D process was flexible enough to be adjusted to new findings (adjustment of market)
- ✓ New R&D findings influenced the project target (adjustment of market and user groups)
- ✓ The project planning was carried out in small steps during the project implementation
- ✓ Despite of potential delays in project execution the developers were flexible and took advantage of opportunities as they arose (implementation strategy and development eHealth master)
The developers allowed the project to evolve as opportunities emerged — even though the opportunities have not been in line with the original project target (implementation strategy and development eHealth master)
- ✓ Potential setbacks or external threats were used as advantageous as possible (implementation strategy)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Affordable loss:

- ✓ Project budgets were approved on the basis of considerations of acceptable losses (founding and funding by own shareholders)

Crazy Quilt:

- ✓ In order to reduce risks, we started partnerships and received pre-commitments (collaboration with KSYOS)

Bird in Hand:

- ✓ The process converged towards a project target on the basis of given means/resources (available funding in the POH/GGZ market)

QUOTES

“First I was a perfectionist. I used to be a professional skater. It's very unilateral, that perfection. Users use your product in a completely different way and view your product completely differently. So, develop something, use it and you will learn from the interaction. Just do it, and of course be honest enough to say, ‘This has not been tested yet, who wants to test it with us?’”

“Try to have your proposition very clear by doing extensive market research. What are the benefits to the market? What value are you going to add and what will it cost?”

CASE STUDY NR 4: TEMSTEM

Organization: Reframing Studio

Interviewee(s): Beatrijs Voornemans, interaction Designer

Technology category: Serious gaming/Mobile apps

Segment: Mental Health

Function: Reducing auditory hallucinations / self-management

Users: For people with auditory hallucinations

User adoption: Currently used by clients of Parnassia Group

User acceptance: positive user evaluation

Care process:

- ✓ e-public health: Education and prevention.

Additional data sources: <https://www.parnassiagroep.nl/hoe-wij-helpen/online-hulp/temstem>, consulted on March 30, 2017

TOOL DESCRIPTION

Temstem is a mobile app that can be used anywhere: At home, at work, at school, at a party or on the bus. With the help of language games, Temstem helps to lessen auditory hallucinations by:

- Temporarily stopping the voices,
- Trying to make the voices less vibrant and impressive, and
- Help the user to feel stronger and more confident.

It works in three different ways:

- Activation of the language area in the brain,
- Double load of the user's working memory, and
- Strengthen the user's self-esteem.

The app contains two language games, Taaltikker and Wordlink. When the users play the games, they are distracted from the voices. In addition, Temstem offers exercises that reduce the vividness of the voices. Temstem is freely available via the App/Play Store.

MOTIVE FOR DEVELOPMENT

One in 10 people experience auditory hallucinations. People who hear voices can use medication and therapy to reduce their impact. However, these treatments are not constantly available in daily life. Therefore, the majority of people who hear voices live in social isolation. A researcher and teacher at the Technical University in Delft and a psychologist at the Parnassia Group established the project 'Recovering from Psychosis through Design.' In this project, designers work closely together with therapists, field experts, service users and scientists to discover how design can shed new light on the domain of mental health care. The challenge was to offer people with voices a different task, which could reduce the voices and improve their quality of life. Bachelor students conducted qualitative research and designed various supportive tools. The Parnassia Group was positively surprised by the student output, and asked Reframing Studio to adopt the designs and develop them further. Beatrijs and her colleagues performed additional research and then commenced the development of Temstem.

INVOLVED STAKEHOLDERS

TemStem is a co-production between the Parnassia Group and Reframing Studio. The Parnassia Group is a mental health institution that helps people become more resilient.

- Parnassia Group
- TU University
- Reframing Studio
- App developer

PHASES OF THE DEVELOPMENT PROCESS

- Context research
- First paper prototype
- Digital prototype
- Implementation
- Ongoing development

EVOLUTION OF THE TOOL

The contextual research conducted at the establishment of the project concerned digitizing. Beatrijs talked to many people who have auditory hallucinations, to become empathetic to this group. She is convinced that becoming empathetic to your user group is crucial for the success of the design. She asked the people how it feels to hear voices. Based on the outcomes of this research, the designers knew that it should be a very positive app, happy, with a large amount of confirmation. This also meant that users should not be able to make mistakes, and could play all levels. People who hear voices may be told by the voices that they are stupid, and that they are doing stupid things. Therefore, the aim was to bring positivity in the app, in contrast to the voices.

The challenge was: Can you call an auditory task (think of your voices) and at the same time do language games that write away the emotional load? In this way, the core concept of the Eye Movement Desensitization and Reprocessing (EMDR) therapy was translated into language areas. Researchers knew that people can be distracted by humming and chewing gum, and that language games can also form a coping mechanism. The team was curious whether they could reduce the clarity of the voices through playing a language game.

Reframing Studio developed a paper prototype. The basic ingredients included language tick (rhythm tapping) and wordlink (word combinations) as a language game. With piles of papers, the designers went to the Parnassia clients. What struck them was that most words failed. The clients had different educational backgrounds, but when hearing voices or using medication, their cognitive ability was influenced. This was an unexpected but valuable insight. Thereafter, Reframing Studio made the games much easier, starting with words of one syllable. To ensure that there would be no negative impact, the team spent two weeks deleting all the negative words from the dictionary behind Taaltikker and searching for positively-associated words

such as sunshine, spring, and summer. Parnassia tested Wordlink using a prototype, where the words were manually thrown into the tool's background. It was found to be good enough to test. During this test, they found that the ease of use should be increased.

During observational research, there was an unforeseen insight about the interpretation of the name of Temstem, then named 'Voice Control.'

Users were asked to think aloud during this test. The first thing a user said was: "Well the app is called Voice Control, so I think I should control him with my voice. Start START." Through this insight, the developers changed the name into Temstem. Eventually, 20 clients used Temstem for one month. After one month, two people no longer heard voices and the other participants stated that they were very content with the tool.

Beatrijs initially saw Temstem as a tool, as something to carry with you, like a pack of chewing gum. Not to be seen as medicine or as something that should be evidence based. She was required to become accustomed to the domain of healthcare, in which evidence-based medicine is the dominant paradigm. Parnassia is currently conducting a randomized controlled trial (RCT), involving 50 clients using Temstem and 50 clients playing a non-healthcare game such as Tetris.

Beatrijs experienced the tests as interventions. The attention and confirmation that the researchers gave during the testing was a positive affirmation that may have influenced clients in their impression of the app.

The app was built by an app developer and made available in the App Store. Reframing Studio won the Rotterdam Design Prize with Temstem. Through this media attention, its use increased. After the introduction of Temstem, user research showed that people use it before they leave their house, not when they are in transit. They also use it not only to reduce the clarity of the voices but also to feel at ease. These were both unexpected insights. There is currently a version available in which results can be tracked and where the user can choose to dodge or eliminate voices (in this latter case, the user would be asked to actively think of the voices). In addition, an increased number of measurements (required by the RCT) and monitoring and reporting tools have been built into the app.

Beatrijs considers implementation to be a different paradigm, which in fact independently forms a design process. Through the development process of Temstem, they have learned to give more attention to implementation and to exert a larger effort to bring the instrument to the users.

LEMONS DURING THE INNOVATION JOURNEY

Lemons which were found during the testing in the use of the tool:

- The clients possessed different educational levels; however, when using medication to treat auditory hallucinations, their cognitive ability was influenced;
- The name 'Voice Control' was misunderstood; clients thought that they could control the app using their voice;

- Temstem was used differently than initially thought; people used the app before they left the house, not when in transit. Furthermore, participants not only used Temstem to reduce the clarity of the voices but also to feel at ease. This was a surprising insight.

All these user insights were used to improve the tool in the testing and development phase. Other lemons were that:

- The mental healthcare domain was new to Reframing Studio. The importance of evidence-based tools was unforeseen.
- Implementation required far more attention than previously thought.

These insights have been included in the development of later tools, such as Project Network (another case study).

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (context research and early prototype testing)
- ✓ The R&D process was flexible enough to be adjusted to new findings (adjustment of product concept)
- ✓ Potential setbacks or external threats were used as advantageous as possible (user insights that were used to improve the tool)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Crazy Quilt:

- ✓ The developers jointly decided with our partners/stakeholders on the basis of our competences (co-creation between content experts of Parnassia Group and design experts of Reframing Studio).

QUOTES

“I think it is important to become empathetic towards the group you work and design for.”

“Mental healthcare is a completely different domain with completely different expectations. From my perspective, we developed something for a group that they didn’t have before. A tool, something you take with you, just like a pack of chewing gum. Not as an evidence-based health intervention.”

“That was a funny anecdote. When we asked our users to think aloud and one of them said: ‘Well it is called ‘Voice Control’ so I think I have to control this tool with my voice. Start START.’ It was the worst name we could have imagined.”

“When you start with the paper prototype you really think, ‘This is embarrassing.’ But ultimately, people do understand it and it works!”

CASE STUDY NR 5: ACTIVE PLUS

Organization: Open University, Department of Health Psychology

Interviewee(s): Lilian Lechner, Professor in Health Psychology

Technology category: Web application and portals

Segment: Physical exercise

Function: Self-help

Users: 65+-year-old citizens with disabilities

User adoption: 3000 users

User acceptance: positive effect study

Care process:

- ✓ e-public health: Education and prevention

Additional data sources:

Peels, D. A. (2014). *Promoting Physical Activity of People Aged Over Fifty: Feasibility and (cost-) effectiveness of the Web-based Versus the Print-delivered Computer-tailored Active Plus Intervention.*

TOOL DESCRIPTION

Active Plus is a computer-tailored, theory-driven, evidence-based intervention aimed at increasing physical activity in people aged over 65 years with disabilities. The intervention, consisting of print-delivered tailored advice to improve the level of physical activity, has proven to be effective in changing physical activity behaviour in the short and long terms, and was effective in reaching and affecting high-risk groups such as people of low socioeconomic status.

Active Plus, developed by the Department of Health Psychology at the Open University, is the first intervention that has been officially recognized as an effective lifestyle intervention by the Dutch Accreditation Committee for Sport and Exercise. Active Plus received recognition for its accessibility, applicability to daily life, for its design and proven effectiveness in improving physical activity.

Participants receive tailor-made advice by mail or online, using a computer program tailored to their demographic characteristics (such as age, sex and education level) and psychosocial characteristics of participants (such as confidence in their own abilities to obtain enough exercise, support from their environment, and problems expected regarding increased exercise). These features are mapped using a questionnaire completed by the participant prior to the intervention. The effects of the intervention were examined and proved by an RCT.

MOTIVE FOR DEVELOPMENT

Physical inactivity is a significant risk factor for cardiovascular disease, obesity, type 2 diabetes mellitus, some cancers, and poor skeletal health, and is identified as the fourth leading risk factor for global mortality. Older people often face physical disabilities, resulting in substantial barriers to physical activity. Because of the aging population and the increasing burden of disease within this population, stimulating physical activity with effective interventions against acceptable cost in an older population is of major relevance. Therefore, the Open University Department of Health Psychology developed the Active Plus intervention.

INVOLVED STAKEHOLDERS

- Open University (developer)
- University of Maastricht
- Fonds NutsOhra (funding)
- Hersenstichting (funding)
- Local government (Zuid-Limburg, Utrecht, Amsterdam, Hollands-Kroon, and Hart van Brabant)
- 65+-year-old citizens with disabilities (users)

PHASES OF THE DEVELOPMENT PROCESS

For the development of Active Plus, the steps of the Intervention Mapping (IM) protocol were followed:

- A needs assessment of the study population was performed,
- Specification of performance objectives and cross-referencing these with relevant determinants into change objectives,
- Selecting theory-informed intervention methods and practical applications to change the determinants of the health behaviour,
- Producing and pretesting program materials,
- Planning program adoption and implementation, and
- Planning for evaluation.

EVOLUTION OF THE TOOL

The researchers optimized the potential reach and effect of the interventions by extending the delivery mode of the print-delivered intervention into an additional web-based intervention. The interventions were adapted based on results of the process evaluation, analyses of effects within subgroups, and evaluation of the working mechanisms of the original intervention. The team pretested the new intervention materials and the web-based versions of the interventions. Subsequently, the new intervention conditions were implemented in a clustered RCT.

The team identified several major lessons from their experience in translating the original intervention into a web-based intervention targeted at older adults. First, it is essential to use a theoretical framework such as the RE-AIM model when evaluating and adapting an original intervention, since it ensures that all important points that can determine the impact of an intervention are systematically addressed. Second, it is of major importance to use process evaluation data, and mediation and moderation results to redesign and strengthen an effective intervention. Finally, it is imperative to thoroughly pretest the new interventions. The combination of quantitative and qualitative pretests used in this study was useful to gain a broad insight into user experiences and preferences, and thereby to improve intervention usability.

From Active Plus, several follow-up projects arose:

- NutsOhra Fund awarded grants to tailor the advice of Active Plus regarding chronic diseases and to the reduction of loneliness. This will be implemented in 2016 in the municipality of Heerlen in cooperation with regional partners.
- Active Plus is also being developed for prostate and colon cancer patients.
- Active Plus is also examining the effect of exercise on cognitive functioning in elderly people with impaired mobility. This research is funded by the Hersenstichting.

The development team learned a great deal from the implementation process. At this stage, several municipalities have agreed to purchase the license for the period of one year and invite users to participate.

LEMONS DURING THE INNOVATION JOURNEY

- Pretest results showed that all the new intervention materials had modest usability and relatively high appreciation. Through this pretest, the team could work further on improving usability.
- During the implementation process of Active Plus, the original research objectives changed. Since the process is ongoing, interactive and intuitive, by constantly assessing the needs of users and intermediaries it is beginning to appear to resemble action research, entering a different scientific paradigm.
- Active Plus was originally aimed at a healthy population aged over 50 years; it now targets those aged 65+ years with disabilities. The market/communities demanded a different target group. The team converted this demand into a market opportunity.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to be adjusted to new findings
- ✓ New R&D findings influenced the project target (new user group)
- ✓ The project planning was carried out in small steps during the project implementation (constantly assessing the needs of users)
- ✓ Despite of potential delays in project execution the developers were flexible and took advantage of opportunities as they arose (new markets)
- ✓ The developers allowed the project to evolve as opportunities emerged — even though the opportunities have not been in line with the original project target (adjustment of research objectives)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Crazy Quilt:

- ✓ In order to reduce risks, we started partnerships and received pre-commitments (municipality, Public Health Service)

Bird in Hand:

- ✓ The process converged towards a project target on the basis of given means/resources (demand different market)

QUOTES

“We learned a lot from the implementation process. You should think carefully about the user group and the level of integration with existing structures. As the level of integration increases, the complexity does too.”

CASE STUDY NR 6: PALLIARTS

Organization: Netwerk Palliatieve Zorg

Interviewee(s): Marije Brull, Founder and Project Leader

Technology category: Mobile apps

Segment: Palliative care

Function: Decision support

Users: General Practitioners, Geriatricians

User adoption: 33.000 users

User acceptance: positive user feedback, a user evaluation is currently conducted.

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data sources: <http://www.pallialine.nl>, consulted on March 27, 2017

TOOL DESCRIPTION

PalliArts provides national and regional information regarding palliative care at any time, anywhere. The app supports GPs in the provision of palliative care by tailoring information to the needs of the patient and his/her family, no matter where the patient is located.

MOTIVE FOR DEVELOPMENT

The core activity of Network Palliative Care was to provide information concerning guidance and care of palliative patients. Many physicians indicated that, when visiting palliative patients, they do not always have the necessary information to hand, especially when the physician is sitting at the patient's bedside. The doctors therefore asked for the development of a digital solution, allowing them to access information at any time. This need formed the motive for Brull and her colleagues to develop the tool. She was eager to help the physicians and to optimize palliative care.

INVOLVED STAKEHOLDERS

- Network Palliative Care (initiator, founder)
- IKNL: Quality institute for oncological research and practice (current owner)
- General practitioners, Geriatricians (stakeholders, co-creators)
- Health insurer VGZ (administrator and financer)
- IT business X (app-developer)
- IT business Y (app-developer)

PHASES OF THE DEVELOPMENT PROCESS

- Start advisory board of General Practitioners and Geriatricians
- Pitch VGZ Grant
- App development: stop cooperation with app builder X/start new collaboration app builder Y
- Fill CMS with content from regions, training
- Launch/implementation
- Monitoring, evaluation and ongoing development

EVOLUTION OF THE TOOL

Brull and her colleagues received the opportunity to pitch for the VGZ (healthcare insurer) Innovation Grant, and eventually won it. When they won, they were obviously euphoric. They received a large amount of media attention. However, the terms and conditions for the pitch were unclear. As the prize, VGZ only offered to assign a project coordinator, not to reimburse the costs of developing the app. This was a tremendous disappointment, because funding was all that Brull and her colleagues needed. After a few months of discussion, VGZ agreed to partly finance the app. Brull maintained her belief in the product. Together with the VGZ, she created a plan with a possible app design. An app builder was selected by the VGZ. The aim was to realize both a national and a regional section of the market. For the national section, they approached the IKNL for collaboration. After some delay, the IKNL agreed to the development and administration of the national part. However, as soon as they did agree, they gave their full commitment.

Thereafter, app development stagnated. The app developer made promises they could not fulfil, and there appeared to be no willingness to deal with the complexity of the project. A year later, Brull and her team decided to quit the collaboration. At these moments, Brull wondered why she had started with the whole idea. However, because of her strong belief in the potential value of the app and her enthusiastic colleagues, she persisted.

An issue that played a role during the entire development process was that the IKNL wanted to expand PalliArts to other user groups, for example to nurses. Brull wanted to maintain the focus on GPs and geriatricians. She considered it of great importance that the content was relevant for this group, because: "The broader you make it, the less it will suit the initial audience." Therefore, Brull remained critical of the concept by asking: 'Is this relevant to the doctor?'

The implementation was well prepared. A phased approach was used, carefully considering how they could roll out the app nationwide by paying explicit attention to regional ownership. The infrastructure of the network was already established, and the key function of the organization was to provide local and national relevant information to GPs. This was a perfect match. Brull and her colleague made it as easy and appealing as possible to their regional colleagues, so that they could not refuse or resist implementation. They provided training in the regions, directing a lot of attention towards usability and stimulated ownership by introducing the tool as their own.

LEMONS DURING THE INNOVATION JOURNEY

- A lemon encountered in the beginning was the 'prize' from the VGZ, which later proved not to be funding but rather project hours. Later, the VGZ acknowledged that it had not been sufficiently clear and eventually offered to invest in the development of the app.
- The app builder did not meet expectations and did not live up to their promise of creating a good design. Eventually, the team decided to terminate the collaboration.
- The partner IKNL exerted pressure to expand the target group to nurses. Brull persevered and convinced IKNL to remain focused on the initial user group.

During these lemons, Brull and her colleagues maintained their belief in the product and showed perseverance. With the support of all networks, it was possible to launch a successful product that exceeded all expectations regarding use.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to be adjusted to new findings (switch of app developer)
- ✓ The project planning was carried out in small steps during the project implementation (Brull continued to work on the project)
- ✓ Despite of potential delays in project execution the developers were flexible and took advantage of opportunities as they arose (showing perseverance)
- Potential setbacks or external threats were used as advantageous as possible (by remaining belief in the product, the health insurer finally did invest in the app development)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- Given means/resources have been the starting point for the project (network of palliative care, needs of doctors)

Crazy Quilt

- In order to reduce risks, the developers started partnerships and received pre-commitments (VGZ, IKNL, regional networks)

Pilot in the Plane

- Maintaining their belief in the product and staying true to the initial target group.

QUOTES

"Stick to your idea, I think that's the most important thing. I constantly fought to preserve the idea."

"We still believe in the product. I think that was one of the success factors. And taking small steps forward."

"The broader the product, the less it suits a specific audience. The question we constantly asked ourselves was: 'Is this relevant to the doctor?'"

"We started with the aim of 1000 users, because we obviously had a limited audience. Quickly, we adjusted this aim to 5000. Now we have 33,000 users."

"It's just one long haul."

"You need to keep on motivating each other."

"We've stimulated ownership by introducing the tool as their own."

CASE STUDY NR 7: ACCENDOWAVE

Organization: AccendoWave & Samsung Galaxy tablets

Interviewee(s): Martha Lawrence, Founder and CEO of AccendoWave.

Technology category: Wearable devices

Segment: Hospitals

Function: Pain management

Users: Generic patients

User adoption: 12.000

User acceptance: positive results effect study

Care process:

- ✓ e-care: Primary care process in cure and care.

Additional data resources:

<http://accendowave.com>, consulted at March 16th 2017

<https://insights.samsung.com/2016/01/05/pain-management-technologies-put-hospital-patients-at-ease>, consulted at March 16th 2017

TOOL DESCRIPTION

AccendoWave offers a form of pain management technology through the use real-time brainwave analysis. With an electroencephalograph (EEG), a patient satisfaction platform is provided that utilizes a proprietary technology to give feedback regarding a patient's feelings of mental or emotional distress, supplementing conventional ways of patient communicate with their healthcare providers.

When using this tool, the patient wears a headband and earbuds that interact and communicate with the handheld tablet. Using the headband, AccendoWave measures a patient's brainwaves and translates these results into the standard chart of facial expressions, which is displayed at the top of the tablet screen. If a patient disagrees with the assessment, they can change the results by selecting a different face. However, according to AccendoWave user surveys, 70 to 75 percent of patients report that the technology correctly senses their level of discomfort.

Care providers also receive tablets, and can view both real-time assessments and trends in patient discomfort levels. Over 12,000 patients currently use AccendoWave in a clinical setting, with 83% reporting a decrease of discomfort while using the tool.

MOTIVE FOR DEVELOPMENT

AccendoWave was created with the aim of minimizing pain. It started as a user innovation. Cary A. Jardin, the business partner of Martha Lawrence, was struck by the degree of pain his wife experienced when giving birth to three children via caesarean sections. He decided to show his respect by getting a tattoo of the name of his wife. While he experienced the pain of the tattoo placement, he thought about the brainwave technology he was then working on. He decided to develop a prototype of this pain tool by testing the brainwaves of other people receiving tattoos. When this worked out well, the idea progressed and he made contact with Martha, who joined him in the development of what is now AccendoWave.

INVOLVED STAKEHOLDERS

- Tattoo artist and parlour - AccendoWave used one of the most respected tattoo artists in the US to assist with their primary research.

- AccendoWave Co-Founder and CTO Cary Jardin and his research lab developed the algorithm and multiple prototypes.
- Hospital Corporation of America (HCA): The HCA owns 165 hospitals in the US. AccendoWave asked four medical directors for guidance in technology development; in this way, the solution of a customer-defined market was identified.
- Samsung is a collaborator, and assisted in providing AccendoWave on their tablet computers as a single application.
- AT&T also collaborated during the development phase and provided the opportunity to have a single network solution for the market deployment of AccendoWave.

PHASES OF THE DEVELOPMENT PROCESS

- Vision development
- Data research: The EEGs of 1,000 individuals receiving tattoos were recorded. The EEGs of 100 individuals receiving piercings were also measured.
- Algorithm development.
- Technology prototype development.
- Industry stakeholder solution development.
- Pilot release and ongoing technology enhancements.
- Upscaling.

EVOLUTION OF THE TOOL

First, a bunny dummy was made, which put its ears up when experiencing pain, and its ears down when at ease. When they pitched their idea to the hospital board (HCA), the board said, "Great idea, but change the bunny." They then went on to further develop the tool. Therefore, the product is now substantially different than first imagined.

AccendoWave is being used in hospital emergency departments, orthopaedic joint replacements, neurology, labour and delivery, oncology, chronic pain and home health. The business model remains the same. Hospitals pay a license to offer the tool. Now that the tools are being used more frequently, patients are willing to pay for AccendoWave themselves. Therefore, the business model will continue to grow as they develop and expand their tool.

LEMONS DURING THE INNOVATION JOURNEY

- The time and length to market were longer than expected and turned out to be seven to eight years. The AccendoWave team persevered, as their mission to reduce human suffering was an important component of their drive. By collaborating with partners such as Samsung, AT&T and the HCA, the infrastructure for the roll-out had already been ensured. This eventually accelerated the process.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to be adjusted to new findings (feedback of HCA)

- ✓ Despite of potential delays in project execution the developers were flexible and took advantage of opportunities as they arose (length of time to market/collaboration with Samsung/AT&T)
- ✓ Potential setbacks or external threats were used as advantageous as possible (collaboration with Samsung/AT&T)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- Given means/resources have been the starting point for the project (collaborating with a known tattooist)

Crazy Quilt

- In order to reduce risks, the developers started partnerships and received pre-commitments (Samsung, AT&T, HCA)

Pilot in the Plane

- By persevering and remaining belied in their mission.

QUOTES

“We persevered - as the mission was an important component of our drive - we wanted to reduce human suffering.”

“At first, we made a bunny dummy, which had its ears up when experiencing pain, and its ears down when at ease. When we went to the board of the hospitals (HCA) to pitch our concept, they said. ‘Great idea, but change the bunny.’ And then we went on developing the tool as it is now.”

“The technology provides a data point around pain or discomfort that the nurse or physician can use to help patients feel more comfortable.”

“Our platform does not diagnose patients or suggest pain management treatment options. But, it’s helpful information for clinical staff to have and provides a full picture of how the patient is feeling.”

CASE STUDY NR 8: OWISE

Organization: PX Healthcare

Interviewee(s): Anne Braincells CEO of PX Healthcare, Founder of O-Wise

Technology category: Mobile apps

Segment: Self-management

Users: Breast cancer/oncology patients

User adoption: 4500 users

User acceptance: positive results effect study

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data sources:

<http://www.owise.nl>, consulted on March 20th 2017

TOOL DESCRIPTION

OWise focuses on providing online help for patients with breast cancer. The initial version of the app was launched in 2013. OWise offers breast cancer patients information on treatment and living with breast cancer. The app consists of treatment-tailored information, the ability to make notes and audio notes during conversations with a doctor or specialist, and a diary and calendar function. In the diary, users can keep track of how they feel. Graphs show the trends, and that information can be shared with a doctor or nurse.

MOTIVE FOR DEVELOPMENT

With a background in pharmacy and biomedical sciences, Bruinvels was interested and specialized in personalized medicine. She was vice-president of the European Personalized Medicine Association. In that role, she discovered that implementation of personalized medicine appeared to be unruly. There was a strict authorization level, which made it difficult to get medication approved. Bruinvels wanted to provide the right drugs to the right people. She was not convinced of the lobby path, but believed that if patients could be empowered with knowledge and support, they could themselves ask for advice and demand proper treatment. This formed the motive for the development of a supporting tool.

As her brother had started a clinic focusing on working during/after breast cancer, it made sense to begin with this user group. Bruinvels became co-owner of PX Healthcare, which now stands for Patient Experience. With the advent of the iPad and later the smartphone she saw that information could be presented in a more user-friendly way than on a website.

INVOLVED STAKEHOLDERS

- Breast cancer patients and doctors of Antoni van Leeuwenhoek hospital
- Front-end designers
- IT company for data storage/privacy/back-end development

PHASES OF THE DEVELOPMENT PROCESS

- Thorough market exploration, reading many books, meeting the right people and attending conferences.
- Development of a first and second version.
- Initial testing.

- Launch OWise in the Netherlands.
- Innovation call England.
- Launch OWise in UK.

EVOLUTION OF THE TOOL

Over time, the name and mission of the company evolved from personalized medicine to the patient experience. Bruinvels developed the content using existing regulations and directives, and wrote the algorithms herself to ensure that relevant information would be presented to the patient.

The front-end design of the first version was not sufficient. Another designer then examined the design and produced a better version. This designer's wife was seriously ill and he had visualized the medical records of his wife as a patient journey to make this clear to physicians and healthcare providers. He used this design as a framework, and this still forms the foundation of OWise.

It was very exciting for Bruinvels to deliver the first version. Luckily, OWise was received very well by both patients as doctors. Bruinvels found that her scientific background contributed to the credibility and reliability of the product and smoothed access to the medical network. OWise received a large amount of feedback from doctors. PX HealthCare took six months to improve OWise. The tool has been tested by hundreds of caregivers, patients and relatives.

Researchers from UMC Utrecht conducted an impact study, resulting in recommendations from nine of 10 patients and nine of 10 doctors. The patients indicated that they could now cope with emotional issues better and faster, because the physical part was 'under control.' This research was published in the Journal of Medical Internet Research.

Through the feedback and the impact study, Bruinvels became strengthened in her idea that all patients should be able to access customized information through the app. OWise empathizes with each step taken by the patient in the care process. This is then realized by the IT group who cooperate with PX HealthCare. According to Bruinvels, it is important that partners think along with you from their own experience, knowing your principles and values, when concerning for example privacy. This resulted in the fact that OWise has never been soiled with patient data.

The Netherlands proved a difficult market for OWise. According to Bruinvels, this was due to fragmentation, many egos and little willingness to cooperate. Bruinvels was astonished that, although the Netherlands is such a small country, people are so territorial about each tiny piece.

Bruinvels was writing a proposal for a Dutch grant when a colleague drew her attention to an English grant that also seemed appropriate. When she decided to write the grant request, there were only 36 hours remaining before the deadline. She worked day and night to finish the proposal. The call for submissions was declared by the National Health Service (NHS), the sixth-largest employer in the world, with two million employees. The NHS initiated the call to accelerate validated innovations that suited their strategy in healthcare. After providing various pitches and interviews, OWise was awarded a grant to join the acceleration. According to Bruinvels, England

is a better environment for small businesses. It is easier to collaborate in that country and there is a strong infrastructure. There are three major cancer centres supporting OWise that work closely together, forming the blueprint of new innovations.

This makes scaling-up possible for OWise. The product is now being expanded to all tumour types. The widespread acceptance of OWise in England is also attributed by Bruinvels to the current need in England. The quality of care and the healthcare system are not at the same level as the Netherlands. The initial development of OWise in the Netherlands has ensured the quality of the product. Dutch patients are committed and often have digital skills. Therefore, the Netherlands will be used as the base for the further development of OWise.

LEMONS DURING THE INNOVATION JOURNEY

- The Netherlands proved a difficult market for OWise, due to fragmentation, many egos and little willingness to cooperate. Therefore, PX Healthcare seized the chance to enter the market in England.
- First, surgeons seemed the right stakeholders to involve when implementing OWise. However, in the UK it appeared to be the oncologists and hospital pharmacists who were better suited as the initial stakeholders. The role of these stakeholders in the Netherlands will be assessed. PX Healthcare is constantly scanning the need in the market, and has no single-line approach.
- OWise has remained largely financially independent. Offers were received from business angels, but the conditions did not meet the intent of the concept. Eventually, Bruinvels was glad she did not respond to the offer. The time she had lost to the investors, was eventually gained when bringing OWise directly to patients.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (new design of app, new stakeholders)
- ✓ The R&D process was flexible enough to be adjusted to new findings (new market opportunities)
- ✓ The project planning was carried out in small steps during the project implementation (prototyping in two versions)
- ✓ Potential setbacks or external threats were used as advantageous as possible (offers from business angels did not meet intent of the concept, decided to bring OWise more directly to patients)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (own resources)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Antoni van Leeuwenhoek, NHS)

Pilot in the Plane

- ✓ Staying in control and staying true to the concept.

Affordable loss:

- ✓ Project budgets were approved on the basis of considerations of acceptable losses (remaining independent in funding)

QUOTES

"We have worked closely with the breast cancer patients with AVL, this really supported the development of OWise. If you want to make something meaningful for patients, you must give priority to the patients. Therefore, patient experience was our motto."

"If we had been pushed by deadlines of external investors, it would all have gone wrong. It was so important for us to remain in control."

"We thought we had to involve the surgeons, but it appeared to be the oncologists and hospital pharmacists in the UK."

"You're spending so much time with investors, while you can also simply bring your product to the patient."

CASE STUDY NR 9: MIRRO

Organization: Mirro Foundation

Interviewee(s): Anne-Linde Schermerhorn, Product Manager eHealth

Technology category: Web applications and portals

Segment: Self-help, decision support

Users: People with mental health problems

User adoption: 40,000 visitors per month, +/-2800 users per month

User acceptance: self-help modules positively evaluated, decision support unknown.

Care process:

- ✓ e-public health: education and prevention
- ✓ e-care: primary care process in cure and care

Additional data sources:

<https://www.mirro.nl>, consulted April 15th 2017

TOOL DESCRIPTION

The Mirro eHealth platform offers 17 online modules in a single environment for people with various (mild) psychological problems. Additionally, it provides triage support to GPs.

MOTIVE FOR DEVELOPMENT

Health insurers noted that the support of patients with mental health problems were randomly provided and that patients were not consistently and unambiguously being referred by GPs, resulting in unnecessarily expensive care. The motive for development was thus to improve the quality of care and referral and to organize this care more cost efficiently.

INVOLVED STAKEHOLDERS

- Parnassia Bavo Group, GGZ Drenthe, GGZ ingest
- Vrije Universiteit Amsterdam
- Health insurer Achmea
- Mirro Foundation
- End users

PHASES OF THE DEVELOPMENT PROCESS

- Launch of the Wijk & Web initiative, funded by an innovation fund run by Achmea.
- Establish working groups for developmental decision support
- Official establishment of the Mirro Foundation
- Development and testing of eHealth modules
- Launch of the first online eHealth modules
- Introduction of decision assistant
- Introduction of business model
- Introduction of licenses for GPs, enabling them to inspect user progress

EVOLUTION OF THE TOOL

Mirro roughly consists of two products: The decision assistant for GPs and the online self-help modules for patients. These two products have each undergone a very different development process with different impacts.

Mirro began as a generic development with the creation of working groups in the fields of business management, content development and screening. Each group had a job description and a schedule. Although this was closely tied together, the 'screening' group failed to reach an agreement about the questionnaires that should be used for the decision assistant.

The 'content' group stood apart from this, and continued developing the content for the online self-help modules. They organized sessions with users and experts to identify the needs and requirements, and to test the content.

The decision assistant was introduced in 2014 by Achmea. They obliged GPs to subscribe to Mirro in order to maintain the 100% participation rate. No appeal was made to an intrinsic motivation for the use of the decision assistant. The health insurer forced the use of the instrument by a negative financial incentive. This led to strong resistance from GPs and to the industry association (NHG) issuing a negative advice on the use of the decision assistant. The GPs and the industry association argued that they were forced to use a tool that was not evidence based.

The self-help modules evolved quite differently. This was an intuitive development, and the products were naturally taken up by users on the internet. The priorities were to truly understand the context and needs of users, and to offer the self-help modules in an accessible way, free of charge. The dynamics of this process were very smooth and natural. Until this year, the modules were freely accessible by users. From January 2017, a nominal annual fee has been charged for the unlimited use of all self-help modules. Although use has decreased since the introduction of the fee, Mirro is not dissatisfied with the results.

LEMONS DURING THE INNOVATION JOURNEY

The impact of the introduction of the decision assistant was different to than expected. The binding character of the implementation caused a large amount of resistance and led to unmotivated use and passive subscriptions.

The lack of evidence of the effectiveness of the decision assistant was eventually recognized as a weakness.

The decision assistant was extended in function, but did not fit the practice of GPs. No specific response to these unexpected events was seen. It became clear during the interview that the team was unable to turn these lemons into opportunities. In contrast, the intuitive approach used in the development of the online self-help modules clearly contributed to the acceptance of Mirro.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to be adjusted to new findings (learnings of the introduction of the decision assistant were taking into account when developing the self-help modules).

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (using an existing network)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (by collaborating with experts for the decision assistant and users for the self-help modules).

QUOTES

"I think the self-help modules are so successful because we didn't push them. Our goal was to let people easily and intuitively find our products when they struggle with mental problems. So, you introduce something in a natural way."

"If it takes a lot of effort to introduce something, you have missed some important information."

"The product was difficult to position. What used to be a responsibility of a mental health institution, now was the GP's responsibility, but they were not engaged at all."

"We were pioneers, kicking against sacred cows but sat at the table with all the big names."

"It was a bumpy road. For this phase, it would be great if everyone would be excited about our products. The mental health organizations are very satisfied with the decision assistant. But general practitioners remain difficult."

"We looked at what words people use when they seek help with problems. And when people find what they want, ultimately, they are prepared to pay for it."

"It is very unnatural if you try to force an innovation with resources. You want to reverse that process and let caregivers talk to health insurers about fruitful innovations which are carried forward by patients."

"There is too little consideration about implementation and business models. There is a pilot or an RCT, but if the instrument is found to be effective, the funding stops."

CASE STUDY NR 10: MYWEPP

Organization: Brevidius

Interviewee(s): Pier Tholen CEO/Founder

Technology category:

- Wearable devices
- Web applications and portals

Segment: Communication, self-management.

Users: People with a mental disability

User adoption: about 110 groups (with an average of 10 members), 1100 individual users and 900 formal and informal caregivers.

User acceptance: positive feedback user evaluation

Care process:

- ✓ e-care: Primary care process in care

TOOL DESCRIPTION

Brevidius offers MyWepp care communities care for seniors and the mentally disabled, and includes several different applications:

- MyWepp News: News of the agenda group summary
- MyWepp Social: Visual WhatsApp (using emoticons and video calls)
- MyWepp Guide: Personal watch with calendar and phone
- MyWepp Tube: Library for a client, group or institution
- MyWepp Personal: Personal customer portal/managing tools

MOTIVE FOR DEVELOPMENT

Pier established Brevidius in 2003, after gaining years of experience in the development of CDI, broadband internet and video on demand. Brevidius initially offered a system for video uploading: Video4all. When YouTube was introduced to the market, the business model for this video system was lost. Only the customers who valued a fully-secured connection remained. Meanwhile, Pier's son, who is mentally disabled, was growing older and it was becoming difficult for him to use media and the internet. This formed the inspiration and motive for Pier to develop MyWepp services. MyWepp was established in co-creation with several organizations. It was then discovered that the planning boards in the living areas of the organizations no longer met the needs of the clients and supervisors. Everyone was annoyed that this board was very laborious. Each day, papers had to be replaced. Therefore, Brevidius developed the MyWepp planner, which now runs in 80 groups in 20 organizations. Over time, MyWepp has become a line of different services, as listed above in the tool description.

INVOLVED STAKEHOLDERS

- Woonmere, organization for the mentally disabled
- Private residential centre
- Odion
- Other customers
- Clients

Together with Woonmere, an organization for the mentally disabled and a private residential centre, Brevidius has developed an initial vision for the necessary

products. Odion also joined the collaboration. Together with these stakeholders, Brevidius developed the first screen with MyWepp Planner and MyWepp news. The participation level of these stakeholders was to advise, decide and co-produce. Brevidius currently works together with all customers and receives improvement suggestions on a weekly basis.

PHASES OF THE DEVELOPMENT PROCESS

- Vision development and establishment of Brevidius
- Development of ABC TV, video on demand
- Vision development with stakeholders
- Development of services for the mentally disabled
- Introduction of MyWepp

EVOLUTION OF THE TOOL

The first concept of Brevidius was ABC TV. This name was chosen because of the different levels of interaction:

A = Passive TV channel "via the internet for people who do not understand buttons and devices, but like personal photos, videos, etc. looks and want to receive reminders."

B = Simple menus, all choices can simultaneously be seen.

C = Extensive menus, including folders, etc.

D = Full, safe internet portal.

The name 'ABCTV' became a problem: TV was no longer 'hot' (tablets and touchscreens were!) and ABCTV sounded too childish for the less mentally disabled. Brevidius collaborated with stakeholders and developed a new vision of what was needed for the mentally disabled living areas. This eventually culminated in the MyWepp services. Brevidius also attempted to roll out MyWepp services for senior audiences. This group, however, showed absolutely no feeling for digital products. Therefore, most attention is being given to the mentally disabled audience.

To be able to maintain a strong business model, Brevidius choose to position several MyWepp services. The institution pays per group, via a subscription. Individual subscriptions also exist. According to Pier, the yield of MyWepp is quality. Clients feel more independent. "Now, I am a grown up," is something Pier often hears from clients. Counsellors and caregivers also receive fewer questions because of the digital exchange of information.

LEMONS DURING THE INNOVATION JOURNEY

- With the advent of YouTube, the business model for Video4all was lost. In response, Brevidius started focusing on 'safe internet' applications, f.i. video for intranet and the market need of the mentally disabled.
- The senior market could benefit as well from these safe internet services, but proved not ready for the MyWepp services by showing a total lack of demand. Brevidius therefore reconsidered its approach to the senior market and is currently preparing a comeback with another product. Pier will not give up easily.
- The unwillingness to pay formed an unexpected obstacle. According to Pier, this was partly caused by the introduction of MyWepp as internet services. People are not accustomed to paying for apps or internet products.

With a lot of presentations and a growing number of 'good practices' this unwillingness has been largely overcome

- Innovation managers from larger institutions find it very hard to decide on the large-scale implementation of the kind of services MyWepp offers, since they are occupied with the introduction of electronic patient records, which has priority. To overcome this barrier, Brevidius approached the personnel in the living and daycare areas of institutions directly, therefore handling a bottom-up approach rather than a top-down approach. In this way, groups can make their own choices regarding budget and instantly receive offers of customized products, which in turn provide added value.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process
- ✓ The R&D process was flexible enough to be adjusted to new findings (focus on new market)
- ✓ New R&D findings influenced the project target (new market)
- ✓ The project planning was carried out in small steps during the project implementation (bottom-up approach)
- ✓ Despite of potential delays in project execution the developers were flexible and took advantage of opportunities as they arose (switch of focus after lack of demand in senior market)
- ✓ Potential setbacks or external threats were used as advantageous as possible (unwillingness to pay was handled by the adjustment of the business model)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (own resources)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Woonmere, Odion, private residential centre)

Pilot in the Plane

- ✓ Soloist entrepreneur/user innovator.

QUOTES

"For many people, new things are not necessarily nice. This surprised me, because I'm totally different. But I learned to leave 'New' and 'Innovative' out of my presentations "

"Everyone was terribly excited. And nothing happened at all."

"It shouldn't be like this: 'Don't bother me, I am busy with the development.' Check everything as soon as possible with your users. Otherwise, after a few weeks, you will realize everything has to change. We fully enhance the idea of scrum."

"Whatever you do, first make sure that someone is willing to pay."

"You should do what you're in control of."

"Do not assume that people are waiting for your product. You must seduce them."

CASE STUDY NR 11: KLIK

Organization: Academic Medical Centre

Interviewee(s): Martha Grootenhuis, Professor of Psychosocial Care and Healthcare Innovation, Lotte Haverman, Psychologist and Post-doctoral Researcher.

Technology category: Web applications and portals

Function: Monitoring quality of life

Segment: Oncology

Users: Cancer patients and their families

User adoption: 4000 users

User acceptance: positive results effect and evaluation studies

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data resources:

Haverman, L., Engelen, V., Grootenhuis, M. A., van Rossum, M. A. J., & Heymans, H. S. A. (2010). Kwaliteit van Leven in Kaart (KLIK). *Tijdschrift voor kindergeneeskunde*, 78(6), 220-227.

TOOL DESCRIPTION

KLIK is a web-based method that screens the quality of life of children who are or were receiving treatment in a (children's) hospital, and their parents, systematically. In the KLIK portal, problems can be identified early and discussed between the care giver, patient and family. In addition, relevant interventions are offered to children to cope with their illness and to support their parents.

MOTIVE FOR DEVELOPMENT

Research by the Department of Psychosocial Care conducted by the Emma Children's Hospital showed that the development of children comes socially and emotionally under pressure when the children grow up with a chronic or life-threatening illness, or are (unexpectedly) hospitalized. Due to increased medical knowledge, children with chronic illness are currently living longer than before. It is therefore increasingly important to pay systematic attention to the quality of life of these children during their development. Research has also shown that communication about emotional issues due to chronic or (life-threatening) illness or a (sudden) hospitalization contributes to the adaptation to the disease, removing uncertainties and negative feelings. To be able to achieve these contributions, the KLIK method was developed.

INVOLVED STAKEHOLDERS

- PhD candidates/researchers AMC/University of Leiden/Vrije University/Radboud University
- Dutch Cancer Society
- Agis
- Emma Children's Hospital, VUMC and Princess Maxima Centre for Paediatric Oncology.
- IT developer BioMedia

PHASES OF THE DEVELOPMENT PROCESS

- Phase 1: Scientific research was conducted on the subject and the analogue version of KLIK was implemented for oncology patients
- Phase 2: A stand-alone KLIK website was developed and applied to rheumatism patients
- Phase 3: Broader implementation of KLIK including diabetes mellitus patients, team expansion
- Phase 4: Implementation within child oncology and business model development

EVOLUTION OF THE TOOL

The basis of the product has remained the same. The application has not changed; it applies PRO (patient reported outcomes) in clinical practice. What does vary is which lists are used, when they are used, where they are used by caregivers, and where they are used by patients and their parents. Therefore, there are infinite possibilities. The KLIK team has tried several approaches to implement KLIK in different departments and care processes.

According to the interviewees, there was an underestimation of the complexity of the implementation. At first, they were first convinced that a generic model was possible, in which all users could be helped and supported. This was eventually recognized not to be the case. There was no 'one size fits all' approach possible with KLIK; each specific group of users had its own needs. Therefore, small steps were taken to be able to offer a tailor-made solution.

A part of KLIK that made it difficult to sell was the simple front-end and the quite complex back-end. It seemed that the caregivers took the complex background for granted, because they were constantly looking for what should be further improved, and did not appreciate the tool as it was.

There was also a large difference between user mentality. Some doctors found it very difficult to use KLIK, while others found it very easy. It seemed that the less they were supported, the more commitment they showed to use KLIK in their practice. The 'not invented here' syndrome also led to resistance in the roll-out of KLIK. Hospitals/care givers considered it important to use their own technology rather than using a tool that was invented elsewhere.

The discovery of an unwillingness to pay was surprising when the business model was introduced. Sometimes, tough negotiations needed to be conducted. When unexpected circumstances occurred, the team responded in an intuitive manner. They learned to take small steps, to let go of negative energy and to gradually improve the product and implementation. Furthermore, the team learned not to scale up too fast, but rather to expand the use of KLIK by providing customized solutions and create champions within the various hospital specialisms. They are now aware of the importance of realizing pre-commitment with all the members involved in a care team. Finally, they have learned not to wait until something is perfect, but to quickly commence implementation and continuously evaluate.

LEMONS DURING THE INNOVATION JOURNEY

- There was no 'one size fits all' possible with KLIK. Each specific group of users had its own needs. Therefore, small steps need to be taken to be able to successfully implement a tool such as KLIK.
- The unwillingness to pay came as a surprise when the business model was introduced. Sometimes, tough negotiations need be conducted. However, the team learned how to realize pre-commitment to the implementation.
- Hospitals/care givers consider it important to use their own technology rather than using a tool that is invented elsewhere.
- There is a large difference between user mentality. Some doctors found it difficult to use KLIK, while others found it very simple. It also seems that the less doctors are supported, the more commitment they show.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (handling the unwillingness to pay by creating pre-commitment)
- ✓ The R&D process was flexible enough to be adjusted to new findings (adjustment of implementation strategy)
- ✓ New R&D findings influenced the project target (no one size fits all possible)
- ✓ The project planning was carried out in small steps during the project implementation (by offering tailor made solutions)
- ✓ Potential setbacks or external threats were used as advantageous as possible (the team learned how to realize pre-commitment to the implementation)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (analog version of KLIK)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (awareness to involve the entire care team)

QUOTES

"We just simply began. Perhaps we underestimated it beforehand. I really thought we could realize a generic model that would work for all users."

"First, we tried to bring it to a kind of perfection before we started and now we just start but quickly evaluate. Now we are creating a run."

"There is so little awareness of how complex the back-end technology is."

"Every time we taking too-large steps, we fail."

"There was a shift, where we first had to peddle. We stopped doing that at one point. And strangely, that seemed to work. Caregivers took more initiative and knew where to find us."

"Some people can't tolerate working with something they did not invent themselves."

"The variation of the use of KLIK, which lists are used, when they are used, where they are used by caregivers and where the user uses them, meant that there were infinite possibilities and that the implementation was complex and time consuming. We didn't think of this beforehand."

CASE STUDY NR 12: C PLATFORM

(Anonymized on request)

Organization: C Platform Foundation

Interviewee(s):

- Project Manager/Content Owner
- Product Manager
- Community Manager/Policy Advisor
- Developer

Technology category: Web applications and portals

Function: Self-management/Decision support

Segment: Oncology

Users: Cancer patients

User adoption: 400,000 visitors per month

User acceptance: positive feedback user evaluations

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data sources: -

TOOL DESCRIPTION

C PLATFORM is an initiative of three oncological sector organizations who joined together to offer reliable information, experiences, knowledge and supportive care in one place for patients.

MOTIVE FOR DEVELOPMENT

The information available to cancer patients was diffuse. Additional research showed that information for cancer patients should be better organized. There was a need for a guide that provided access to all relevant information regarding cancer treatment. The main idea was to harvest valuable and trustworthy information via a portal and to simultaneously empower and connect patients by facilitating the building of a community.

INVOLVED STAKEHOLDERS

The project commenced in a collaboration between patient advocates, a research institute and a fundraising institution. The goal was to create a common vision, gather relevant content from various partners and to unlock and distribute this information through a community platform composed of cancer patients. The level of participation of the partners was to co-produce. At the start of the collaboration, the stakeholders first explicitly examined their commonalities. This way, they provided pre-commitment to the vision and goal of the program; however, the decision-making process was eventually further complicated during the development process.

- Patient advocates
- Knowledge and quality institute for oncology
- Fundraising institution

PHASES OF THE DEVELOPMENT PROCESS

- Vision development and decision making
- Content and software development

- Focus on KPIs and the role of marketing
- Launch
- Exploitation

EVOLUTION OF THE TOOL

Vision development and decision making

The initial idea involved harvesting reliable information from a variety of sources and distributing this information through a portal. This appeared to be too optimistic regarding the quality of the content and the technical features required. The new aim was to bring user-generated content and institutional content together by offering personalized information to cancer patients. Regarding personalization, larger ambitions existed that were eventually accomplished. The intention was that user-generated content could provide information to other patients, personalized to their situation. Furthermore, the idea was that all sorts of parties could plug in to add relevant content. All these aspirations have not (yet) been fulfilled. However, the promise still exists. Both the product and the environment were very complex. It was a dual process: A high political playing field and a start-up. C Platform was developed beyond the edges of the organization with the belief that it should be differentiated to create their own profile before entering partnerships. The expectations were very high. This platform was expected to bring "The big change." The development team thought: "If it is really going to be as we think, it's going to be very good for Dutch cancer patients. However, changing the lives of these patients is a complicated process." The team considered that they partially failed in maintaining modesty.

Content development

The development process was laborious. Three parties were involved who shared the same mission towards patients. Yet, their roles in achieving that mission were competitive. First, the initial idea was that all parties would retain their own role in content development. Editors were responsible for their own specific items. This proved to be difficult in practice. There was a difference in the tone of the text; it was too paternalistic, too formal. The other parties pleaded for an increase in the voice of the patient. As a consensus could not be reached on this subject, the parties decided to create an independent source. This was a courageous decision, which supported the progress of the portal development. Still, this independent content team was required to prove its ability to create the correct content to the responsible parties. Therefore, pilots were performed, which resulted in delays in content development.

Software development

The development team initiated a selection of three software developers that worked according the SCRUM methodology. At that time, this method was very appealing and appeared to fit the conditions of the program: The vision was clear, but the road to it still needed to be designed. The development team decided to build a unique CMS system. During this process, additional assignments were given to develop the CMS for the partner websites. In retrospect, this overextended the team and led to a delay in the development of the CMS system. Therefore, the CMS was developed in a chaotic context. The other software parts were perfectly SCRUM made.

There was an initial energy during the development process. The development team was very confident. This was necessary, because the project itself was very complex. The development of a community platform, a unique CMS, a complex semantic layer, search and privacy issues, were all major challenges. It was all created thoroughly, although everything was new and complex.

Focus on KPIs and the role of marketing

After the first development phase, more attention was turned to the impact and the expected user numbers. In this phase, marketers were added to the project team. In retrospect, this was flawed: The development team should have engaged the "enemy" of marketing earlier. In addition, an important insight was that C Platform was an independent foundation and that there was little political influence. Although independency was required, influence within the existing structures suffered. The team considered their effort as working from the outside in: They had a good understanding of the needs of patients. They saw this as a way of creating change: The current team handles an inside-out way of working by putting its own interest first. The initial ambition required supply-chain thinking. However, often did not move beyond individual interests.

LEMONS DURING THE INNOVATION JOURNEY

- Harvesting information appeared not to be an option. The team then decided to develop authoritative content.
- Creating content together with these different stakeholders was not an option. Therefore, an independent content team was build.
- The political playing field and decision-making process was very complex. There were too many individual interests. Therefore, the development team kept their distance and worked beyond the edges of the organization.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (adjusting the product concept)
- ✓ The R&D process was flexible enough to be adjusted to new findings (building an independent content team)
- ✓ New R&D findings influenced the project target (ambition to offer tailor made information was not fully realized)
- ✓ Potential setbacks or external threats were used as advantageous as possible (by keeping their distance and focusing on their vision)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (listening to the patient needs)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (tripartite collaboration)

Pilot in the Plane

- ✓ During complex political issues, the team kept focus on their vision and intentions

QUOTES

“If it is really going to be as we think, it’s going to be very good for Dutch cancer patients. However, changing the lives of these patients is a complicated process.”

“It was important that we were important, but modesty in managing those expectations was equally important. We have partially failed in maintaining modesty.”
“There was a great confidence in harvesting information. The idea from the start was to only diffuse information. We didn’t think about how to edit the information. Within six months, we completely returned to this, because we experienced that was just not how it was going to work.”

“The product has become very different anyway. The ambition is a lot higher.”

“It was instructive, exciting but also difficult. And as always, it comes down to the individuals.”

“Knowledge and skills, but also the characters, are very important.”

“Ultimately, a small team can make a difference.”

“During complex political issues, we have been constantly saved by our vision and our intentions.”

CASE STUDY NR 13: PHILIPS HEALTHSUITE

Organization: Philips

Interviewee(s): Hans Nootenboom, Head of Digital, Philips Healthcare Informatics

Technology category: Wearable devices/Web applications and portals

Segment: Diabetes

Function: Self-management

Users: Patients with diabetes mellitus type 2

User adoption: unknown, testing phase

User acceptance: unknown, testing phase

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data source:

<http://www.philips.nl/about/news/archive/standard/about/news/press/2017/20170217-philips-en-zorgnetwerk-midden-brabant-werken-aan-een-persoonlijke-gezondheidsomgeving.html>, consulted on February 18th 2017.

TOOL DESCRIPTION

This tool consists of a support application for patients with diabetes mellitus type 2, and a coordination portal for healthcare providers. Together, this forms a shared file, concentrating data concerning a patient in one place. This promotes communication with the patient, stimulates collaboration between healthcare providers, and gives the patient, who is the owner of the file, increased control and insight into his/her health status.

MOTIVE FOR DEVELOPMENT

A patient's care team can consist of many different healthcare providers. This causes difficulties for both the patient and the healthcare providers who want to exchange information. According to the Future Health Index, 50 percent of care professionals and 93 percent of patients in the Netherlands do not feel they are in control of their medical data. Therefore, there is a need for a personal health environment that is built around the patient.

INVOLVED STAKEHOLDERS

- Philips Healthcare
- ZMBR (Zorg Netwerk Midden Brabant)
- Diabetic patients

PHASES OF THE DEVELOPMENT PROCESS

- Vision development and collaboration
- Health Suite lab session: Part I: Vision lab; part II: Solution lab
- Prototyping
- Testing
- Implementation

EVOLUTION OF THE TOOL

The personal health environment was developed by Philips HealthSuite Labs. In this innovative environment, Philips, together with an extensive healthcare network, worked on specific challenges within healthcare. This approach is based on co-

creation, design thinking and agile development methods. In July 2015, ZMBR approached Philips, patients and caregivers to improve care for people with diabetes mellitus type 2. Philips has years of experience in medical technology and ZMBR has an extensive network of healthcare organizations. There was therefore a solid base for a fruitful collaboration. Currently, the tool is in a test phase, and Philips continues to improve the prototype using feedback from test users. The goal is to create a clearer insight into how these improvements affect the care process. This first step is crucial for Philips, to further their approach to other chronic diseases.

At the end of January 2017, the personal health environment was deployed to patients and GPs. ZMBR and Philips want to identify how this affects patient behaviour and interaction between healthcare providers. During this pilot, the focus was on GP practice, however, the solution is easily expandable to hospital specialists, to create further lines of communication between patients and professionals. In the future, this environment will also be used for patient groups other than diabetic patients.

LEMONS DURING THE INNOVATION JOURNEY

- During the co-creation sessions, Philips discovered that patients are not only interested in the data generated, but also in the interaction with their network, both professional and personal. For example, the patients manage their condition and want to share this or ask questions to their caregivers, but also but also be able to approach their family, friends of neighbors. Philips wants to make this part of their overall solution.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (existing means of Philips and its network in medical hardware)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Philips Healthcare, ZMBR)

QUOTES

"You want to create an environment in which the patient can take ownership of his own data, his own connectivity, own devices."

"In every country, the stakeholder landscape is different. In the Netherlands, health insurers are dominant, in America you see a greater role for employers."

"We co-create in the Netherlands at the high-tech campus in Eindhoven and in Cambridge in America. We view these sessions very strategically; the main condition is that there are stakeholders in the market who want to solve a relevant problem together. And it must be based on the principles of Health Suite."

"The power of the Health Suit concept is that we involve the whole ecosystem. Philips Interaction designers, IT developers and healthcare professionals such as

internists, dietitians, diabetic nurses and patients together. Then, we try to define the problem and build a prototype on the spot, so that we test and research in fast, small steps.”

CASE STUDY NR 14: LEKKER PUH!

Organization: Radboud UMC, Games for Health Projects

Interviewee(s): Jurriaan van Rijswijk, CEO/founder Games for Health Europe

Technology category: Serious gaming

Segment: Healthcare/Education

Function: Speech therapy

Users: children with speech problems

User adoption: 300 research participants

User acceptance: unknown, research phase

Care process:

- ✓ e-public health: education and prevention

Additional data source:

<https://www.gamesforhealtheurope.org>, consulted on March 15th 2017

TOOL DESCRIPTION

Lekker Puh! helps young children with cleft lip and palate, with everyday speech exercises in a fun way. Lekker Puh! literally listens to the child's speech. The child plays and at the same time learns to express letters, words and phrases in a proper way. The motivation for the child is playing a fun game and the result is an improvement of speech.

MOTIVE FOR DEVELOPMENT

Radboud UMC had the ambition to improve speech through (applied) research. Games for Health Europe believes that people are naturally programmed to play. And that play is learning by trial and error, in other words, learning by doing. As strategic partners, Radboud UMC and Games for Health Europe explored the possibilities to develop a fun game that could help young children with cleft lip and palate to exercise speech with their parents and improve their speech in a playful way.

INVOLVED STAKEHOLDERS

- Radboud UMC, MKA department
- Games for Health Europe
- Speech therapists, orthopedagogues, teachers
- Children with speech problems

PHASES OF THE DEVELOPMENT PROCESS

- Exploration game development
- Prototype
- Start empirical research / RCT
- Impact case
- Launch

EVOLUTION OF THE TOOL

Lekker Puh! has been developed at the initiative of the speech therapists of Radboud MC. Because the mission was clear and the ideas about the product concept were well developed, Games for Health Europe (GFHE) could get started quickly. Currently, a prototype of Lekker Puh! is being tested with 300 children.

LEMONS DURING THE INNOVATION JOURNEY

- GFHE handles an iterative development process. By building a prototype quickly, unexpected insights can be processed directly into the further design. Therefore, the lemonade principle is already handled in the design of the development process.
- A current uncertainty is whether the application can provide the expected effectiveness.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process
- ✓ The R&D process was flexible enough to be adjusted to new findings
- ✓ New R&D findings influenced the project target
- ✓ The project planning was carried out in small steps during the project implementation
- ✓ The developers allowed the project to evolve as opportunities emerged — even though the opportunities have not been in line with the original project target

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (moonshot sessions)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Radboud UMC)

QUOTES

“We do not have customers, we have partners. We are now investing in development together with partners. All our methods are evidence based, and it is our job to make them awesome for users.”

“We try to move more to the domain of health. Because in care, innovation is still too expensive and the willingness to pay is low.”

CASE STUDY NR 15: MEDI&SEINTJE

Organization: Games for Health Europe / Sint Maartenskliniek / pharmacist AbbVie.

Interviewee(s): Jurriaan van Rijswijk, CEO/founder Games for Health Europe

Technology category: Serious gaming

Segment: Pharmacy

Function: Medication management

Users: Patients using medication

User adoption: unknown, will be launched in May 2017

User acceptance: positive feedback tests

Care process:

- ✓ e-care: primary care process in cure and care

Additional data source:

<https://www.gamesforhealtheurope.org>, consulted on March 15th 2017

TOOL DESCRIPTION

Through a positive stimulus by the puzzle game called Medi&Sientje, medication adherence is implicitly encouraged.

MOTIVE FOR DEVELOPMENT

Many patients have difficulty in managing their medication, while there is a great health gain to be achieved, by increasing medication adherence. This was the motive for Games for Health Europe, the Sint Maartenskliniek and pharmacist Abbvie to develop a playful solution.

INVOLVED STAKEHOLDERS

- Games for Health Europe
- Maartenskliniek
- Pharmacist AbbVie

PHASES OF THE DEVELOPMENT PROCESS

GFHE's development method is to organize a two-day moonshot session, laying the foundation for the tool together with the involved stakeholders.

- Moonshot session
 - Articulate level playing field
 - Define Moonshot
 - Learn to design
 - Design the concept(s)
- Prototype
- Start empirical research / RCT
- Impact case
- Launch

EVOLUTION OF THE TOOL

Games for Health Europe analyzed the value and distribution chain in healthcare and looked for the stakeholders who had the most frequent interaction with the patients. These proved to be the pharmacists. Due to an accidental meeting at the rheumatoid days, Jurriaan van Rijswijk met the pharmacist of the Maartens Kliniek. Both were convinced that there is still a great deal of health gain to achieve through increasing

drug fidelity. Therefore, they decided to invest in a game. The research phase of Medi & Seintje is almost completed, mid-May the game will be officially launched by the Maartenskliniek.

LEMONS DURING THE INNOVATION JOURNEY

- Access to technology is not yet evident for (end) users. Games for Health Europe learned that the key to success is to stimulate call to action.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (moonshot session)
- ✓ The R&D process was flexible enough to be adjusted to new findings (parallel ongoing development during research)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (moonshot sessions)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Maartenskliniek, Pharmacist AbbVie)

QUOTES

“Play and sickness are universal principles. That is why we find it so interesting. Also in terms of impact.”

“Everything we do has never been done before. Therefore, we conduct analyzes on systems and chains within healthcare.”

CASE STUDY NR 16: INTERVIEWR

Organization: Games for Health Europe / Sensire

Interviewee(s): Jurriaan van Rijswijk, CEO/founder Games for Health Europe

Technology category: Serious gaming

Segment: generic

Function: client information

Users: people within their home situation

User adoption: 1453 clients, 2000 employees

User acceptance: positive feedback evaluation

Care process:

- ✓ e-care: primary care process in cure and care

Additional data source:

<https://www.gamesforhealtheurope.org>, consulted on March 15th 2017

TOOL DESCRIPTION

InterviewR engages with people. With the help of video, questions are asked and answered. This creates a personal and natural dialogue. This conversation is recorded and edited into a nice video review. InterviewR is made up of semi-structured questions. With the specially developed smart technology of InterviewR, the answers are translated into text and analyzed. This provides InterviewR with real-time, up-to-date, reliable and representative information about things that make people happy.

MOTIVE FOR DEVELOPMENT

After gaining experience in health care, Rijswijk wanted to shift the focus from fighting sickness to restoring and promoting happiness and wellbeing. He sought for partners who wanted to play a role in this movement. Therefore, Sensire became a strategic partner of Games for Health Europe. Games for Health Europe and Sensire together want to enable elderly to communicate easily how they value the care. Without any hindrance, at any time. That knowledge is used to improve the existing services and to think about new services that people want.

INVOLVED STAKEHOLDERS

- Games for Health Europe
- Sensire, health care professionals and clients

PHASES OF THE DEVELOPMENT PROCESS

GFHE's development method is to organize a two-day moonshot session, laying the foundation for the tool together with the involved stakeholders.

- Moonshot session
 - Articulate level playing field
 - Define Moonshot
 - Learn to design
 - Design the concept(s)
- Prototype
- Start empirical research / RCT
- Impact case
- Launch

EVOLUTION OF THE TOOL

Work for hire, the traditional customer-supplier relationship appeared to be very difficult for creative processes. Therefore, Games for Health Europe now has partners, instead of customers. Here we left 2 years ago. Together with their partners, they invest in development.

With a moonshot session, they found the moonshot for Sensire: the best healthcare provider is a healthcare provider who does not deliver care. After identifying this moonshot, they knew what behavior they wanted to influence. But behavior as such is nothing. Therefore, they wanted to know the actions, the verbs, so they could link the game actions to it. When the behavior, actions and game actions were clear, the game was created.

The involved stakeholders were trained in designing, so they could participate in developing the concepts. From these concepts a prototype followed. With the stakeholders, within iterations from weeks working prototype is built.

The prototype was tested with users, as the research started immediately. First, empirical research and observation research was conducted, to see if it works.

Parallel, an RCT was immediately executed on the effectiveness of the game. At the same time, the product and aesthetics were improved. When the research and development were finished, and the impact case was made, the game was ready for the market. InterviewR is currently used by 1453 clients and 2000 employees.

LEMONS DURING THE INNOVATION JOURNEY

- Care has proved a barbarous field. When innovations in care do not give rise to substitution, innovation is expensive. Rijswijk decided to shift the focus from fighting sickness to restoring and promoting happiness and wellbeing.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (moonshot session)
- ✓ The R&D process was flexible enough to be adjusted to new findings (adjustment of market)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (moonshot sessions)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (Sensire)

QUOTES

“Through our collaboration with Sensire, the roll-out of the product has been ensured.”

“We found the moonshot for Sensire: the best healthcare provider is a healthcare provider who does not deliver care. The shift to wellbeing and happiness provides an answer to the required transformation in care. Serious games could be the transformers.”

CASE STUDY NR 17: GG-DJ

Organization: Games for Health Europe / Radboud University Medical Center

Interviewee(s): Jurriaan van Rijswijk, CEO/founder Games for Health Europe

Technology category: Serious gaming

Segment: Wellbeing

Function: Real-time health monitoring of the population

Users: 18+ citizens

User adoption: 1000 users

User acceptance: positive feedback users

Care process:

- ✓ e-public health: education and prevention

Additional data source:

<https://www.gamesforhealtheurope.org>, consulted on March 15th 2017

TOOL DESCRIPTION

GG-DJ asks quiz type questions that relate to health. The personal approach of GG-DJ through a chat stimulates the involvement of participants and offers continuity. The addition of general questions, facts and the combination with a scoring system, makes GG-DJ fun to do. As a reward users gain insight in their own health and wellbeing. GG-DJ delivers real-time current, reliable and representative information on the health of citizens to the GGD health monitor.

MOTIVE FOR DEVELOPMENT

Regular questionnaires collected by the GGD from citizens are often not completed, because they are too long, too boring or too complicated to complete. To increase the response and create insight for participants into their own health, Games for Health Europe and the Public Health Service successfully created the idea for a fun quiz. Where regular health surveys fail, GG-DJ ranks high in response.

INVOLVED STAKEHOLDERS

- Games for Health Europe
- GGD Brabant-Zuidoost
- Dutch citizens

PHASES OF THE DEVELOPMENT PROCESS

GFHE's development method is to organize a two-day moonshot session, laying the foundation for the tool together with the involved stakeholders.

- Moonshot session
 - Articulate level playing field
 - Define Moonshot
 - Learn to design
 - Design the concept(s)
- Prototype
- Start empirical research / RCT
- Impact case
- Launch

EVOLUTION OF THE TOOL

The GGD had questionnaires and the challenge for Games for Health Europa was to make this awesome. There were four colleagues from the GGD involved in the moonshot session. During this session, they learned to design by means of working methods. Together they developed a concept. After the concept development, a prototype was built and tested in practice. Now GG-DJ is on the eve of a national rollout.

LEMONS DURING THE INNOVATION JOURNEY

- Cope with uncertainty is guaranteed in GFHE's development processes. Therefore, there are no clear lemons found in these cases, but the insights that came on the table were almost immediately converted into opportunities for the product.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (moonshot session)
- ✓ The R&D process was flexible enough to be adjusted to new findings (parallel ongoing development during research)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (moonshot sessions)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (GGD Brabant-Zuidoost)

QUOTES

“Our prototype is empirically tested with users and an RCT on our prototype starts immediately. At the same time, we are improving the product and its aesthetics. When the research is finished, the development is finished and we can introduce the game in the market.”

CASE STUDY NR 18: HARTWACHT

Organization: FocusCura

Interviewee(s): Ronald Scheffer, Business Development Director

Technology category: Wearable devices

Segment: Cardiology

Function: Real-time monitoring

Users: Cardiac patients

User adoption: 2500 users

User acceptance: Positive results user evaluation

Care process:

- ✓ e-care: Primary care process in cure and care

TOOL DESCRIPTION

HartWacht operates on the basis of the FocusCura Home and Measurements apps. From home, patients can send measurements such as blood pressure, weight and heart rate to their cardiologist. If a measurement is made, a signal will immediately be sent to the healthcare provider. In case of a deterioration, video can be recorded immediately via ImageBellen. The data measured are immediately added to the CardioPortal, the CCN online electronic patient file, which allows the patient access to specific self-management information.

MOTIVE FOR DEVELOPMENT

Patients with heart failure, cardiac arrhythmias or cardiovascular problems are often concerned about the functioning of their heart. This regularly leads to GP visits or, in the worst-case scenario, to emergency assistance being requested. If patients are being monitored remotely, many of these types of hospitalizations can be avoided.

INVOLVED STAKEHOLDERS

- Cardiologie Centra Nederland (CCN)
- Zilveren Kruis Achmea (healthcare insurer)
- FocusCura (healthcare innovations)

PHASES OF THE DEVELOPMENT PROCESS

- Development of cVitals by FocusCura.
- Vision development and pre-commitment of Zilveren Kruis, CCN and FocusCura.
- Moonshot vision: To offer a solution to cardiac patients using the cVitals technology, the medical expertise of CCN and the financial infrastructure of the healthcare insurer Zilveren Kruis.
- Business case/impact case.
- Launch/market introduction/roll out.

TOOL EVOLUTION

Zilveren Kruis invited CCN, an innovative cardiology centre and FocusCura, a healthcare innovation company, to meet. Each organization had great ambitions to transform healthcare using new solutions.

The three parties were open about their ambitions and interests. CCN was particularly vulnerable, as the replacement of care through digital solutions could

constitute a financial risk. All parties were transparent about their business model and the necessary financial resources. This promptly created a good basis for cooperation. With a moonshot vision to offer a solution for cardiac patients within a short period of time, the organisations worked to introduce HartWacht during the eHealth week in January 2016. Eventually, this became June 2016. This was due to the complex processes that had to be completed within Zilveren Kruis. According to Scheffer, a strength here was that they developed the service holistically, not solving a piece of the problem but offering a total solution. The starting point for the business case was to lower care costs or to better the quality of care for the same cost. Both promises have now been fulfilled, achieving a triple-aim effect in health gained, user satisfaction and lower cost. HartWacht has now been offered to 2500 patients of CCN.

LEMONS DURING THE INNOVATION JOURNEY

- The time to market was longer than expected, in particular the time required to complete the processes with the healthcare insurer.
- eHealth use by caregivers had been overestimated. Care providers do not universally have the skills to deal with digital applications, and have not been educated in their use.
- Product acceptance was difficult to obtain. FocusCura originally thought that this would be easy. They learned that it is important to pay careful attention to caregivers when implementing innovations. They therefore tried to not only provide a solution for the end users (patients), but also to solve a problem experienced by caregivers.
- Focusing and maintaining faith in the product are, according to Scheffers, important factors in the success of an innovation. The product must remain simple to retain its effectiveness and user friendliness.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The R&D process was flexible enough to adjust to new findings (challenges in product acceptance and implementation).
- ✓ The project planning was carried out in small steps during the project implementation (moonshot).
- ✓ Despite potential delays in project execution, the developers were flexible and took advantage of opportunities as they arose (by focusing and maintaining belief in the product).
- ✓ Potential setbacks or external threats were used as advantageously as possible (by providing a total solution).

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird-in-hand principle:

- ✓ The given means/resources were used as the starting point for the project (own resources).

Crazy quilt principle:

- ✓ In order to reduce risks, the developers established partnerships and received pre-commitments (Zilveren Kruis Achmea, CCN).

Pilot-in-the-plane principle:

- ✓ Maintaining belief in the product

QUOTES

“We developed the service holistically, not solving a piece of the problem, but offering a total solution.”

“One of the success factors was that all parties were transparent about their interests. Therefore, there was no further discussion and we could continue working on the content.”

“You must truly believe in your product in order to succeed.”

“It is important to solve a problem for healthcare professionals too, not just for end users.”

CASE STUDY NR 19: SEXY LEXY

Organization: Reframing studio

Interviewee(s): Beatrijs Voorneman, Interaction Designer

Technology category: Mobile apps/serious gaming

Segment: Mental Health

Function: Sexual Education

Users: Young people with a mental disability

User adoption: Test phase

User acceptance: Positive needs evaluation

Care process:

- ✓ e-public health: education and prevention

Additional data sources:

<http://www.reframingstudio.com/projects/learning-about-sex>, consulted March 20th 2017

TOOL DESCRIPTION

Sexy Lexy is a sex game through which adolescents can practice sexual behaviour and all social interactions involved. From flirting, to kissing, to sharing personal photos online, the application educates users about the diversity of sex, both the pleasures and pitfalls, in a playful and adventurous way.

MOTIVE FOR DEVELOPMENT

Within Dutch society, we are constantly confronted with sex: Advertisements showing scantily-dressed men and women, sex in movies and television series, sex and porn spam on social media. The images we have of sex, how we should have sex and who should (not) have sex, is strongly influenced by these media. Sometimes, these images are the only understanding people have of sexual relations, e.g., if they have not received sexual education. This is the case for most adolescents with a mental disability; this is a group for whom sex remains taboo. Social interactions with other people are more difficult to interpret for this group, as well as communicating personal boundaries and overseeing the consequences of their actions. This makes these adolescents more vulnerable when it comes to sex. Sense, a Dutch centre for sex and health, asked E-hulp and Reframing Studio to develop eHealth interventions that prepare and educate adolescents in a positive way about sex to reduce their vulnerability for unintended misunderstandings and abuse.

INVOLVED STAKEHOLDERS

- Reframing Studio
- E-hulp
- Sense
- Rutger Stichting, SOA AIDS
- Sexologists, journalists, adolescents with a mental disability and their caregivers.

PHASES OF THE DEVELOPMENT PROCESS

- Context research
- Idea generation
- First paper prototype of two concepts

- Digital prototype
- Implementation

EVOLUTION OF THE TOOL

During the research phase of this project, Reframing Studio involved a diverse group of people. They worked with a sexologist, a correspondent on sex in society, a philosopher, several adolescents with a mental disability, and their caregivers. All individuals had a different view of sexuality in Dutch society. Together with other sources (e.g., articles, documentaries, literature), a vision was created of the future behaviour of adolescents with a mental disability when it comes to sex. Of the seven ideas forwarded, two concepts were chosen, further expanded upon and tested with the adolescents and their caregivers.

What Reframing Studio noticed during this evaluation is that young people with a mental disability indicated that they want to use the tool, but only because it is fun and not because they feel as though they have a lot to learn about sex. This reveals something interesting about the (hidden) motive of the user group.

When conducting research, the developers wondered whether this is typical behaviour of people with mental disabilities or whether this was due to puberty alone. They found that the user group held an ideal of what they thought was normal. They desire to be as normal as possible; they wanted a house, a car and a beautiful girl/boy. They are constantly confronted with normal things, but are told that they should not attempt to be normal.

According to Reframing Studio, it is important to teach users how sex works and that it will not be the same as it is portrayed in the movies. That it is much more stupid and complicated. That one can experience sexual encounters differently than expected. That people do not always like the same things. From these insights, Sexy Lexy was further developed.

Unfortunately, the collaborating organizations decided to place further development of Sexy Lexy on hold because of other priorities. Since Reframing Studio is convinced of the need for Sexy Lexy, they are orientating to roll-out the app themselves.

LEMONS DURING THE INNOVATION JOURNEY

- When evaluating the tool, clients said they would use it, but only for fun, not to learn something, because they felt that they already knew everything about sex. The developers used this insight in the positioning of the product.
- The user group feels that it is being told that they better not get involved with sex, while all they want to do are normal things. The developers attempted to remove the taboo surrounding this subject.
- The organisations who were responsible for the tool decided to pause further development. Currently, Reframing Studio wants to develop Sexy Lexy further themselves.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers always tried to integrate surprising results and findings during the R&D process (insights in user needs)

- ✓ The R&D process was flexible enough to be adjusted to new findings (adjustment of product positioning)
- ✓ New R&D findings influenced the project target (taboo surrounding the subject)
- ✓ Potential setbacks or external threats were used as advantageous as possible (by possibly taking over the further development and implementation)

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Bird in hand

- ✓ Given means/resources have been the starting point for the project (paper prototype)

Crazy Quilt

- ✓ In order to reduce risks, the developers started partnerships and received pre-commitments (E-hulp, Sense, Rutger Stichting, SOA AIDS)

QUOTES

“We were just thinking: is this typical behavior of people with mental disabilities or is this just puberty?”

“When evaluating the app, young people with a mental disability indicated that they want to use the tool, but only for fun and not because they have something to learn. So here was our hidden motive for the tool.”

“When you start with the paper prototype you really think: this is embarrassing. But ultimately, people do understand it and it works!”

CASE STUDY NR 20: TINYBOT TESSA

Organization: Tinybots

Interviewee(s): Wang Long Li, Founder and CEO Tinybots

Technology category: Robotics

Segment: Dementia, empowerment

Function: Cognitive support

Users: Dementia patients

User adoption: 112 pilot robots are currently being tested

User acceptance: unknown, pilot is currently carried out

Care process:

- ✓ e-care: Primary care process in cure and care

Additional data sources:

<http://www.tinybots.nl>, consulted on May 20th 2017

TOOL DESCRIPTION

Tinybot Tessa is a social robot that encourages dementia patients and their families to be more active.

MOTIVE FOR DEVELOPMENT

Tinybots focuses on the human psychological needs for autonomy, competence and connection. Tinybots provides technology to support individuals with cognitive impairments in their daily activities or to encourage them to be active. This increases their sense of self-esteem and competence, increasing their confidence to maintain good relationships with others, which in turn strengthens their relationship with loved ones. Thus, with Tinybots, Wang wants to contribute to the well-being of the individual and to increase his/her perception of happiness.

INVOLVED STAKEHOLDERS

- Several production partners for specific elements of the robots.
- Care institutions (implementation).
- Health Valley (network support).
- Rockstart (start-up support).

PHASES OF THE DEVELOPMENT PROCESS

- Needs assessment.
- Prototyping.
- First production batch (100 robots).
- Pilot implementation.
- Product refinement.
- Second production batch (1000 robots).

TOOL EVOLUTION

Wang and co-owner Robert Paauwe were PhDs at the Vrije Universiteit of Amsterdam to conduct research into the deployment of robots in the care domain. During this investigation, various robots were tested by elderly people. What became clear was that the elderly participants did not require a robot to replace physical tasks, but rather a robot that could provide them with social support. For example, by offering instructions, reminders of small social tasks or memory triggers.

During their study, Wang and Robert received an increasing number of questions from the elderly participants about when they could use the robot. Although Wang and Robert performed many pitches to global innovative companies, no company wanted to be involved in production. Wang and Robert then decided to establish a project to validate and produce the robots themselves.

In October 2015, Tinybots was selected by Rockstart for start-up support. Wang and Robert both quit their jobs and started their business. During the Rockstart program, six investors were interested in Tinybots. Eventually, one investor was selected. They jointly agreed upon a business plan.

By collaborating with Health Valley, a network of care institutions was made available for Tinybots to test the robot with users. At the current time, 112 robots are being used by dementia patients in several care institutions. The aim is to test the use of Tessa for one year, to gain knowledge and experience that will then be used in further development and to optimize the conditions for use.

The first batch of the 100 robots was very complex. The interdependence between different suppliers regarding specific elements of the robot particularly required careful planning and a clear demarcation of responsibilities. This was an unexpected insight. In addition, the implementation of the robot also proved challenging. Although the management level at care institutions are often excited about innovation and robotics, this is far less obvious for healthcare practitioners. Wang also referred to the novel concept of a robot, which was difficult for many people to imagine.

As soon as a demo robot was provided, caregivers began to understand what Tinybot Tessa could mean for their patients. Further communication is therefore needed to clearly communicate the possibilities of Tinybot Tessa prior to a demo being introduced.

In addition, according to Wang, a quick scan is needed to determine whether healthcare organizations are ready for the implementation of this innovation; whether there are IT workers available, a working internet connection, and most importantly, if there are enthusiastic caregivers. These are, according to Wang, indispensable preconditions for proper implementation.

The next batch will run at approximately 1000 pieces, a solid growth. For this second batch, Wang and colleagues have improved the production process so that all production steps are well-matched. At this time, the first product Tinybots have developed is Tessa; she will learn more about which activities stimulate well-being. In the future, she will likely receive brothers and sisters, each specializing in the wishes of the different groups that Tinybots serves.

LEMONS DURING THE INNOVATION JOURNEY

- The production of the specific components and interdependencies in production was more complex than originally thought. The production process for the following batch will be adapted.

- The implementation and use of a robot within healthcare organizations proved to be difficult. Robotics are entirely novel, and must be carefully introduced to caregivers. The current idea is to previously scan whether a healthcare organization has the correct conditions to support robotic innovation. In addition, increased attention must be given to marketing and communication materials about the product.

APPLIED CONSTRUCTS OF THE LEMONADE PRINCIPLE

- ✓ The developers consistently attempted to integrate surprising results and findings during the R&D process (identifying user needs).
- ✓ The R&D process was sufficiently flexible to be adjusted to new findings (learning production process and implementation).
- ✓ New R&D findings influenced the project target (social needs robot instead of physical support).
- ✓ Potential setbacks or external threats were used as advantageously as possible (the knowledge gained is now being used to optimize production process and implementation).

ADDITIONAL OBSERVATIONS REGARDING EFFECTUATION

Crazy quilt principle

- ✓ In order to reduce risks, the developers established partnerships and received pre-commitments (Rockstart, investor, Health Valley, care institutions).

QUOTES

“With a television, care providers know how the elderly will respond to it. A talking robot will cause uncertainty. While the function is comparable to a radio. We really need to communicate clearly about what a social robot such as Tessa can mean for people.”

“According to our idea, we had simplified the technology. But there were more challenges in getting the best out of the electronics.”

“We introduce technology to support individuals with cognitive impairments in their daily activities and to activate them.”