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DESIGN OF A REMOTE EMOTIONAL REQUIREMENTS ELICITATION FEEDBACK METHOD

Master's thesis

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Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

User emotions are often neglected in requirements engineering, even though they are critical to technology adoption, and it is difficult for small organizations building sociotechnical applications to evaluate user-feedback to requirements. The current CoVid-19 pandemic has hampered the ability of face-to-face interaction, and thus presents further barriers to capturing user-feedback. Although requirement elicitation and feedback techniques are well-established, there is a gap in the state of the art pertaining to zero-cost methods that integrate both emotionally-driven development of features and remote capturing of feedback to these features. Using a psychosocial cancer support prototype as its use-case, this thesis conducts emotional-goal modeling to integrate emotionality into requirements building. Next, a method is presented, termed the Remote Emotional Requirements Elicitation Feedback Method (REREFM) that integrates multimedia tools for remotely capturing and analyzing user-feedback to these emotionally-driven requirements. The REREFM is evaluated for utility using Design Science Research evaluation methods. The objective of this thesis is to design a novel and low-cost remote user-feedback method that provides a positive user-experience for interviewees, while simultaneously capturing feedback that is relevant and useful for small organizations developing sociotechnical applications.

List of abbreviations and terms

AOM	Agent-Oriented Modeling
DSR	Design Science Research
FR	Functional Requirement
HD	High-Definition
IS	Information Science
NFR	Non-Functional Requirement
OBS	Open Broadcast Software
POSE	People Oriented Software Engineering
RE	Requirements Engineering
REREFM	Remote Emotional Requirement Elicitation Feedback Method
TAM	Technology Acceptance Model
UK	United Kingdom
US	United States
USD	United States Dollar
UX	User-Experience

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1 Introduction

Fundamental to successful software development is Requirements Engineering (RE) [1], which is traditionally driven by the expression of two core components: functional requirements (FRs) and non-functional requirements (NFRs). FRs constitute what an application does, while NFRs represent the quality an application seeks to embody when implementing functionality [2].

Ultimately, the main objective of RE is to ascertain the needs and goals of humans through user-analyst communication channels, otherwise termed as requirement elicitation, so developers can create systems people want to use [3]. Failure to develop appropriate and feasible FRs and NFRs generally leads to cancellation or deficient implementation of a software project [4].

Although modern RE has developed agile methodologies like SCRUM for creating more efficient RE methods, software development has primarily focused on extracting requirements in very traditional ways, struggling with incorporating the volatile, socio-political nature of different use-case environments [5] [6]. In this sense, socio-political entails the values, or personal beliefs of individuals, and the emotions users and stakeholders all experience before, during and after using software applications [6]. In particular, emotions are frequently overlooked in RE in favor of more utilitarian aspects of FRs and NFRs [7].

Emotions are central to the human experience — they are at once abstract, yet concrete in how they manifest physically through laughter of happiness and tears of sadness. Human emotionality is difficult to define, but we know it exists and has considerable influence on technology adoption, arguably more than the utility a software may provide [8] [9]. For the purposes of this thesis, conceptualizing emotions in the context of RE comes through the form of emotional goals, which represents how a user wants to feel when using a system, or how a stakeholder of a system wants users to feel [10]. However, in order to understand the integration of emotional goals in the RE process and thereby,

building features, one must establish efficient feedback channels between stakeholders, software developers and users.

As documented by Proynova and Paech [11], there are a multitude of issues when it comes to establishing these channels: traditional survey distribution to users asking for feedback about certain requirements leads to misinterpretations and misconceptions over features; user-feedback processes are extremely resource-dependent, where less resources generally means less-quality feedback, and the current CoVid-19 pandemic is hampering the effective capturing of feedback by limiting face-to-face user-availability.

Understanding how users feel before, during and after experiencing a software product is immensely valuable. Yet with challenges aforementioned, it's difficult to reach out to potential users to assess these feelings, much less taking into consideration the current pandemic environment. In order to reach potential users, innovative remote methods must to be cultivated for establishing the user-stakeholder-developer feedback loops so vital to the success of software development projects.

1.1 Thesis Objectives

Thus, the objective of this thesis is to create a remote user-feedback method for assessing emotionally-goal driven requirements, *before* actual coding is done, reducing the chances of building something that does not meet stakeholder and user emotional goals, while expending a low amount of resources capturing user feedback through pre-existing multimedia tools. This method is termed the Remote Emotional Requirement Elicitation Feedback Method (REREFM).

The software project use-case is a high-fidelity, interactive front-end prototype visualization for a psychosocial cancer support application, Recovery Companion (RC). The initial requirements for RC will be developed through establishing emotional goals via an expert stakeholder interview. The prototype will then be assessed by five former cancer patients from Australia and United States through a requirements walk-through embedded in the REREFM.

Streamlining this feedback capability may be advantageous for small-scale organizations who do not have the resource capacity to elicit user-feedback from user-populations that may be disadvantaged, vulnerable or difficult to access. Thus, this thesis specifically focuses on the process of developing requirements with emotionality integrated into them, while also capturing user-feedback to these emotionally-driven features, as opposed to measuring whether these features accurately elicit the emotional goals in question.

1.2 Existing Body of Knowledge and State of the Art

The proceeding section provides an overview of the existing body of knowledge and the state of the art. Emotions are defined in Section 1.2.1 proceeding to the influence emotions have on technology adoption in Section 1.2.2. Section 1.2.3 outlines different methodologies of emotionality integration into RE, and lastly Section 1.2.4 describes various remote user-feedback methods.

1.2.1 Defining Emotions

In modern science, Darwin provided the first framework for defining emotions. Darwin considered emotions to have "functional" utility, providing an individual with an adaptive coping mechanism for responding to environmental stimuli, through a core set of six emotions: happiness, sadness, fear, disgust, anger, surprise, which are associated with universally recognized facial expressions [12]. Izard describes these as "basic emotions" as they are unable to be learned or taught [13].

Darwin's theory has been modified over time by psychologist Robert Plutchick's wheel of emotions. Plutchik extended the core six emotions to eight by adding "acceptance and anticipation" and blending emotions together to create secondary emotions. For instance, the blending of "anticipation" and "joy" leads to optimism. [14]. From a psychological perspective, the primary theory on emotions is the James-Lange theory, presented in 1927.

According to this theory and its modern adaptations, emotions are the *byproduct* of the autonomic nervous system reacting to external stimuli. For instance, a person will feel high blood pressure and increased heart rate when facing a large animal, leading to fear.

Thus, fear does not lead to the physiological changes above, but vice-versa [15]. A counter-theory to James-Lange is the Cannon-Brad's Theory, which supports the opposite causality chain [15].

In summary, there is no scientific consensus on a pure definition of emotions, and this thesis does not seek to deeply explore emotion from this lens, although general tenets suggest that emotions are generally triggered by stimuli, multifaceted, yet universal in certain respects, while also influenced by culture and external environment.

1.2.2 Emotions and Technology Acceptance

Despite the abstract nature of emotionality, emotions play a pivotal role in the acceptance of technology. One of the first theories observing this phenomena was Arnold Magda's appraisal theory, which defined emotions as "the felt tendency toward anything intuitively appraised as good (beneficial), or away from anything intuitively appraised as bad (harmful)" [16]. In Magda's viewpoint, when a user interacts with a product they develop emotions related to evaluating whether the product is beneficial —in other words— an appraisal [16].

A more nuanced approach to Magda's appraisal theory is the Technology Acceptance Model (TAM), a widely-cited theory proposed in 1986 by Fred Davis, which explores two primary factors influencing a user's decision in technology adoption: "perceived ease of use and perceived usefulness" and their dynamic relationship between external system characteristics [17]. Both variables are fairly self-explanatory, with "perceived ease of use" summarizing the user-experience and the impediments when using a device to achieve a user's intent, and "perceived usefulness" is correlated with the utilitarian value a product provides a user [17].

Although these two variables are straightforward, they will play an important role in the REREFM from the perspective of the interviewee. This is discussed in further detail in Chapter 5. A modernized version of the TAM model has been extended to include four variables: "external predictors", for example, "technological literacy and technological anxiety"; the next is "factors from other theories", which include "cultural norms", "risk and trust"; thirdly are "contextual factors" pertaining to socio-demographic factors like

age and gender*;* and lastly, "usage measures" quantifies user perceptions and actual usage rates of a technology [18].

While both the Magda's appraisal and TAM theories focus on adoption through a technology's perceived utility, user-experience and external variables like gender, there has been an increased focus since the beginning of the 21st century on emotion being intrinsic to the *design* of different technologies and therefore, contributing to the adoption of such technologies. Arguably the most influential work on this subject was produced by Don Norman. Norman's framework proposes three levels of human perception that influence emotionality, and thus should be incorporated into design processes for successful product adoption [19].

The first level is *"*visceral", which is concerned with the aesthetic design of a product as humans make quick, pre-conscious judgements that influence how an individual feels [19]. The second is "behavioural", where the utility and user-experience of a product is processed by the subconscious, leading to pleasureful or negative experience [19]. The last level is *reflective*, where meaning is imbued to a product over a longer period of time and a larger variety of differing reactions between individuals, as opposed to the former two levels containing universal qualities [19].

1.2.3 Emotionality in Requirements Engineering

In recent years, incorporating emotionality has gained traction in the software engineering community, resulting in research being proposed for describing and capturing user emotion in the RE process [3], [6], [20], [21], [22]. However, much of this research focuses on the semantics of conceptualizing emotion, as well as ascribing emotion's importance to RE. For example, Proynova et al., use "personal values" from the field of psychology to reflect the emotions of users in relation to RE in the context of healthcare [20]. Further examples include the assertions of Thew and Sutcliffe, who provide a taxonomy of emotionalism in RE through understanding stakeholder "values, motivations and emotions" (VME) [6].

In the modelling notation *i** presented by Yu, soft goals are represented by emotionally-driven non-functional requirements, like "trustworthy" and "normal lifestyle", however

there is no process in the notation for capturing such elements [21]. Colomo-Palacios et al. [3] proposed a more intensive method for garnering user-emotions for RE, entitled the "Affect Grid". They conducted an emotional evaluation of requirements by asking stakeholders the question "*What is your emotion regarding this requirement definition?".* Stakeholders then placed a marker on a single item scale of pleasure and arousal for each requirement, proving emotions influence the stability of requirements [3].

One of the most recent methodologies in emotional RE is People Oriented Software Engineering (POSE) designed by Miller et al [22]. This method is highly integrated with Norman's three-layered behavioral design framework and applies Sterling and Taveter's [23] agent-oriented motivational goal modeling to express emotional goals. Motivational goal models are lean and high-level abstract visualizations of FRs (termed functional goals) and NFRs (termed quality goals) for socio-technical systems, where agents, whether human or software, fulfill a role and are assigned a responsibility in the system in relation to the functional and quality goals elucidated in the model.

In POSE [22]., emotions are separated into two distinct classifications: personal emotions and context specific emotions. Personal emotions are how "a person feels or wants to feel" regardless of the software in question's objectives, such as feeling loved. On the other hand, context specific emotions directly relate to how an individual feels or wants to feel about the software he or she's engaged with, such as feeling frustrated when using a system [22]. Syntactically, emotional goals are distinct from functional and quality goals and through a linkage to Norman's *reflective level* of emotional design [22]. To ascertain the emotional goals of users, Miller et al. conducted interviews with participants of an elderly monitoring system, asking them:

1) "What should the technology do for you?" (functional goals)
2) "How should it be?" (quality goals)
3) "How do you want to feel?" (emotional goals)

For the purposes of this thesis, the POSE framework will be used for eliciting the emotional goals of an expert who is a cancer survivor and currently a cancer counselor through a semi-structured interview. The emotional goals will then be expressed using [23]'s agent-oriented motivational and role modeling of the RC use-case in Chapter 3.

1.2.4 Remote User-Feedback for RE

Central to this research is the establishment of a remote user-feedback method for emotionally-driven requirements instantiated by an interactive, high-fidelity mockup prototype. In order to optimally utilize development resources and build products people want to use, integrating user-feedback is vital in the early stages of RE [24]. Although traditional techniques of eliciting requirements from users have been well-established [25] [26], problems remain with ill-defined requirements hampering development and burdening organizations with development costs [25].

Per Morales-Ramirez et al., remote user-feedback is defined as when "the evaluators are separated in space and/or time from users" [27]. Further refined, this process is either *synchronous*, where the "the evaluator is separated from the user spatially, but not temporally" or *asynchronous, "*where the evaluator is separated from the user both temporally and spatially" [27]. Feedback can manifest as *implicit* through documenting user-behavior via logs, or it can be *explicit*, where a user(s) directly corresponds with stakeholders [27].

Literature on the remote capturing of user-feedback has been around for over two decades [28]. However, the main focus has been on conducting usability testing and different methods for targeting problems with user-interfaces [28]. According to Sutcliffe and Sawyer [25] general approaches to user-feedback for eliciting requirements can take the form of interviews, observation, workshops, protocols/dialogues, scenarios and prototypes. Although in [25]'s opinion, "a combination of techniques rather than structured interviews *per se* is probably the most effective approach" for eliciting requirements [25].

Thus, establishing integrative remote user-feedbacks methods by applying innovative multimedia tools can be classified as a "growth area" in RE [25]. Considering the current Covid-19 crisis where face-to-face interactions have been drastically reduced, innovative, low cost approaches to eliciting requirements feedback is crucial for the sustainability of smaller organizations developing socio-technical applications.

1.3 Research Methodology

The logical research methodology for this thesis is Design Science Research (DSR). DSR is an ideal paradigm for socio-technical systems as it is centered around the *building* and *evaluation* of novel artifacts and design theories which provide solutions to problems, or upgrade existing knowledge to the field of Information Sciences (IS) [29]. Hevner et al. [29] define artifacts as consisting of "constructs, models, methods and instantiations", ranging from algorithms to visualizations and textual descriptions of IS best practices. Ultimately, the output of artifacts must make a clear contribution to the existing environment for socio-technical systems [30].

1.3.1 Design Science Research Theory

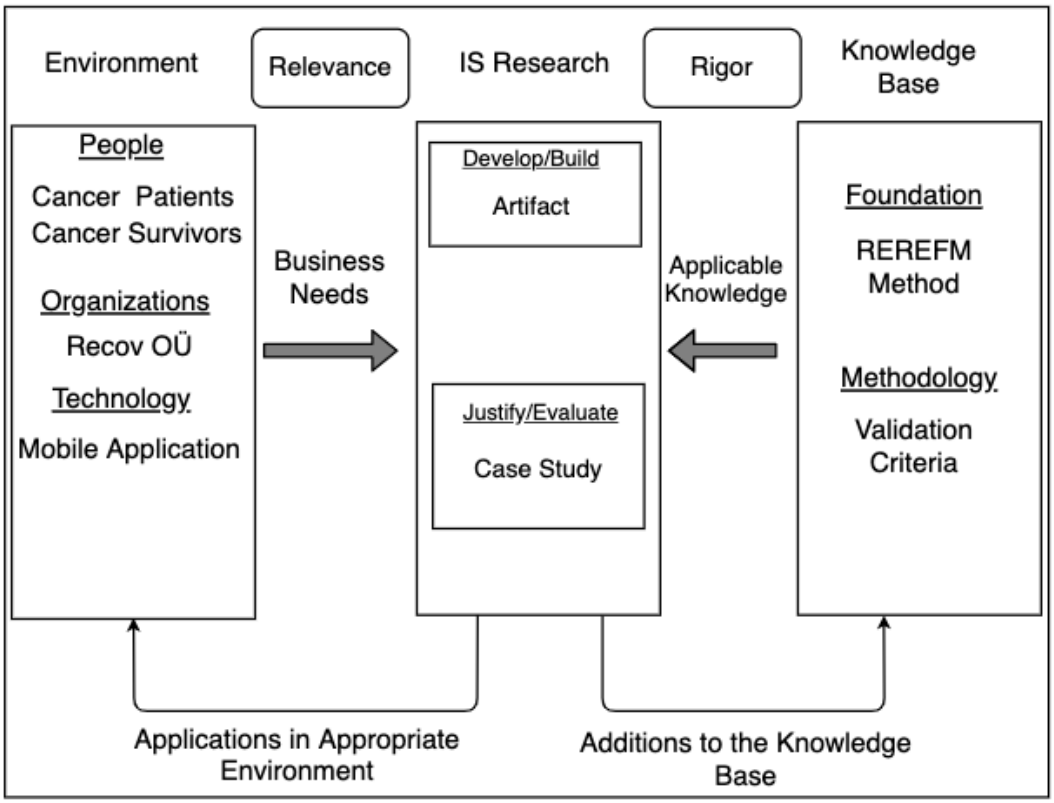


Figure 1 DSR Theory Overview for RC Use-Case [29]

In Figure 1, [29]'s seminal DSR framework is presented for the RC use-case. The visualization provides a framework for creating novel artifacts in IS using DSR. Artifacts are underpinned by the problem-solving relevancy in the use-case environment,

composed of people, organizations and technology. In this research context, the people involved are cancer patients and survivors; the organization is the Tallinn-based Recov OÜ who is developing the mobile application, Recovery Companion.

The middle pillar in Figure 1 is categorized by its affiliation with IS research, where either a theory is developed or an artifact is built. For this thesis, an artifact is built

The knowledge base pillar contains the foundation for designing the artifact which is the REREFM method. The methodology applied to the artifact is validation criteria. The output of the artifact contributes to the existing knowledge base, while also providing relevancy to the business needs of the use-case environment.

In addition to the holistic framework for internal DSR processes in Figure 1, several guidelines have also been promulgated by [29] for conducting successful DSR research. The following sections will integrate the context of this thesis into the guidelines shown below in Figure 2.

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Figure 1 DSR Guidelines [29]

1.3.2 Design as an Artifact

As elucidated previously, the central aim of DSR is to produce and evaluate artifacts, which consist of "constructs, models, methods and instantiations". For this thesis, a method for remotely capturing user-feedback on emotionally-driven prototype features will be produced as the main artifact to be evaluated, entitled the Remote Emotional Requirement Engineering Feedback Method (REREFM). Peffers et al. [31] defines a method as an "Actionable instructions that are conceptual (not algorithmic)" . The method is visually represented by a waterfall-based process model in Chapter 4.

1.3.3 Problem Relevance

In general, there is a lack of emotional integration into requirement building processes, in addition to the challenging task of capturing user-feedback on requirements for small organizations with minimal resource capability who cannot afford to squander capital with low-adoption feature builds. This problem has been further compounded by the COVID-19 crisis, which is migrating offline interaction towards virtual spaces, presenting its own set of challenges for coordinating user-feedback.

1.3.4 Design Evaluation

In order to ascertain the viability of an artifact, it must be rigorously evaluated. [29] classifies this rigor through different metrics of "completeness, consistency, accuracy, performance, reliability, usability", or other metrics that encapsulate the artifact's utility. Figure represents [29]'s different existing knowledge base methodologies applied to the evaluation method, while demonstrating different DSR evaluation approaches.

1. Observational	Case Study: Study artifact in depth in business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation – Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

Figure 2 DSR Evaluation Methods [29]

In this thesis, Chapter 5 is solely devoted to conceptualizing and justifying the different DSR evaluation methods used for assessing the utility of the REREFM. For greater research clarity, Figure 4 provides a visualization of the evaluation process undergone in Chapter 5.

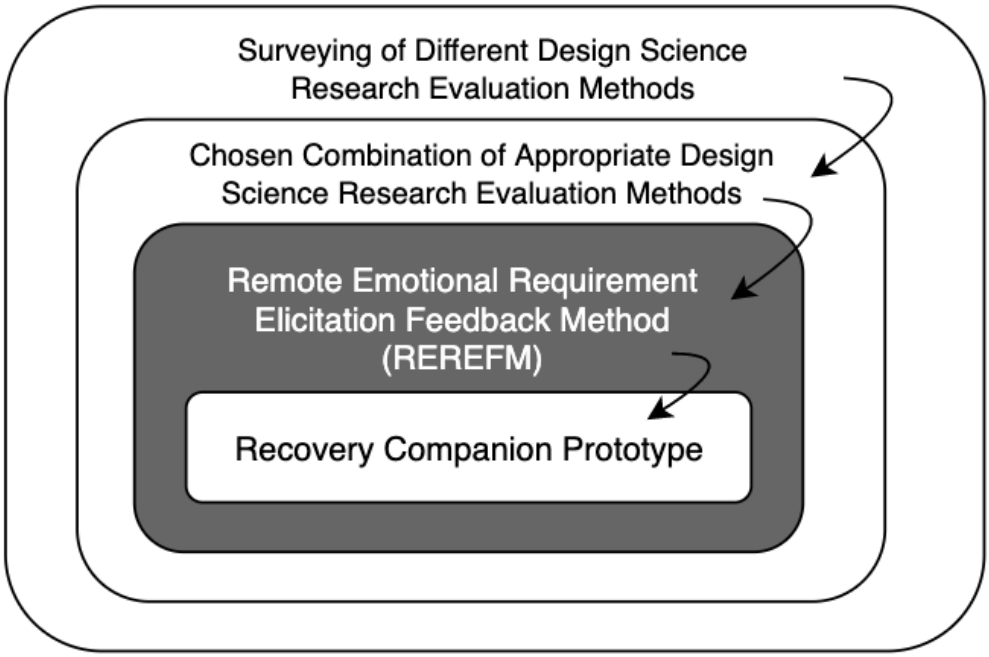


Figure 3 DSR Evaluation Process Visualization

1.3.5 Research Contributions

This thesis seeks to make a new contribution to the requirements engineering field through the instantiation of a novel, remote user-feedback method for emotionally-driven prototype features. The method is innovative in its zero-cost approach by combining open-source multimedia tools to share prototype visualizations while also focusing extensively on the user-experience of the interviewee. As a byproduct of the REREFM, a greater understanding of RC's efficacy as a solution for those going through cancer will also be established.

1.3.6 Research Rigor

Through using AOM modeling for eliciting emotional goals, process modeling the remote user-feedback process a multimedia tech stack as well as establishing a comprehensive argument for the DSR evaluation method chosen, methodological rigor is established.

1.3.7 Design as Search Process

According to [29] design is intrinsically an "iterative" process, where optimal solutions are materialized through the search process of problem-paradigms in IS. This thesis's

search process identifies a two-part problem-paradigm: first is the lack of emotional integration into requirements engineering and the second is a gap in remote effective and positive interviewee experience user-feedback methods for emotionally-driven features. The REREFM seeks to solves these problems through one standard of operation.

1.3.8 Communication of Research

The communication of this research occurs through the form of this thesis and dissemination to the academic and relevant stakeholder community in written and presentation form.

1.4 Research Gap

It has been established that emotions are generally neglected in requirements engineering, despite playing a pivotal role in technology adoption. Methods for eliciting requirements are mature, traditional and non-integrative, corresponding to organizational resource capacity. However, a gap exists in the state of the art in regards to a neglect of effective remote requirement user-feedback methods that integrate different multimedia tools for a positive user-experience for the interviewee.

1.5 Research Questions

Based upon the research gap, the meta research question (RQ) is the following:
How to create a remote feedback method for emotionally-goal driven requirements by combining multimedia tools and evaluating its utility?

To further answer this question in a formidable fashion, the meta RQ is deconstructed into three sub-questions:

RQ-1: How to model emotional goals?

RQ-2: How to combine multimedia tools for implementing the REREFM?

RQ-3: How to establish an evaluation method for measuring REREFM utility?

RQ-1 will be answered by eliciting the emotional goals of a stakeholder through an expert stakeholder interview under POSE, ascertaining the emotional goals, roles and meta-emotional goal model through an agent-oriented framework.

RQ-2 will be answered by establishing an overarching process model for eliciting user-feedback for prototype requirements, then existing multimedia tools will be analyzed and assigned into the process model.

RQ-3 will be answered by analyzing and synthesizing different DSR methods into a taxonomy and constructing a utility tree for the REREFM. The most applicable components of the DSR methods will be combined into a meta-DSR evaluation method applicable for REREFM.

1.6 Thesis Structure

The remaining portions of this thesis will be as follows: Chapter 2 describes the use-case; Chapter 3 contains a meta-emotional motivational goal model using agent-oriented modeling principles. Chapter 4 develops a waterfall process model for the REREFM while also analzying pre-existing multimedia tools and integrating them into the REREFM. Chapter 5 focuses on DSR evaluation methods by creating a taxonomy and detailing compatible DSR methods and qualities. Chapter 6 provides the results and a discussion of the REREFM, and lastly Chapter 7 concludes this research with limitations and future work provided.

2 Presuppositions

The following sections outline the presuppositions needed to understand the remaining chapters of this thesis. Section 2.1 describes the problem the use-case is trying to solve, Section 2.2 delves into the benefits and digitization of peer support in cancer, and lastly Section 2.3 describes the Recovery Companion use-case in-depth.

2.1 Use-Case Problem

Cancer is among the world's top devastating diseases, causing an immense amount of physical, emotional and economic damage. In 2018, the World Health Organization reported over 18 million new cases of cancer diagnosed across the globe, in addition to 9.5 million deaths [32]. It's also the second largest cause of death in the world, where 70 percent of all cancer-related deaths can be observed in low to middle-income countries [33]. From an economic perspective, the impact of cancer was attributed to over one trillion USD in costs when calculated in 2010 [33].

The statistics are clear about the negative impact cancer has on global health and development. Yet, the problem of cancer goes beyond the quantitative, as it has immense negative psychosocial impact on diagnosed individuals. Psychosocial can be defined as the relationship between a person's intrapersonal psychology and the social environment one is immersed in [34]. In the context of cancer, common psychosocial factors affecting cancer patients include: treatment and post-treatment care, financial and child-care assistance, as well as emotional and spiritual concerns related to the patient and their family or caregiver, among other factors [35].

Consequently, cancer patients are critically underdiagnosed for anxiety and depression, which can drastically influence an individual's recovery outcomes**.** Studies have shown depression rates for individuals with cancer ranging from 4-49 percent [36]. A 2015 study of 3,623 ovarian cancer patients conducted by oncologists in the United Kingdom (UK) discovered 25 percent of the target group suffered from depression pre-treatment, 23 percent during treatment and 13 percent after treatment had finished [37]. In the same study, anxiety levels were shown in 19 percent of the target group pre-treatment, and an increase in anxiety levels to 26 percent during treatment and 27 percent post-treatment [37].

In another survey similarly structured to the one above, researchers interviewed 4,494 patients with prostate cancer, and discovered 17 percent suffered from depression pre-treatment, 14.70 percent during treatment and 18 percent post-treatment [38]. The rates were even higher for anxiety, with 27 percent exhibiting this emotion pre-treatment, 15 percent during and 18 percent post-treatment [38].

For cancer patients exhibiting anxiety and depression, an additional problem is a decrease in adherence to medical treatment [39]. This is critical because non-adherence to treatment exacerbates existing negative side effects, and can contribute to an individual's early mortality [40]. In addition to anxiety and depression, a related psychosocial aspect to cancer patient outcomes is isolation. One study conducted with 2,835 breast cancer patients showed isolation can increase rates in mortality by 66 percent [41].

The ramifications of anxiety and depression on the well-being of cancer patients goes beyond the emotional, as there are direct physical consequences. Individuals who exhibit "distress and psychiatric morbidity", which encompasses anxiety and depression, were shown to negatively impact survival outcomes — meaning there is a direct relationship between the psychosocial wellbeing of cancer patients and their likelihood of surviving [42].

2.2 The Benefits of Peer Support

As exemplified in the previous section, cancer patients suffer from a tremendous amount of psychosocial angst internally and externally. Thus, the need for psychosocial peer support networks is pivotal to cancer treatment and recovery, as multiple studies have shown peer-support networks provide positive efficacy for those diagnosed with cancer [43] [44]. Researchers Pinquart and Duberstein [42] cite two primary reasons for this: individuals with peer support have access to information from other network members about best practices and hospitals, amongst other information, and peer support gives members higher motivation and willingness to engage in treatment.

A cornerstone of peer support is experiential sharing, where individuals who have cancer or are survivors are able to fill in an experiential gap, as opposed to family members, friends and healthcare workers who cannot understand the experiences cancer patients face [44]. Having individuals who can directly relate to the experience of being diagnosed with a life-changing disease is a powerful mechanism for ameliorating some of the psychosocial problems afflicting cancer patients. Accordingly, Boyes et al., notes that for cancer patients "finding someone to talk to who understands and has been through a similar experience is among the top ranked items of unmet needs" [44].

2.2.1 Digitization of Cancer Peer Support Tools

In recent years there has been an explosion of mobile health applications (mHealth) on the marketplace, with over 318,000 offered on the most popular application stores [45]. This market trend has also expanded to cancer-centric mHealth applications, where the ubiquitous nature of smart-phone proliferation has been considered an opportunity to provide accessible and innovative healthcare services, in conjunction with maximizing budget expenditures [46].

A 2019 comprehensive study by Adam et al. [47] analysed 151 mobile cancer applications and concluded the apps have five primary objectives: information sharing, cancer care management strategies, patient and healthcare professional connectivity, coping mechanisms and lastly, patient monitoring and sharing of self-created data [47].Crucially, [47] also discovered multiple applications available in the Apple and Google Play app stores touting "cures" and promotional products, like alkaline water, and charging up to 700USD for "Advanced Packages" promoting a cure for prostate cancer specifically.

According to [47], 45 percent of the applications were developed in the United States and 63 percent focus on "imparting information about cancer" through different mediums of "text, newsfeeds, videos and question and answer" formats about cancer treatment, diagnosis and terminology, as well as the promotion of different dietary and exercise regimens. Around 25 percent of the apps focused on connecting cancer patients together, with a similar percentage applicable to "feedback about cancer management" involving users self-monitoring their symptoms [47].

As shown in [47], the most recent and intensive study this author has come across surveying cancer applications across the global application marketplace. Based upon [47]'s conclusions, the current mHealth cancer application environment can be summarized as follows:

- The marketing language used by a majority of the applications focus on empowerment, taking back control as a patient, as well as metaphorical, warlike language, which can have counterproductive effects.

- Self-monitoring of symptoms and sharing with healthcare professionals facilitated by these applications is generally considered positive, however it may cause an undue burden on the patient.
- The prevalence of scam applications on google and apple app stores mixed with legitimate ones causes confusion and potential loss of trust.

Overall, the cancer application environment is quite diverse in objectives, with a multitude of private and public stakeholders providing input and ownership. It is safe to say a majority of cancer applications have good intentions, with some implementing artificial intelligence to help understand patterns of user symptoms. Yet, there is room for improvement among these applications directly related to the funneling of users to quality of information and connection, while simultaneously integrating user-emotions into functionality. Arguably in this context more than most, emotionality is a central component to making users feel at ease and adopting these kinds of applications.

2.3 Recovery Companion Application

Based upon the aforementioned problems and also from the author's personal experience of observing a loved one with a twice diagnosis of breast cancer, the author is currently a cofounder at a registered start-up company, Recov OÜ, headquartered in Tallinn, Estonia, With the resources at hand, Recov OÜ is developing a prototype application "Recovery Companion" for cancer patients and survivors

The FRs and NFRs for the application are based upon the presuppositions, as well as a stakeholder interview conducted for this thesis with a former cancer patient and current local cancer counsellor who is an official advisor. The requirements will then be assessed by five former cancer patients from the US and Australia using validation criteria. Therefore, the REREFM encapsulates and facilitates these objectives.

The objective of the application is to provide peer-reviewed, validated cancer information and survivor stories created in collaboration with a local cancer counselor and former cancer survivor. The prototype provides a peer-to-peer social network for cancer patients

and survivors based on manual matchmaking for similar diagnosis, treatment and age range to share experiential knowledge amongst each other.

Based upon the framework provided in [47]., the prototype can be categorized as “imparting information about cancer” and “interacting with others”. The objective of the application is to provide psychosocial support tools to improve patient connectivity in a private environment for users to share experience and gain knowledge from trusted sources. These features will be explored in-depth in Chapter 3 through the lens of emotional goal modeling.

3 Emotional Goal Modelling

The following chapter describes the process of constructing RC’s emotional goals through Agent-Oriented Modelling (AOM) and the POSE framework. Using the input of presupposition and an expert interview, a combined hybrid notation of AOM and POSE is put forth for visualizing a meta emotional goal model of RC. Further explanations are provided for the personal and context-specific emotions of RC’s users, as well as the functional and quality goals of the application.

3.1 Introduction

The essence of this chapter is to answer RQ-1: **How to model emotional goals?** RQ-1 is further distilled into three sub-questions:

- **RQ1.1 - What are the emotional goals of Recovery Companion?**
- **RQ1.2 - What are the roles of the goal model?**
- **RQ1.3 - What is the meta-emotional goal model?**

Section 3.2 will provide a contextual overview to Agent-Oriented Modeling (AOM) and its emotional goal augmentation provided by Miller et al. [22]. Section 3.3 will answer RQ1.1 through implementing Miller et al.’s [22] emotional goal modeling framework

which is integrated into Sterling and Taveter's AOM architecture [23]. Section 3.4 will answer RQ1.2 by creating role models through AOM, and RQ1.3 will be answered by combining the previous components into a meta-emotional goal model in section 3.5.

3.2 Agent-Oriented Modelling

Software applications are complex entities with multiple interacting components, users and environments. Traditional software engineering cannot cope with the levels of abstraction needed for interdependent, multi-faceted and collaborative social actors in a software system [48]. In the context of IS, these software systems may be further defined as "sociotechnical systems", where "human, organizational and technical" involvement is intrinsic to the design, functionality, business processes and execution of the software [49].

An increasingly popular methodology to handle this complexity is Agent-Oriented Modelling (AOM). Agent-oriented modelling is an alternative paradigm for software

engineering that utilizes an agent or multi-agents, through different model-oriented protocols and schema geared towards achieving goals [50].

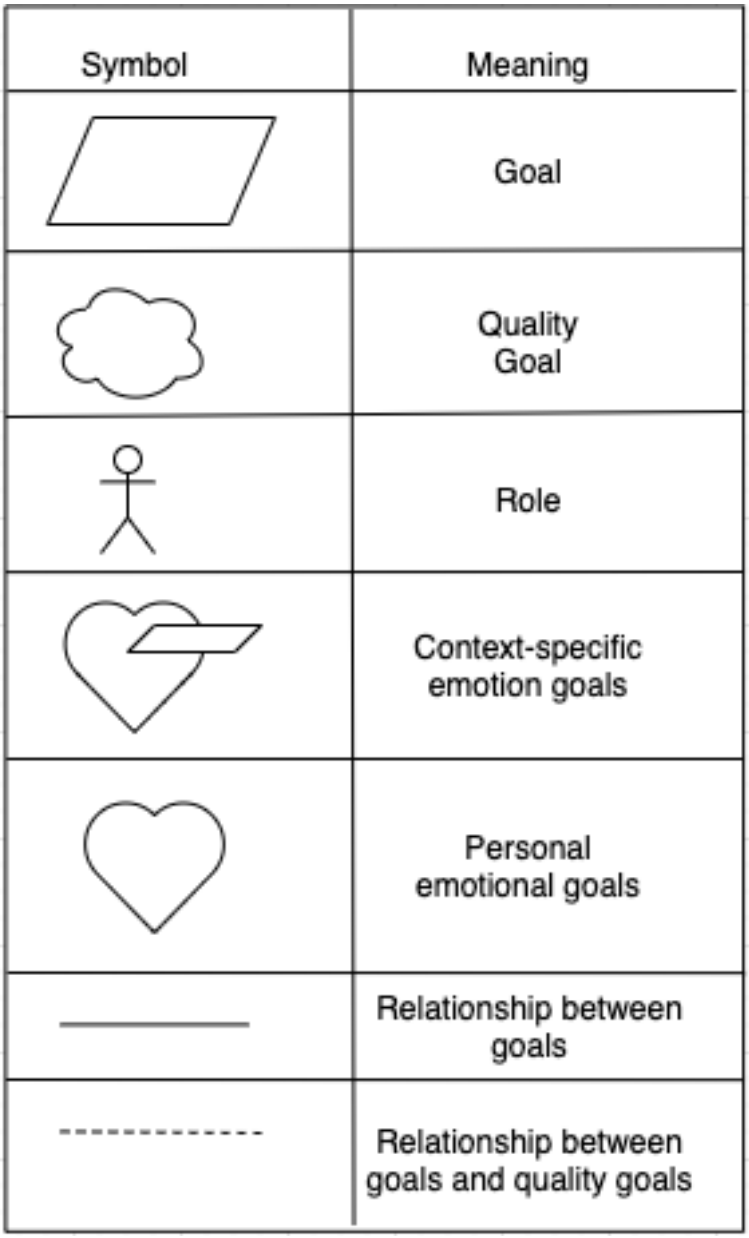


Figure 4 AOM Notation [23] with Emotional Goal Modelling [22]

One of the most common AOM patterns is provided by Sterling and Taveter [23]. Ontologically, Sterling and Taveter [23] provide a strong basis for motivational modelling for capturing FRs and NFRs in the early-stages of software development, which is the current stage Recovery Companion is in. A functional goal represents what the system intends to do, while quality goals are softer, or early stage NFRs, providing a threshold

of quality that should be achieved during the execution of a functional goal [23]. Lastly, roles are synonymous with agents, taking human or computer form, and are defined by "responsibilities" which dictate actions needed to occur for a functional goal to be actualized [23].

Extending the Sterling and Taveter AOM notation to encompass emotional goals is Miller et al.'s POSE framework [22]. As elaborated in chapter 1, POSE classifies emotional goals into two categories: "personal emotions" and "context specific emotions," and integrates them into AOM motivational modelling through the symbols shown in Figure 1.1. Accordingly, "Personal emotions" feelings felt by a user independent of the application's objectives or functional nature, although personal emotions are intrinsic to the individual regardless of the application, they are still related to the system's context, albeit, indirectly [22].

On the other hand, "context specific emotions" incorporate how a user "feels or wants to feel" directly in relation to a system's objectives [22]. There may be overlap and no clear cut distinctions between personal and context-specific emotions in certain cases [22]. It should also be noted that in [22] they do not distinguish between an emotion and a feeling from a psychophysiological perspective, and neither does this author. However, the emotional goal framework is appropriate and applicable for the RC use-case.

3.3 Emotional Goals of RC Prototype

An expert interview was conducted with Recov OÜ's cancer advisor, a former cancer patient and certified cancer counsellor. During the interview, the advisor was asked questions pertaining to his emotional state during his cancer journey, how he envisions the application's functionality meeting emotional needs of cancer patients and how functionality should be developed. Using the results of this interview, coupled with the peer-reviewed context of psychosocial support for cancer patients and survivors provided in Chapter 2, emotionally-goal-integrated FRs and NFRs were established for Recovery Companion. The following section will textually outline the emotional goals in question.

3.3.1 Personal Emotions

1. Beneficent

Beneficence is an important normative concept in medicine and psychological counselling [51]. So much so, that the American Psychological Association has enshrined the principle of beneficence in their code of conduct for general ethical principles [52]. The emotional connotation of beneficence can be summarized as a professional obligation of those involved (physicians, counselors, etc.) to "do good and to prevent harm" [53] in providing healthcare support for cancer patients.

Extending this further, beneficence can be expressed as the "duty to help others further their important and legitimate interests when we can do with minimal risk to ourselves" [53]. By helping others and focusing on the patient's interests, the power dynamics between patient and healthcare worker are asymmetrically inclined toward the patient through *collaboration*, not through the self-interests of the healthcare worker [53]. As Recovery Companion has an integrated psychological counselling component, beneficence is already established as a foundational feeling dictating the interactions between patient and counselor. Thus, counselors want to feel like they are doing good for the patient, and thus, feeling beneficent.

2. Empathy

While being beneficent is pertinent to medical ethics, a fundamental component of Recovery Companion is experiential sharing and thereby, empathizing with others. During the expert interview, a common theme occurred: those who have been through cancer have a desire to share their experience with other cancer patients in order to help them overcome the challenges and tribulations of a diagnosis.

Cancer survivors are in a unique position to empathize with other cancer patients, as they pragmatically and normatively understand the implications a cancer diagnosis has on everyday living [54]. Accordingly, medical literature also supports this anecdotal evidence, as Rini et al.'s [55] study on peer mentoring by survivors asserts "patients like getting experiential information and many former patients enjoy providing it". As

Recovery Companion seeks to enable peer support of this nature, empathy is a personal emotion that cancer survivors generally are predisposed towards, and as such, is integrated into their support contribution before interaction with Recovery Companion.

3.3.2 Context-Specific Emotions

1. Support

A 2013 UK study estimated nearly one in four newly diagnosed cancer patients have insufficient social support in place, when extended to the general UK cancer population, this equals to around 70,000 patients [56]. Terminologically, social isolation can be defined as the inadequacy of recognized social relationships to satisfy the expected social needs of a cancer patient [57]. The feeling of social isolation experienced by cancer patients is extremely detrimental, negatively influencing their health outcomes and mortality rates to the same degree that "smoking, obesity and hypertension" does [57].

In the expert interview, the interviewee expressed a desire for support by finding others going through similar circumstances. Additionally, he would've utilized digital tools to do so if they were presented to him during his diagnosis and treatment. From a statistical perspective, in a study conducted by Boyes et al., 59 percent of cancer patients surveyed either "participated or wanted to participate in peer support" [58]. Consequently, Recovery Companion seeks to counteract this by establishing peer-to-peer connections between cancer patients and facilitate a feeling of support between them, which, generally speaking, most cancer patients logically wish to feel.

2. Hope

Feeling hope is an important emotional goal for cancer patients. In medical literature, the power of hope has been documented as a responsible agent for influencing the overall happiness and survival outcomes of patients [59]. Hope is intrinsically tied to an individual's outlook for the future and is deeply interrelated to "trust and faith" along with motivation [60]. From a connectivity perspective, hope can also be directly influenced by interpersonal relationships with peers [59], and thus Recovery

Companion's facilitation of peer-to-peer connection provides an avenue to cultivate the feeling of hope cancer patients want to experience.

3.4 Role Models of Recovery Companion Prototype

As expressed in section 3.1.1, roles play a vital role in the expression of AOM. Sterling and Taveter [23] define roles as having "some capacity or position that facilitate the system to achieve its goals". Roles express the facilitation by having *responsibilities* delegated to it, which dictate the actions roles are required to take for achieving functional, quality and emotional goals [23]. Indeed, roles in the context of AOM mirror traditional "human organizations" where titles are given to individuals in different departments, who are in charge of different responsibilities for achieving the aims of the organization. Syntactically, verbs are utilized to express the responsibilities of roles.

Crucial towards shaping the execution of these responsibilities are *constraints* [23]. *Constraints* provide the necessary parameters a role must allow for when executing a responsibility [23]. For instance, the role of a police officer has the responsibility of protecting the welfare of citizens, yet is constrained by the legal system which dictates the officer's actions. A more technical example would be the role of a chatbot whose responsibility is to answer the concerns of clients, yet is constrained by the limits of Natural Language Processing. Using the Miller et al. [22] framework, emotional goals are integrated into the following role models:

Role Name:	Cancer Counselor
Description	The role of the counselor for Recovery Companion
Responsibilities	Answer psychosocial questions patients may have. Provide emotional support that benefits the patients. Provide accurate information pertaining to the patient's question. Must answer questions in a timely manner.
Constraints	Must be a licensed counselor specializing in cancer care. To answer questions, counselor must have an interfacing component with the patient via internet connection and chat functionality.
Personal - emotional goal	The counselor wants to feel they are doing good for the patient on a professional level, termed "beneficence".

Figure 5 Cancer Counselor Role Model

In Figure 6, the role of counselor in Recovery Companion is a certified cancer counseling professional who answers the questions and concerns of patients from a psychosocial perspective, in an accurate, beneficial and timely manner. During the expert interview, a key consideration for helping patients was having access to a counselor to field the psychosocial questions in a timely manner. Waiting for test results is an extremely stressful time, and peer-reviewed literature shows that psychotherapeutic counselling can reduce stress, engender greater feelings of hope, as well as positively impact an individual's quality of life and survival outcomes [61] [62] [63].

The constraints imposed on the role relate to the licensing of the counselor as a cancer psychosocial specialist, and from a technological perspective, the counselor must have an ability to interface with the patient through a chat functionality and strong internet connection. As a counseling professional, the feeling of beneficence is already a part of the counselor's duty to the patient, and thus can be classified as a personal emotional goal.

Role Name:	Matchmaker
Description	The role of a matchmaker for Recovery Companion, which is a matchmaking algorithm presented as a chatbot.
Responsibilities	Onboard users by asking basic information. Match companions together based on defined criteria. Present matches to users through a dynamic network.
Constraints	Must only ask predefined questions to users. Uses only predefined criteria for matching individuals together: age-range, diagnosis, treatment and location.

Figure 6 Matchmaker Role Model

In Figure 7, the role of matchmaker is conducted by a lightweight matchmaking algorithm, which takes the form of an interview chatbot. The chatbot is responsible for onboarding Companions by asking pre-defined basic questions about a Companion's diagnosis, treatment, age-range, location and interests. The matchmaker then matches Companions together by presenting individuals who provide similar answers to the previously mentioned criteria.

This responsibility is backed by literature stating that for Australian and Canadian cancer patients "finding someone to talk to who understands and has been through a similar experience" is a top priority, yet also an "unmet need [64]. The constraints for the matchmaker are it can only abide by predefined questions and can only use the criteria captured from the interview to conduct matchmaking. As the matchmaker cannot generate emotional qualities as a stakeholder, they will not be included in the role model.

Role Name:	Companion
Description	The role of a companion for Recovery Companion, who is also a a cancer patient.
Responsibilities	Communicate with other companions by sharing experience and knowledge of their treatment.
Constraints	Must have an internet connection. Must abide by the terms and conditions of Recovery Companion.
Context-specific emotional goals	The companion wants to feel hopeful about his or her situation. The companion wants to feel support from others going through similar circumstances.

Figure 7 Companion Role Model

In Figure 8, the role of Companion is assumed by those who are currently going through cancer. In this context, the is to be communicative with other companions who are going through similar circumstances, as being an active participant will further the bonds between companions. In addition to the expert interviewee who felt a desire to connect with others going through the same cancer, studies suggest that peer support has important utility and positive benefits to those going through cancer [65] [66].

Being able to share experiential knowledge is constrained by having access to an internet connection and by abiding to the terms and conditions of Recovery Companion, which in sum are meant to protect users from hateful, or distressing messaging that may cause harm to others. The emotions generated are highly contextual, where Companions aspire to feel support and hope about their situation. Experiential sharing can produce hope by increasing self-esteem [67]. On the other hand, support takes on an informational character akin to “advice, suggestions and information” about the treatment and diagnosis a fellow Companion is going through [68].

Role Name:	Story Sharer
Description	The role of a Story Sharer for Recovery Companion, who is also a a cancer survivor.
Responsibilities	Communicate with other companions by sharing experience and knowledge of their treatment through authored stories, videos and blog posts. Provide positive support to individuals.
Constraints	Must be willing to share their experience to a public audience.
Personal - emotional goal	The story sharer feels empathetic towards individuals going through cancer as he or she has already experienced the

Figure 8 Story Sharer Role Model

In Figure 9, the role of story sharer is fulfilled by those who have survived cancer. Cancer survivors provide an empowering perspective on the cancer journey, contributing to better psychosocial effects to not only other patients, but to themselves as well when they disseminate their story [69]. This was anecdotally reflected in the expert interview, as the opportunity to share his story and express that there are possibilities to beat the diagnosis and recover a sense of self that cancer strips away was important to the expert. Thus, the responsibilities of the story sharer is to communicate through different content mediums and reinforce positive scenarios for those going through cancer.

The constraints of the story sharer is he or she must be willing to have their story distributed to a public audience, which for some, going through cancer is an extremely private experience and they may not want to share such information to the public at-large. For the personal emotional goal, the feeling of empathy is one survivors inherently feel [65], and thus experience before interacting with Recovery Companion beforehand.

3.5 RC Meta Emotional Goal Model

The following section integrates functional, quality, personal and context-specific emotional goals into a comprehensive meta-emotional goal model for Recovery

Companion. It should be noted that the model makes a more visually explicit relationship between emotional goals and actors compared to the framework expressed in [22].

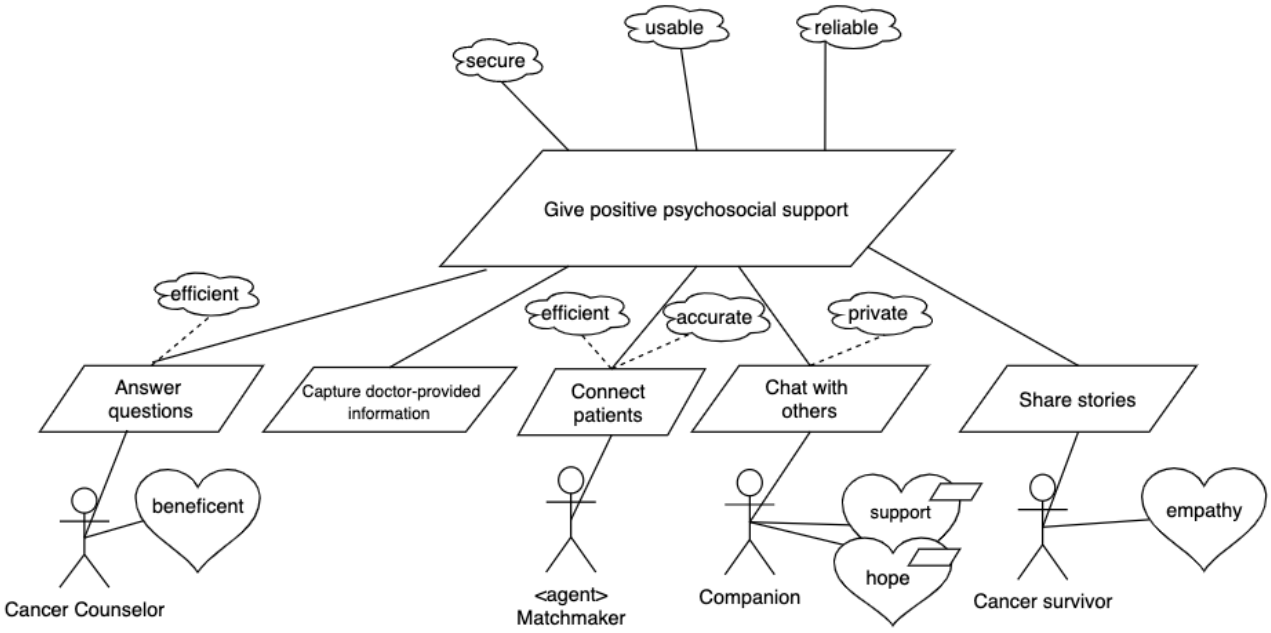


Figure 10 Meta Emotional Goal Model

3.5.1 Give Psychosocial Support

The overarching functional goal for Recovery Companion is to *give psychosocial support* to those going or have gone through cancer. The American Psychological Association defines psychosocial as encapsulating the interrelated and intersectional dynamics of "social, cultural, and environmental variables influencing the mind and behavior" [70]. Thereby, Recovery Companion seeks to provide psychosocial support of a positive nature to those going through cancer, and in particular, the social dynamic of connectedness to others.

The soft non-functional quality goals for *Give psychosocial support* are *security*, *usability* and *reliability*, which are inherited throughout the sub-functional goals. The quality goal *secure* relates to ensuring no unauthorized access occurs on the platform. This is accomplished by limiting access to the platform through a special code received by the patient and survivors through a medical professional and the Recovery Companion team.

According to Lauesen and Younessi [71], Recovery Companion's quality goal, *usability*, encapsulates five different "usability factors" enabling a user to navigate and use an application effectively:

- Ease of learning - The application must be uncomplicated to learn regardless of users' technical experience.
- Task efficiency - The application must be efficient for the user in executing tasks.
- Ease of remembering - The application must easily facilitate remembering for a "casual user".
- Understandability - The objectives of the application must be comprehensible to the user.
- Subjective satisfaction - The application must engender a sense of internal satisfaction for the user.

The quality goal, *reliability*, is a quantifiable metric pertaining to the "probability that the software works without failure for a specified period time" [72]. Recovery Companion seeks to ensure a high probability of the application working without failure over its lifetime.

This section described the functional goal of *Give psychosocial support* which manifests through different sub-functions and their attached emotional goals given in the proceeding sections.

3.5.2 Answer Questions

The functional goal *answer questions* is enabled by an interfacing connection between patients and counselors, where patients can ask questions pertaining to their emotional state and potential treatment questions they may have to the role of *Cancer Counselor*. The quality goal, *efficiency*, dictates that the technical latency between the patient asking a question and the receiving of the question by the counselor should be as low as possible. The cancer counselor feels the personal emotional goal of *beneficence* when executing the functional goal of *answer questions*. This feeling is a moral obligation in healthcare to do good by the patient, ensuring the answers are in the best interest of the patient.

3.5.3 Capture Medical Advice

The functional goal *capture doctor medical advice* enables the user to record doctor-patient appointments. A problem patients face is the inability to process medical information provided by a doctor to them. The prerequisite for such a function is that the medical professional must be informed he or she is being recorded.

3.5.4 Connect Patients

The functional goal of *Connect patients* is allocated to the non-human agent of *Matchmaker*, which conducts an interview with the user as a chatbot, capturing the diagnosis, treatment and a few interests of the cancer patient. Using this criteria, the *Matchmaker* presents similar matches to the user. The quality goal of *efficiency* ensures the onboarding interview and matchmaking process is not frustratingly time-delayed for the user, while the additional quality goal of *accuracy* ensures the matches are accurate based upon the input provided by the user. This mitigates the opportunity for mismatching which can cause confusion and mental distress to users as different stages of different cancers have vastly different experiences.

3.5.5 Chat With Others

The functional goal of *chat with others* is allocated to the role of *Companion,* who are cancer patients. *Chat with others* is instantiated through a communication channel between two matched *Companions*, where experience can be shared between them. The quality goal associated with *chat with others* is *private. Private* utilizes encryption to ensure the channel is not monitored by outside actors, as conversations are sensitive in nature pertaining to emotional and mental health. Consequently, there is a report mechanism integrated into the channel for users to report suspicious behavior or for violating Recovery Companion's terms and conditions.

The context-specific emotions tied to *Companion* are *support* and *hope*. The feeling of *Support* is underpinned by the sharing of information related to treatment and diagnosis, while *hope* directly relates to a positive outlook for the future and having an anchoring partner to share emotional experiences which elicits such a feeling.

3.5.6 Share Stories

The functional goal of *share stories* is assumed by the role *Story Sharer* who are cancer survivors. The survivor stories are shaped through different multimedia formats to the story sharer's preference. The personal-emotional goal of the *Story Sharer* is *empathy*, as survivors share a proclivity for relating to others who are going through cancer by already surviving their diagnosis. Therefore, empathy is already a feeling present in many survivors who want to share their story with others to help them understand that there is a light at the end of the tunnel.

3.6 Conclusion

We have described and ascertained the personal and contextual emotional goals for Recovery Companion. Next, the roles of Recovery Companion have been visualized through role descriptions and modelling of responsibilities, constraints and the emotional goals associated with the role models. Lastly, we have constructed a meta-emotional goal model using the input from the previous sections. For future work, the sub-goal functions of the meta-goal model should be extended to encompass further functional goals related to each sub-goal. This will provide a more comprehensive picture of the application as it is further developed.

4 Remote Emotional Requirement Elicitation Feedback Method

The following chapter outlines the specificities of the REREFM through waterfall process modelling architecture and summarizing each corresponding stage. Multimedia tools are presented and given reasons for the integration into the REREFM based on architecture, logic and capability. The final component of this chapter integrates the multimedia tools into specific stages deemed most applicable, and the process model is updated to reflect these integrations into a holistic method.

4.1 Introduction

This chapter's objective is to answer **RQ2: How to combine multimedia tools for implementing the REREFM?** RQ-2 is further distilled into three sub-questions:

- **RQ2.1 - What is the overarching process model?**
- **RQ2.2 - What are the pre-existing multi-media tools?**
- **RQ2.3 - What are the multimedia tool assignments?**

Section 4.2 will answer RQ2.1 by introducing the Remote Emotional Requirement Elicitation Feedback Method (REREFM) through a process model using waterfall architecture. Section 4.3 will answer RQ2.2 by expounding upon the pre-existing multimedia tools applicable and most appropriate for the REREFM. Lastly, Section 4.3 will assign and integrate the multimedia tools into the REREFM process model.

4.2 The REREFM Process Model

An important aspect to early stage requirements engineering is the elicitation of requirements and capturing user feedback of said requirements [3]. There are many techniques for executing such elicitation and feedback. However, these techniques neglect the emotionality of technology acceptance by users [7], as well as the resource-deprived nature of small organizations [11] and in light of the current pandemic, it is difficult to conduct face-to-face interviews to understand the needs of users on a deeper level.

Thus, bridging the divide between requirement elicitation theory and practice by establishing an effective and cost efficient remote process for capturing user-feedback is extremely relevant in the field of RE. Conceptually, the REREFM is instantiated using a waterfall process model presented in Figure 11.

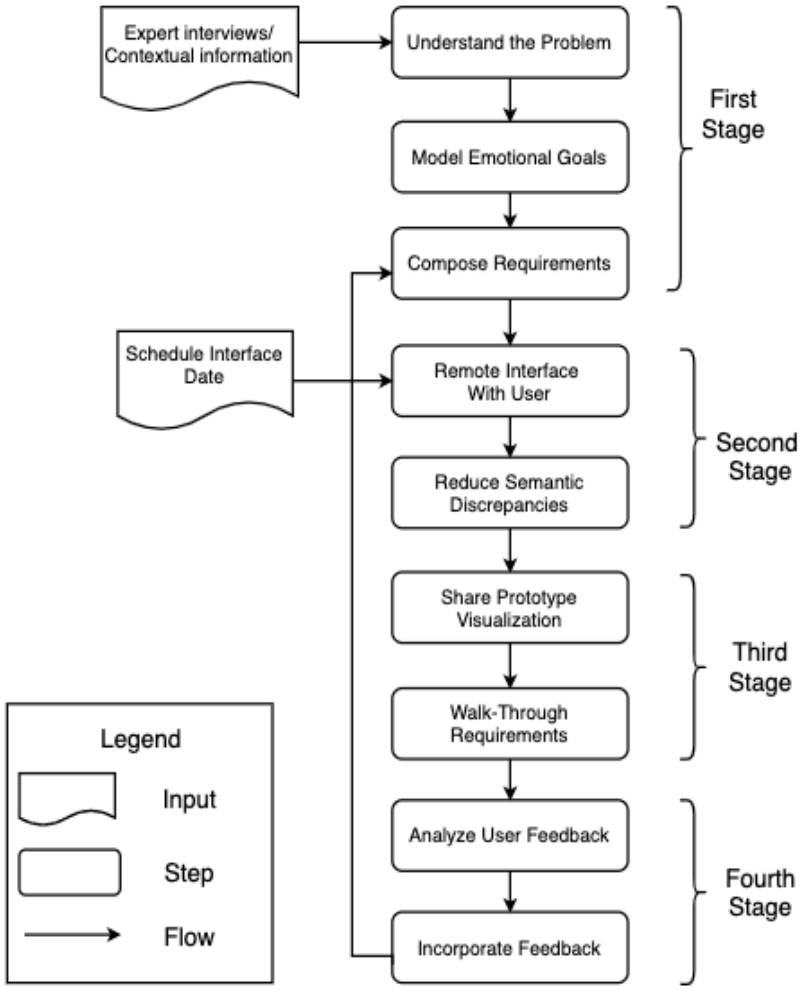


Figure 11 REREFM Process Model

4.2.1 REREFM: First Stage

1. **Understand the Problem:**

   The first step in the first stage of the REREFM is to *Understand the Problem*. Logically, to develop applications that meet the needs of users and stakeholders their problems must be taken into account. This is achieved by integrating the input of expert interviews and contextualized information relevant to the problem.

2. **Model Emotional Goals:**

Having a thorough understanding of the problem enables the next step of the REREFM process to occur, *Model Emotional Goals.* The lack of emotional integration into requirements engineering has thoroughly been established in this research. Through the implementation of AOM, this step seeks to abstractly visualize the goals of functional and non-functional requirements and the emotions present personally and contextually in relation to the application.

3. **Compose Requirements:**

As AOM is a lightweight representation of requirements engineering, formalized documentation may be required for developers. The *Compose Requirements* step provides an avenue to accomplish such a task through varying requirements documentation methods, including agile methodologies such as SCRUM, that do not rely as much on formal documentation but through the use of a product backlog. In sum, this step necessitates requirements composition conducive to an organization's resources or requirement engineering philosophy.

4.2.2 REREFM: Second Stage

4. **Remote Interface With User**

The beginning of the second stage of REREFM focuses on establishing a remote environment to conduct feedback elicitation through *Remote Interface With User*. It is assumed there are users interested in conveying such feedback, and thus the input of scheduling a time with the user occurs in conjunction with the step of remote interfacing. Users should be made aware their contribution is important to the development of the product, and in some cases, compensation may be necessary.

5. **Reduce Semantic Discrepancies**

A major challenge for practitioners when eliciting requirement feedback is the "culture gap or basic semantic differences" [73] that occurs during communication between stakeholders, users and developers when trying to construct technical solutions for solving a problem the target user may have. *Reduce Semantic Discrepancies* addresses this concern. Mitigating semantic discrepancies before the sharing of prototype feature visualizations provides the user with context about the system in question and requirements engineering, reducing potential confusion and leading to more effective feedback elicitation in the proceeding stages.

4.2.3 REREFM: Third Stage

6. **Share Prototype Visualization**

After a remote connection has been established and semantic discrepancies have been reduced, the step *Share Prototype Visualization* occurs. This is a logical step that must occur before any form of engagement can be initiated. Sharing the visualization may occur through screen-sharing and a confirmation that the user can see the prototype on his or her screen is necessary. In sum, this step enables the user to visualize the prototype and proceed through the *walk-through of requirements*.

7. **Walk-Through of Requirements**

The practitioner conducts a *walk-through of requirements* via the execution of the preceding step, *share prototype visualization*. Walking through visualized requirements gives the user an opportunity to share opinions and give an experiential perspective to the practitioner he or she would not have otherwise. Additionally, a walk-through establishes an environment for users to understand the functional and quality goals of the front-end prototype, with emotionality integrated into the context. This step requires clear and concise communication between the practitioner and the user, implementing semi-structured interview techniques.

4.2.4 REREFM: Fourth Stage

8. Analyze User-Feedback

The first step of the fourth stage, *Analyze User-Feedback,* centers around aggregating and dissecting the user-feedback generated from the third stage. A prominent technique for conducting feedback analysis is transcribing the walk-through interview and applying a thematic analysis to identify recurring patterns, vocabulary, ideas etc. from the user. Thereby, this thematic technique understands the concerns, comments and suggestions of the user in a structured way.

9. Incorporate Feedback

Through the ascertainment of user-feedback in the previous step, the last step of the REREFM is *incorporate feedback* into the third step, *compose requirements*. The incorporation of feedback relies on communicating the analytical output of the walk-through to stakeholders and the development responsible for requirement documentation. Based upon this communication, feedback can be incorporated into the requirements documentation, capturing the needs and wants of users and closing the feedback loop and enabling another cycle to occur.

4.3 Pre-Existing Multimedia Tools

Integral to the execution of REREFM are pre-existing, low-cost multimedia tools. Multimedia tools are defined by the "interactive presentation" of varying visual, audio and sensory output [74]. The REREFM is purposefully technology agnostic, where different multimedia tools can be incorporated based upon an organization's resources. For the purposes of this research, pragmatism and feasibility are the primary drivers for adoption. However, an understanding of the specifications and utility of each implemented multimedia tool provides a cohesive context for their assignment in the REREFM process model presented in Section 4.3.

4.3.1 Open Broadcaster Software

Description: Open Broadcaster Software (OBS) is a "free and open source software for video recording and live streaming" available for Windows 7 and later versions, macOS 10.11 and later versions, as well as the Linux operating system [75]. The programming languages used for OBS are C and C++, and the Qt widget toolkit is implemented for OBS's graphical user interface. OBS is primarily a software suite for live-streaming gaming content through the Real Time Messaging Protocol via Youtube, Facebook and Twitch, and encodes video via the x264 open-source video encoding library [76]. However, a key feature of OBS is it facilitates the recording and saving of an unlimited amount of videos directly to a specified folder on a personal computer.

Reasoning for REREFM Adoption: According to TechRadar, a top 600 website in the world [77] with over 73 million readers per month in 2018 [78], OBS is rated as the number one screen recorder application for 2020 [79]. As a free and open source solution, OBS is ideal for small organizations looking to produce video content, in addition to high-resolution screen recording. From a financial perspective, OBS does not require a subscription or payment [75], giving users unfettered access to OBS's recording and streaming services. Thus, the high-resolution screen recording functionality mixed with OBS's unlimited screen-recording capacity make it an ideal tool for REREFM adoption.

4.3.2 YouTube

Description: YouTube is the largest online video platform in the world, with 2 billion monthly unique users recorded in 2019 [80]. Fundamental to YouTube is the ability for users to upload, watch, comment, share and be recommended videos for Google Chrome, Firefox, MS Edge, Safari and Opera browsers [81]. However, in order to "upload videos, comment or make playlists" a user must create a channel to establish a "public presence" [82]. Relating to the REREFM, optimal video specifications for upload encoding settings is MP4 format (standard, HD, Ultra HD, 4K quality) [83]. Additionally, upload optimality stipulates that videos "should be encoded and uploaded in the same frame rate it was recorded" [83].

Reasoning for REREFM Adoption : As exemplified by the above statistic, YouTube is a well-known brand, providing a free platform to upload videos and communicate with

others in a simplified way through channel establishment. As uploading is free and creating a channel is streamlined through having a previous google account, the adoption of YouTube to disseminate video content is a logical one compared to other video platforms.

4.3.3 Figma

Description: Figma is a code-free, browser-based visualization tool for creating interactive prototypes for web and mobile user-interfaces. As of 2019, Figma offers over 40 different plug-ins, widening prototype capability and capacity [84]. For potential users, the Figma prototyping environment allows for observable "research sessions" conducted via proxy through the internet.

Reasoning for REREFM Adoption: A key differentiator of Figma compared to other visualization alternatives is the ability for team collaboration and the ability to share clickable prototype designs through a single URL. For instance, this enables the possibility for conducting requirements walk-through with the user by browser instead of deployment through an app store. Ultimately, Figma's free "Starter" level prototype visualization package suffices, enabling a requirement walk-through to occur through web-based interfacing between practitioner and user for low cost.

4.3.4 Google Meet

Description: As a part of Google's G Suite package, Google Meet is a real-time virtual meeting platform that enables encrypted video conferencing on Microsoft Windows, Apple macOS, Chrome OS and Ubuntu/Linux based operating systems, and is compatible with Chrome, Mozilla Firefox, Microsoft Edge and Apple Safari web browsers [85]. Accordingly, obtaining a G Suite account is a precondition for using Google Meet. Upon creating and verifying an account, the user assumes the role of administrator and can control meeting room accessibility. The user invites participants to the video conference through sending a pre-structured link without requiring invited participants to have a G Suite account.

Reasoning for REREFM Adoption: In light of the current CoVid-19 pandemic, video conferencing solutions have risen in prominence as teams move to remote working conditions. Consequently, there has been increased scrutiny on the security protocols of different video conferencing platforms. For instance, an alternative video conferencing platform, Zoom, was found to have misleading information in regards to their encryption regime being end-to-end [86]. The security standards are more transparent and limit access to meeting rooms through the role of an administrator. In sum, Google Meet is a frictionless solution between practitioner and participant, as it does not require any sign-up process from the interviewee.

4.4 Multimedia Tool Assignments

Based upon the multimedia tools described and adopted in Section 4.2, they are assigned to different stages in the REREFM waterfall process model in Figure 4.2. Further explanation for each assignment will be presented in the following sections.

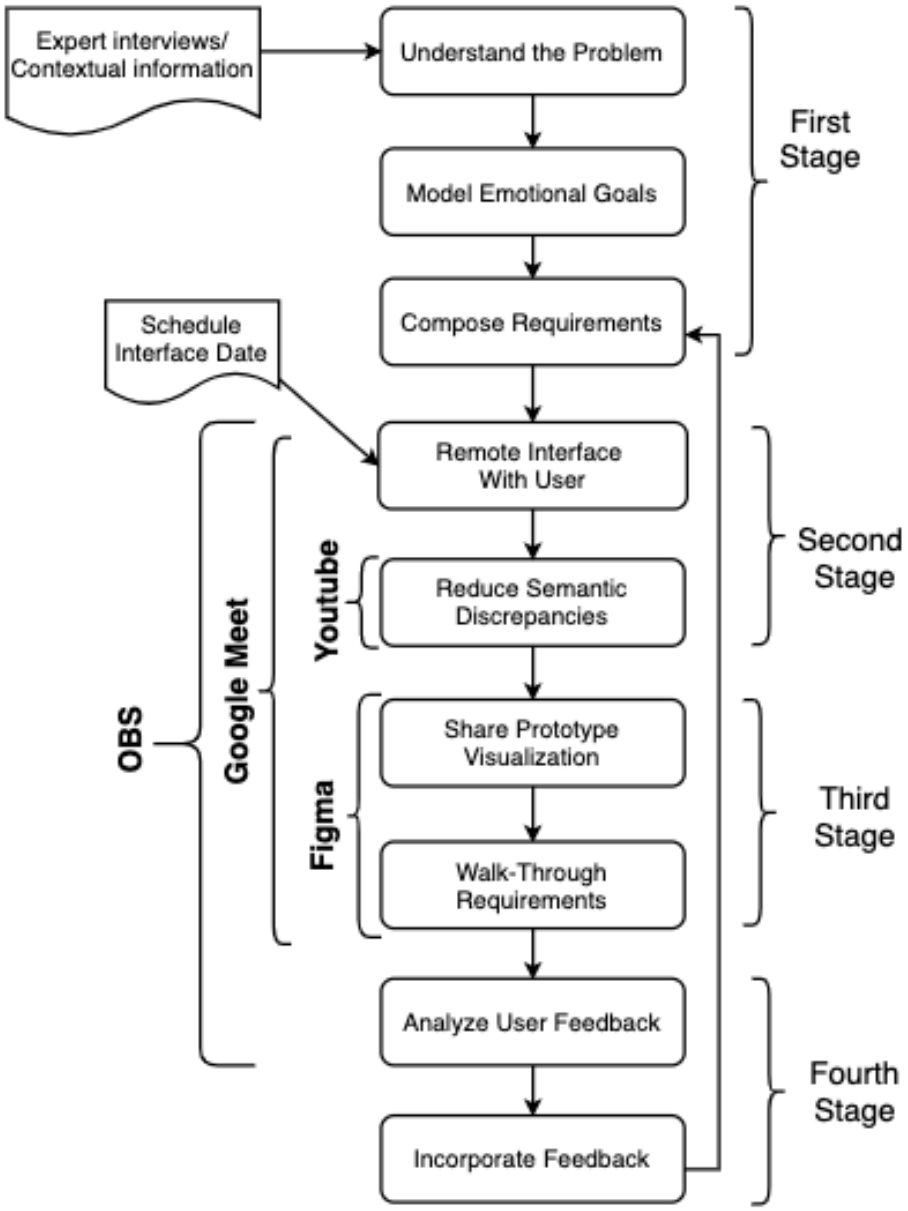


Figure 12 Multimedia Tool Assignments

4.4.1 OBS Assignment

In terms of operational time, OBS has the longest assignment as it encompasses the second and third stages in totality, and the first step in the fourth stage. In the REREFM, Screen-sharing is initiated through OBS before the step, *Remote Interface With User*. This ensures OBS is capturing the practitioner's screen without the need to interrupt the interviewee when proceeding with the second and third stage. Consequently, OBS is continuously running in the background, but is not a component concerning the

interviewee directly. However, if there is an interruption in OBS's operation, it could hamper the overall capturing of feedback.

OBS's criticality is most apparent during the first step of the fourth stage, *analyze user feedback.* By screen recording the entire *requirement walk-through* step, user feedback can be extracted, transcribed and analysed using the local video file saved by OBS. Without the OBS component, analysis would have to occur in real-time, which is unfeasible in a peer-to-peer interview setting. This takes the stress out of capturing the feedback instantaneously, and allows for future communication of requirements feedback with the development team, who is in charge of composition.

4.4.2 Google Meet Assignment

Google Meet's assignment is to the second and third stage of the REREFM. In the second stage, Google Meet enables the practitioner to execute the first step, *Remote Interface With User* by sending a pre-structured invitation link to the interviewee via email, Facebook instant messaging, or other digital communication mediums. After the interviewee accepts the invitation, he or she can only access the video conference when the practitioner allows them to do so.

Once permission is granted, the remote interfacing is established and the practitioner implements tactics for the second step, *Reduce Semantic Discrepancies*. To satisfy this step for this research, Google Meet's chat functionality is utilized by sharing a YouTube video link.

After the second stage's conclusion, the third stage is initialized through Google Meet's screen sharing functionality. Screen sharing allows for the *Share Prototype Visualization* to be viewed on the interviewee's screen while simultaneously being controlled by the practitioner. The practitioner then proceeds with the next step, *Walk-Through Requirements* using the Google Meet screen sharing environment. It should be noted that integral to this assignment's success is both the practitioner and interviewee's internet connection and access to a functioning internal or external webcam.

4.4.3 YouTube Assignment

As summarized in Section 4.1.1 The “culture gap and basic semantic differences” [73] between stakeholders, users and developers is a critical roadblock for successful requirements elicitation. In the REREFM, there is a strong need to invoke synergy between practitioner and interviewee, where the context of the prototype, as well as a general understanding of requirements engineering is established for the interviewee in a dynamic way. Thus, a YouTube video explaining Recovery Companion’s objectives and a lightweight explanation of requirements engineering is assigned to this step to reduce any semantic discrepancies that may occur.

4.4.4 Figma Assignment

The critical objective of eliciting requirements feedback in the REREFM is captured by conducting a requirements walk-through. Therefore, the prototype visualization software, Figma, is assigned to the third stage where this objective is addressed. Figma’s ability to be easily shared through a browser and visualize the prototype’s features make it an ideal multimedia tool to be assigned at this stage.

4.5 Conclusion

In this chapter, the technology agnostic REREFM was elucidated through a four stage, nine-step looping waterfall process model with corresponding step descriptions. Next, applicable multimedia tools were summarized and reasoned for REREFM adoption. Then the multimedia tools were optimally assigned into the REREFM process model, corresponding to their functionality and architecture.

For future work, the integration of APIs for different multimedia tool stacks chosen in conjunction with an organization’s resource capacity provides an interesting research opportunity in the field of requirements elicitation and feedback. The potential result could be an all-in-one application for conducting remote video interviews, eliciting feedback and having instant analytical capacity for this feedback to be integrated into requirement documentation.

5 Utility Evaluation Using DSR Methods

This chapter contains an overview of different DSR evaluation methods and their specific features, framing the introduction of a utility tree used to visualize the REREFM's specific attributes that will be assessed. Then a holistic analysis will take place determining which DSR evaluation methods and strategies will be applied for evaluating the REREFM.

5.1 Introduction

This chapter's objective is to answer **RQ3: How to evaluate REREFM utility?** RQ-3 is further divided into three sub-questions:

- **RQ3.1 - What are the design science research (DSR) evaluation methods and their specific features?**
- **RQ3.2 - What is the utility tree for the REREFM?**
- **RQ3.3 - What are the best combined DSR evaluation methods applicable for the REREFM utility tree?**

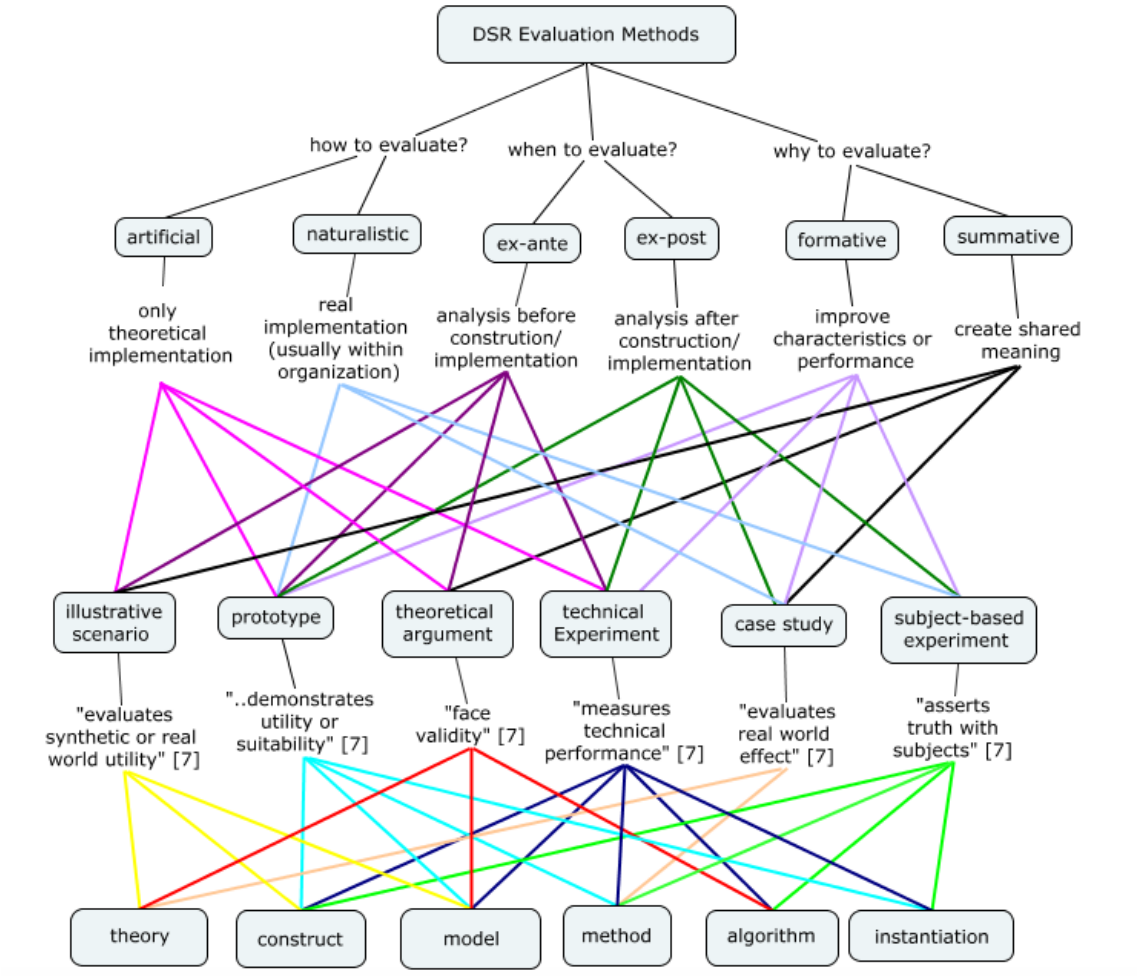
Section 5.2 answers RQ3.1 by concept mapping varying Design Science Research (DSR) evaluation methods into a taxonomy visualization. Section 5.3 answers RQ3.2 by creating a utility tree for the REREFM. Lastly, Section 5.4 expresses the best chosen combination of DSR evaluation methods applicable for the REREFM utility tree via textualizing a table summary.

5.2 DSR Evaluation Methods

Integral to DSR as a viable research methodology is the evaluation of artifacts [29]. [29] categorizes artifacts into "constructs, models, methods, or instantiations". Although it is widely recognized in DSR literature that evaluation is a significant aspect to the DSR paradigm, there is no consensus on a systematic approach [87] [88] [89]. Consequently, many DSR researchers have proposed evaluation criteria and methods for artifacts, but they are incohesive and "fragmented" [88]. Therefore, surveying different DSR artifact

evaluation methods into a holistic structure is apropos for formulating a cohesive combination of evaluation methods to evaluate the REREFM artifact.

To achieve this objective, a three-layered DSR evaluation taxonomy is shown in Figure 5.1 through “Cmap” [90], a software tool created by the Florida Institute for Human & Machine Cognition. Cmap is regarded as “an effective means of representing and communicating knowledge” [91] and enables the taxonomical mapping of hierarchical relationships via linked phrases, termed propositions, with general concepts at the top and more specific ones at the bottom.



5.2.1 Top Taxonomy Level

At the top of the taxonomy are three questions recognized in DSR literature as fundamental premises for understanding evaluation methods: how, when and why to evaluate? [87] [88] [89]. Despite the incoherence of DSR evaluation methods, concept

mapping reveals six high-level concepts that answer these questions. The first question pertains to the nature (the how) of executing an evaluation in DSR, and is shaped by two different frameworks: artificial vs naturalistic [92]. In the artificial evaluation framework, evaluating an artifact is always conducted in a "contrived and non-realistic way" [92] from a disproportionately positivist perspective [92], and primarily concerned with the testing of design hypotheses [92]. Hence, when deploying an artificial evaluation to an artifact, the results pertaining to a real organizational setting is negligible. Yet the ability to "control potential confounding variables" [93] makes artificial evaluation particularly adept to laboratory settings.

On the other hand, naturalistic evaluation can be viewed through Sun and Kantor's [94] "three realities paradigm", where evaluation of a technological solution occurs through "real tasks" achieved by "real users" in a "real environment" (organization). A byproduct of this interaction with real situations is a more rigorous evaluation framework compared to an artificial one [89]. However, the tradeoff is more resource and financially intensive to implement [89]. Naturalistic evaluation is inherently empirical and typically a social endeavor, where the capture of individuals' opinions and perspectives can be used to assess the efficacy of a technological solution.

The second question of when to evaluate an artifact is answered by the dichotomy: *ex-ante* and *ex-post.* The *ex-ante* evaluation paradigm relies on pre-determining the efficacy of a technology or technologies for organizational adoption without implementation in a live environment [93]. *Ex-ante* is primarily concerned with analyzing the financial ramifications of adopting a technology [93]. On the most basic level, this analysis occurs through a cost-benefit analysis and rises in complexity when more criteria, such as "balanced scorecards" [93] for instance, are integrated into the analysis,

Contrarily, *ex post* evaluates an artifact after its instantiation or implementation in a live environment, or events that have occurred in the past [88]. Yang and Padmanabahn [95] distinguish *ex-post* evaluation methodologies using two distinct classifications for live environments: automatic and human quality measures, where automatic utilizes quantifiable data post technology implementation for generating analysis, and human relies on analyzing the aggregation of individuals' subjective opinions after they use a technology or system.

In sum, *ex-ante* and *ex-post* evaluation are defined by their timing. *Ex-ante* focuses on the preliminary aspects of technology adoption, primarily concerned with financial tradeoffs and organizational metrics to make an adoption decision, and *ex-post* is concerned with a system or technology's effect on human, non-human, live or historical environment post-implementation.

The last question of why to evaluate is dictated by two different, but sometimes intersectional, general evaluative concepts: formative and summative. According to [89] formative evaluations "produce empirically based interpretations that provide a basis for successful action in improving the characteristics or performances of the evaluand". Summative evaluations are "used to produce empirically based interpretations that provide a basis for creating shared meanings about the evaluand in the face of different contexts" [89].

5.2.2 Middle Taxonomy Level

The middle taxonomy level focuses on six different method types for executing an evaluation, which conform to certain characteristics inherited from the top level based on compatibility. Table 1 defines these method types using [31]'s definitions and integrates [96]'s research of compatible high-level evaluation characteristics for greater clarity.

Table 1 DSR Evaluation Method Types

Evaluation Type	**Definition [31]**	**High-level Attributes [96]**
Illustrative Scenario	"Application of an artifact to a synthetic or real-world situation aimed at illustrating suitability or utility of the artifact"	Artificial Ex-ante Formative
Prototype	"Implementation of an artifact aimed at demonstrating the utility or suitability of the artifact"	Artificial or Naturalistic Ex-post Formative or Summative

Logical Argument	"An argument with face validity"	Artificial Ex-ante Formative
Technical Experiment	"A performance evaluation of an algorithm implementation using real-world data, synthetic data, or no data, designed to evaluate the technical performance, rather than its performance in relation to the real world"	Artificial Ex-ante Formative or Summative
Case Study	"Application of an artifact to a real-world situation, evaluating its effect on the real-world situation"	Naturalistic Ex-post Summative
Subject-based Experiment	"A test involving subjects to evaluate whether an assertion is true"	Artificial Ex-ante Summative

5.2.3 Lower Taxonomy Level

The building and evaluating of artifacts is the central focus of DSR. As mentioned previously in this section, artifacts consist of "constructs, models, methods, or instantiations" [29]. For the taxonomy's purposes, the most common and modern DSR artifact have been included based upon [31]'s research, which also includes algorithm as a type. Based on DSR literature, certain artifacts are more. Table 2 uses [31] to define the artifacts and assesses the evaluation method types in the middle level of the taxonomy.

Table 2 DSR Artifact Types

Artifact	**Definition [31]**	**Method Type Compatibility [31] [96]**
Algorithm	"An approach, method, or process described largely by a set of formal logical instructions."	Illustrative Scenario Logical Argument Technical Experiment, , Subject-Based Experiment
Construct	"Concept, assertion, or syntax that has been constructed from a set of statements, assertions, or other concepts."	Illustrative Scenario, Logical argument,

		Technical Experiment, Subject-Based Experiment,
Instantiation	"The structure and organization of a system's hardware or system software or part thereof."	Illustrative Scenario Prototype, Technical Experiment, Subject-Based Experiment,
Method	"Actionable instructions that are conceptual (not algorithmic)."	Prototype, Technical Experiment, Subject-Based Experiment Illustrative Scenario, Case Study
Model	"Simplified representation of reality documented using a formal notation or language."	Prototype, Logical Argument, Technical Experiment, Illustrative Scenario,

Reasonings will be provided for table 5.3. However, for conciseness purposes, the artifacts will be assessed based on their *non-compatible* associated evaluation type.

Algorithm: algorithms cannot be compatible with case-studies or prototypes because they do not pertain to organizational or human impact. Furthermore, algorithmic artifacts are disproportionately evaluated using technical experiments in Computer Science literature and much less so in Information Science [31].

Constructs: constructs are also not compatible with case studies or prototypes, as they represent the lowest impact level of artifacts, and as such, are highly conceptual in nature. Experimental approaches and low-level assertions, simulations and logical arguments are conducive to constructs because of their dissociation from live environments [96]

Instantiation: Instantiations are not compatible with logical argument or case study evaluation types because on one hand, they have more validity and rigor than a logical argument, but on the other, they do not relate directly to the impact on an organization, but rather reflect the efficacy of a system or technology as a standalone entity.

Method: A method has a wide array of evaluation method types at its disposable, and centers around actionability. Thus, logical arguments are not compatible with methods because they are non-actionable in nature.

Model: Similar to method, models encompass a wide variety of evaluation methods, however they lack direct organizational impact and are not compatible with case studies. Additionally, models do not have connection to subject-based experiments because they are conceptually-based.

This section provided a taxonomical structure for different DSR evaluation concepts, methods and types. By organizing the evaluation components in such a way, the REREFM's utility can be assessed. The following section provides a visualization of these utility attributes provided by the REREFM.

5.3 Utility Tree

In Information Science, a utility tree is a flexible, heuristic visual model for expressing the utilitarian attributes of an application, software, etc. in a cohesive manner, generally through FR and NFRs [97]. In the DSR paradigm, *utility* is existential for understanding whether an artifact solves the problem(s) it intends to address [29]. Extending this further, [29] proposes two foundational questions for DSR: "what utility does the new artifact provide?" and "what demonstrates that utility?". An artifact provides a vehicle for expressing utility, and different evaluation method types establish whether utility is achieved.

Although the REREFM is not coded software or an application, and therefore lacks traditional FR or NFRs from a strictly IS perspective, it nevertheless takes on quality attributes that mirror NFRs. Without these quality attributes, an assessment of the REREFM's utility for capturing remote user-feedback on the Recovery Companion prototype would be unattainable. Figure 5.1 expresses the utility tree of the REREFM through quality attribute leaves connected to the utility primary root. The proceeding section will provide further description of these quality attribute leaves.

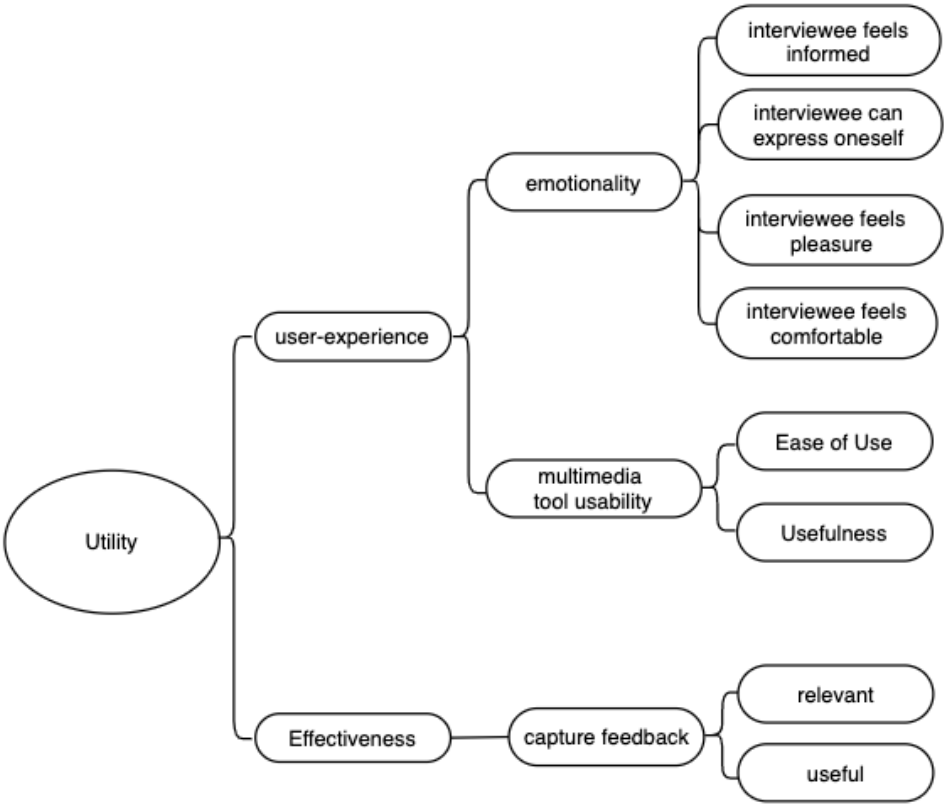


Figure 1 REREFM Utility Tree

5.3.1 User-Experience

Although there are different frameworks for defining user-experience (UX), an elemental definition produced by Nurka et al. [98] is "user experience refers to the experience a person gets when he/she interacts with a product in particular conditions". For the context of this research, the definition can be refactored: "user experience refers to the experience *the interviewee* gets when he/she interacts with *the REREFM* in particular conditions". UX is informed by the emotions of the user, and in this case, the interviewee.

Emotions dictate the experience a person undergoes when interacting with the second and third stage of the REREFM which has embedded technological products for facilitating the interview. Furthermore, as seen in Chapter One's state of the art, emotionality is intrinsic to the appraisal of not only technology, but situations and environments.

When it comes to interviewer-interviewee relationships, the perspective of the interviewee is often neglected [99]. As a result, the quality attributes of UX take on

massive importance for the utility of REREFM, as the method relies on communication between the practitioner and the interviewee who interacts with different multimedia tools engineered to garner feedback.

With Recovery Companion having high emotional context with its association with psychosocial support for cancer, the interviewee's feelings must be taken into account and nurtured in order for the REREFM to have utility as a feedback mechanism. This means the different multimedia tools the interviewee interacts with must have high usability, which is distinguished by whether the tools are easy to use and if they are useful to the interviewee.

On the other side of the second level of the utility tree is effectiveness. Effectiveness connects directly to the primary organizational purpose of implementing the REREFM: capture feedback.

5.3.2 User-Experience: Feel Informed

A critical emotional aspect the REREFM seeks to engender is to make the interviewee "feel informed" about the Recovery Companion prototype and requirements engineering. Feeling informed specifically addresses the "semantic gap" described in Chapter 4 as a problem between practitioners, stakeholders and users. In layman's terms, one could describe this as everyone getting on the same page by providing context and eliminating semantic discrepancies.

To achieve this, a short YouTube explaining the general concept of Recovery Companion as well as a lightweight description of requirements engineering is provided to the interviewee, occurring in the second part of the second stage in the REREFM after interfacing has been established. The user should feel informed after watching this video, providing a seamless transition into the requirements walk-through.

5.3.3 User-Experience: Feel Expressive

Integral to the instantiation of the REREFM for Recovery Companion is the ability for interviewees to express their opinions and elicit feedback to the prototype. A definition

of this concept is self-expression. Being able to express oneself is important in the field of technology adoption, as it enables emotional attachment to occur for services, or in this case, Recovery Companion, which thereby gives the user motivation to provide feedback.

Of course it is the job of the interviewer to elicit and guide this self-expression, but without the interfacing and prototype sharing technological components, the interviewer will have no framework in which to enable an interviewee's self-expression. Logically, if an interviewee does not feel like they were able to express themselves openly and honestly, the requirements feedback elicited will not be as satisfactory as it potentially could be. Thus, the multimedia tools enable self-expression to occur, while the interviewer steers self-expression into constructive feedback.

5.3.4 User-Experience: Feel Pleasure

Per the Oxford English Dictionary, pleasure is "the condition of consciousness or sensation by the enjoyment or anticipation of what is felt or viewed as good or desirable; enjoyment, delight, gratification" [100]. In the context of products, Jordan [101] identifies the manifestation of pleasure via three categories: emotion, hedonic, and practicality. Additionally, Chang and Wu [102] note that the interaction between an individual and a product or service can trigger the feeling of pleasure.

Applying Jordan's [101] framework , measuring pleasure is conducted when the interviewee assesses the Recovery Companion prototype visually and verbally, triggering emotional, hedonic and practical feedback during the requirements walk-through in the third stage of the REREFM. Producing pleasure for the interviewee will be seen as a positive sign for Recovery Companion's functional requirements, with negative pleasurable feedback creating a constructive environment for beneficial changes.

5.3.5 User-Experience: Feeling Comfortable

The emotion of feeling comfortable for the interviewee is important for bringing the best possible evaluation environment possible for the prototype. If the interviewee does not feel comfortable during the interview, they may not be as expressive.

This captures whether the interview environment is potentially influenced by technological anxiety when interacting with the multimedia tools, as well as the interviewer's skill in making the interviewee feel comfortable discussing highly personal information in regards to cancer treatment. It should be noted this utility factor is the most abstract, and grounded by practicality as opposed to a strictly theoretical basis.

5.3.6 Usability: Ease of Use and Usefulness

Usability is a byproduct of user-experience and encapsulates both perceived usefulness and perceived ease of use of the multimedia tools integrated into the REREFM. Both factors are instrumental for whether a user adopts a technology [103]. Davis defines perceived usefulness as "the degree to which a person believes that using a system would enhance his or her job performance" [103]. To understand this definition in the context of the interviewee, it is their job to provide feedback to the prototype, and the multimedia tools provide a medium to do so. Thereby, understanding the perceived usefulness of the tools will establish their validity for use in the applicable stages of the REREFM.

Additionally, Davis defines perceived ease of use as the "degree to which a person believes using a particular system would be free from effort" [103]. Perceived ease of use of the multimedia tools is highly important to the overall efficacy of the requirements feedback. From a practical perspective, if the multimedia tools require heavy exertion for an interviewee to use and comprehend the less likely they will feel comfortable during the interview, potentially inhibiting feedback and derailing the REREFM's most important objective: capturing feedback.

5.3.7 Capture Feedback: Relevant and Useful

From an organizational perspective, the main utility of the REREFM is the capturing of feedback from the interviewees, so the feedback can be incorporated into requirement improvements for Recovery Companion which is being developed by Recov OÜ. Capture feedback is composed of two factors: relevance and usefulness. Relevant asks the question if the feedback is pertinent to the prototype's functionality. For instance, if the prototype feedback is about how the interviewee disproves of talking to people in general, then it will not have relevance to the prototype's functionality, only their emotional disposition to disliking people.

The second component to capturing the feedback is its usefulness. Usefulness can be measured as to whether the feedback directly impacts or reinforces the requirement documentation. This decision occurs in the fourth stage of the REREFM through analyzing and incorporating feedback captured during the requirements walk-through. Ultimately, feedback usefulness is decided by the leadership in the organization who is in charge of product management. However, in smaller organizations, like Recov OÜ, it is a more top-heavy decision stemming from the CEO.

5.4 Selected Combination of DSR Evaluation Features

Because evaluation is vital to the legitimacy of DSR, the composition of a comprehensive argument for the chosen evaluation method and strategy is necessary. Based upon the previous two sections, Table 5.3 summarizes the chosen DSR REREFM evaluation method; its inherited qualities; the implementation of the evaluation method; the artifact itself; implemented interview methodology, and the evaluation criteria used to assess the REREFM.

Table 3 DSR Evaluation Methods Selected

High-level Qualities	Naturalistic, Ex-post, and Summative
DSR Evaluation Method Type	Case Study
Case Study Implementation	1. Expert interview (emotional goals) 2. Requirements walk-through with users 3. Post walk-through Likert survey 4. Recov OÜ CEO feedback analysis 5. Recov OÜ CEO Likert Survey 6. Likert Survey Results 7. Thematic analysis of interview transcripts
Artifact	Method
Interview Methodology	Semi-Structured
Evaluation Criteria	User-Experience and Effectiveness

5.4.1 Naturalistic, Ex-post and Summative

In conjunction with the presuppositions in Chapter 2, the REREFM will enable users to evaluate the Recovery Companion prototype via individuals who have gone through cancer previously. As Recovery Companion is a prototype developed by the organization Recov OÜ and being evaluated by real people, the trifecta of “real tasks” with “real users” in a “real environment" is satisfied. This inherently leads to the application of naturalistic as a high-level quality for evaluation. Ex-post is applicable for when to evaluate the REREFM, as assessment of utility will occur after implementation. This assessment occurs summatively, where the overall picture of REREFM’s utility is captured and analysed, as opposed to iterative approaches used in formative assessments.

5.4.2 Case Study

The characteristics of a case study are ideal for evaluating the REREFM as it is “an empirical method aimed at investigating contemporary phenomena in their context” [104]. Zelkowitz and Wallace classify case studies as an “observational method” [105]. Case studies do not focus on causality, rather they focus on probing deeply into observable events to generate a better understanding of the phenomena in question [106].

Although case studies may contain quantitative rigor of analytical and controlled studies, the complexities of human emotion and thought go beyond numbers, and a qualitative approach captures this complexity thoroughly. Specific to the context of DSR, a case study is the "application of an artifact to a real-world situation, evaluating its effect on the real-world situation" [31]. Indeed, the REREFM deals greatly with the real world by having real users interact with the method, real tasks are given to the interviewer and interviewees, and the method is conducted in a real environment for the purposes of the real organization, Recov OÜ.

5.4.3 Case Study Implementation

The case study in this thesis is implemented in five sequential parts. The first part is conducting an expert interview to elicit the emotional goals of Recovery Companion which occurred in Chapter 3. The second is implementing the second and third stages of the REREFM using the Recovery Companion Prototype as a use case. This occurs through in-depth interviews with five individuals from the United States and Australia who have gone through cancer.

The third action evaluates the second and third stage of the REREFM with the above users through a five point Likert scale for assessing the artifact's user-experience described in Section 5.2. The fourth part utilizes a similar approach of conducting a semi-structured interview with the CEO of Recov OÜ. To provide further analytical insight to this qualitative research, a thematic analysis will be applied.

Thematic analysis (TA) involves "systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set" [106]. While the central focus of TA is analyzing the patterns that emerge among a rich set of qualitative data imbued with nuance and complexity, the analysis must pertain to the relevancy of answering "particular research questions" [106]. In this case, the qualitative data comes from interview transcripts of the five former cancer patients and the CEO of Recovery Companion. Codes are applied to the interview transcripts

5.4.4 Artifact

A method was chosen as the REREFM artifact as it contains "Actionable instructions that are conceptual (not algorithmic)" [31]. Expressed in Chapter 4, the REREFM classifies different actionable instructions into a conceptual waterfall process model. These instructions are followed and executed to build a prototype that takes into account emotionality; enables the capturing of user-feedback through interfacing; provides a positive user-experience for the interviewee and allows for the analysis and integration of feedback into requirements documentation.

5.4.5 Interview Methodology

A semi-structured interview format will be conducted in order to understand the feelings and perceptions of the interviewees who interact with the second, third and fourth stage of the REREFM. Semi-structured interviews can be described as a two-way communicative exchange between interviewer and interviewee, where the interviewer follows a structured question pattern that has open ended characteristics, giving the interviewer flexibility to probe answers further or for interviewees to raise unforeseen topics [107].

Implementing a semi-structured approach coincides well with evaluating how users feel during the requirements walk-through portion of the REREFM, while also maintaining avenues to explore different topics further when they arise. Ultimately, this framework grounds an interview so it doesn't get off-track, but has leeway to make the users feel like they have freedom to answer questions in an uninhibited way.

5.4.6 Evaluation Criteria

The ultimate question for an artifact is does it provide utility? In section 5.2, the utility root was distilled into two different leaves. On one side of the tree was the user-experience of the interviewee. User-experience is composed of emotionality and four specific emotions the REREFM seeks to generate: the interview feels valuable, can express him/herself, feels pleasure and feels comfortable. On the other side of the user-experience leaf is multimedia tool usability. Usability encompasses two leaves: ease of use and

usefulness. Ease of use relates to the interviewee's experience using the different multimedia tools and whether it was challenging for them.

On the other side of the tree is effectiveness. Effectiveness is distilled further by the basic function the REREFM seeks to accomplish: feedback. Capture feedback has two leaf extensions: relevant and useful. Relevant pertains to the feedback's connection to the prototype's emotionally-translated features. Useful relates to whether the feedback has impact on the initial requirements used to create the early-stage Recovery Companion prototype version.

For the user-experience side, Interviewees are asked about these criteria after experiencing the REREFM using a 1-5 Likert scale, with one being not at all, and lowest and five being very much expressed in Figure 14. For the effectiveness side, the CEO of Recovery Companion was interviewed to assess the relevance and usefulness of the captured feedback.

			Distribution				
Property	Sub-Property	Criteria	-	-	o	+	++
User-Experience	Emotionality	Feel Informed Feel Expressive Feel Pleasure Feel Comfortable					
User-Experience	Multimedia Tool Usability	Ease of Use Usefulness					
Effectiveness	Feedback Captured	Relevant Useful					

-- Not at all, - not really, o undecided, + somewhat, ++ very much

Figure 14 Evaluation Criteria Likert-Scale

5.5 Summary

In the first part of this chapter the immense importance evaluating artifacts in DSR was established and A taxonomy was presented for different DSR evaluation methods, their qualities and the different types of DSR artifacts compatible with each DSR method. The second section of this chapter discussed the importance of utility to DSR evaluation of artifacts. A utility tree was constructed for the second, third and fourth stages of the REREFM, producing two leaves from the utility root: user-experience and effectiveness.

The user-experience side of the tree was distilled further into two components: emotionality and usability. Emotionality captures how the interviewee feels during the second and third stages of REREFM through four feelings: informed, expressiveness, pleasure, comfortability. Usability captures the interviewees interaction with the multimedia tools by assessing the perceived ease of use and usefulness of the tools.

On the other side of the utility tree is the effectiveness of the feedback captured: is it relevant and useful? This is assessed through interviewing the CEO of Recovery Companion analyzing the feedback captured.

The third section of this chapter contains an overview of the DSR evaluation methods chosen and the reasoning behind their choosing, while presenting the interview methodology and the qualitative measures used to capture the utility tree criteria through a thematic analysis of the interview transcripts and asking interviewee participants their views of the REREFM stage they experienced through a five-point Likert scale.

Future work for Chapter 5 involves expanding the utility factors to encompass as many attributes and qualities as possible with the REREFM. As this is the REREFM's initial conception, more utility factors will undoubtedly emerge in further instantiations specific to the process. In particular, utilizing requirement documentation tools in the feedback loop is a potential avenue for further exploration as well.

6 Evaluation

This chapter concludes the evaluation statement contained in DSR's main premise for artifacts: build and evaluate [29]. Section 6.1 presents the results from interviewees responses to the Likert Scale survey. Section 6.2 discusses the results with qualitative interview evidence provided. Section 6.3 introduces a thematic analysis to the interview transcripts, and lastly Section 6.4 concludes Chapter 6.

6.1 Results

The results of the REREFM case study are presented below in figure 6. Five individuals who have been through cancer from the U.S. and Australia participated in the second and third stages of the REREFM: remote interfacing, reducing semantic discrepancies, sharing prototype visualization, and a requirements walk-through of the RC prototype.

The participants were then asked to assess user-experience variables described in chapter five on a five-point Likert scale. From an organizational perspective, the feedback captured via the REREFM was presented to the CEO of Recov OÜ and was assessed for its relevance and usefulness using the same Likert Scale.

			Distribution				
Property	Sub Property	Criteria	--	-	o	+	++
User-Experience	Emotionality	Feel Informed			1	1	3
		Feel Expressive					5
		Feel Pleasure				2	3
		Feel Comfortable					5
User-Experience	Multimedia	Ease of Use					5
	Tool Usability	Usefulness					5
Effectiveness (Organization)	Feedback Captured	Relevant					1
		Useful					1

-- Not at all, - not really, o undecided, + somewhat, ++ very much

Figure 15 REREFM Results

6.2 Discussion

The following discussion incorporates the transcripts gathered from the semi-structured interviews. For clarity purposes, the author has recalibrated the transcripts to be more grammatically succinct without damaging the integrity of the interviewee's statement.

The first variable of feel informed was premised by the concept of reducing semantic gaps between stakeholders and users through a short informative YouTube video explaining Recovery Companion's primary objective: reducing isolation by connecting those with cancer together based on similar diagnosis and interest, and also providing a lightweight description of requirements engineering.

A majority of interviewees felt the video helped them be informed about Recovery Companion and the interview process because of its simplicity, as well as having an anchoring transcript underneath the speaker. As interviewee D explained:

> "*because you put the little transcript underneath, you know when you're talking it's one good thing and you're watching but the little transcript keeps affirming what you're hearing..and the fact that it is simple and straight up, that's really good and you come across well but the information comes across well, once I listened to that I felt like I really understood what I was up for"*

From another perspective, interviewee E commented that the video wasn't impactful because of the elapsed time between watching it and doing the requirement walk-through:

> *"I think you know our interaction with your application is what I remember more than your YouTube video and your first presentation of it."*

Ultimately, based upon the results of the interviewees, the YouTube video provided needed context for reducing semantic discrepancies that could have occurred during the interview, thus informing the viewer. Yet its impact may be negated by the practicalities of time elapsing between watching and finishing a requirements walk-through.

It should be noted from observation, closing the YouTube video was the most challenging aspect of the multimedia tools, as users were confused when the video ended, and another video started based on YouTube's algorithm. Interviewees did not know whether the next video was a part of the original, leading to confusion, but not enough to derail information retention.

6.2.1 Emotion: Expression and Comfortability

The second user-experience emotionality variable is expression, measuring how an interviewee feels they were able to express themselves. Based upon responses, expressiveness is closely related to comfortability, as the interviewees were unanimous in that they felt they were very much able to express themselves very much and felt very much comfortable doing so. For instance, interviewee F responded:

> *"I felt comfortable and I felt that you were really interested in hearing about my experience and you were really reaching out, you were engaged."*

Similarly, interviewee D elaborated further on this aspect of engagement during the requirements walk-through:

> *"..this is an exploratory process, I didn't feel like there were any demands made of me, we were walking through together and you were genuinely interested and you're not just taking me through the emotions and we were part of that journey, part of that companion process to walk through it in that way so it's very invitational."*

Enabling self-expression is an important attribute the interviewer must facilitate, especially in situations where very personal emotional stories are being told. Although the objective of the REREFM is to capture feedback, it must be an organic process and the interviewer plays an extremely important role in facilitating an interviewee's self-expression, as interviewee B described:

"I thought that I was able to give you my views and my points of view without any, I just felt a freedom to express what I was feeling, I thought I was able to tell you everything that I wanted to without any hindrances."

Interviewee F described in further intensity the comfortability she felt from experiencing the REREFM second and third stages:

"*very comfortable, extremely comfortable, very non-threatening, non-judgmental, super comfortable"*

Indeed it is up to the interviewee to utilize his or her skillset in conjunction with the REREFM's structure, providing the interviewee with a comfortable environment free of anxiety to express their opinions and life events that may be deeply personal in socio-technical application requirements feedback and elicitation.

6.2.2 Emotion: Pleasure

The last analysed emotionality variable directly relates to if the interviewee felt the RC prototype was visually or conceptually pleasurable during the requirements walkthrough, providing the Recov OÜ organization an avenue to gauge whether the prototype requirements formulated by emotional goals are accurate, elicit positive emotions or whether the requirements need to be reassessed. Empirically, all of the interviewees felt the prototype was somewhat or very much pleasurable. For instance, the simplicity of functionality was found to be extremely appealing to interviewee D:

"..the simplicity of it is what matters, it's just and again if I'm, maybe it's partly to do with my age, but also I think when people are a bit worried about where they're going the simpler the steps are, the clearer the options are the simpler the options are the better it is for people."

Interviewee F had a retrospective outlook on the prototype and the "pleasure" it would've brought her during her cancer experience:

"..what kept going through my mind was I wish I had had something like that when I went through my experience"

Interviewee F elaborated further with connecting the prototype's concept of facilitating the matching of people with similar diagnosis and treatment to problems she's faced in the past with cancer support groups and other friends who've gone through cancer:

I kept thinking about how helpful that all would've been. You know I explained my support group problem and actually I had that identical issue with other friends that had cancer, they would call but they couldn't relate, they didn't have the repeated surgeries and the chemo that just went on forever and ever and they weren't like critical, so to team up, wow, what a difference.

Yet, interviewee E noted the prototype's peer-to-peer communication aspect could be improved upon:

I think the meet and greet and the ping portion, I think that needs a little bit of restructuring to it.

In sum, the prototype's pleasantness was positive in general, with simplicity of functionality and the opportunity for Recovery Companion to enable precise matchmaking cited as key positive factors.

6.2.3 Usability: Ease of Use and Usefulness

Integral to the viability of the REREFM is the ease of use and usefulness of the multimedia tools for establishing the remote interfacing environment, reducing semantic gaps and executing the requirements walk-through. In this regard, there was unanimity to both factors for the tools being very much easy to use and very much useful.

Interviewee B marveled at the usefulness of the technological capability for conducting a remote interview with the selected multimedia tools:

"..given that you are in Estonia and I'm in Lincoln, Nebraska, they were pretty great, I thought you picked a really good mix and they worked well"

Similarly, interviewee D commented on the ease of accessing the remote interfacing through Google Meet:

> *"..you sent a link through and the link opens straight away and from there you were guiding the process, it was easy."*

An notable facet for the REREFM integration of multimedia tools is the impact CoVid-19 on technological literacy. As interviewee D described:

> *"I have to predicate as a result of covid-19 we've had to up our skills these tools anyway"*

This answer is insightful as it shows there's a proclivity for interacting with remote multimedia tools due to the current situation, which could enable the REREFM to target a larger audience of age segments. Despite the recent upskilling trend of remote technological tools, interviewee F noted it was important that the practitioner provided guidance of how to operate certain aspects of the multimedia tools:

> *"left to my own resources I would've really struggled because I'm a dinosaur, I'm old, but you explained it well I got it and it was easy"*

Thus, although the multimedia tools were unanimously considered easy to use and relevant by the interviewees, guidance in operating the tools is necessary by the practitioner in certain situations where the technological literacy of the interviewee may be at a low-level, such as the above quote as being a "dinosaur".

6.2.4 Feedback Captured: Useful and Relevant

For organizations, the REREFM is a conduit to obtaining user feedback to requirements. Analyzing this feedback for key points of requirements affirmation or reconfiguration. A semi-structured interview was conducted with the CEO of Recov OÜ where the collected prototype feedback was presented.

In the CEO's opinion, the captured feedback's usefulness and relevance was achieved because discerning which functionalities should have priority in the development process is vital to the bottomline.

> *"Each one of these functionalities is expensive to add..I think the confirmation of this appointment calendar is the best because we've definitely learned this is the most important functionality to people based on the REREFM"*

Other useful insights of affirmation were gained from the feedback in regards to criteria individuals want to be connected on to communicate with one another according to the CEO.

> *"We've also confirmed that people don't care about being connected peer-to-peer based on similarities and hobbies etc.."*

> *"The same clinic thing is really interesting because they don't want to hear any negative feedback about their clinic, I think that's fresh and new insight."*

Capturing feedback through the REREFM gave the organization greater impetus to achieve development of the Recovery Companion prototype:

> *"This method gives us so much more momentum"*

The REREFM channels the feedback of users into a useful and constructive way, enabling smaller organizations to share their visual prototypes to users directly, while guiding them through requirements in an interactive way and non-threatening way. The multimedia tools enable the capturing of such feedback, giving useful insight in real-time and after execution.

6.3 Thematic Analysis

In conjunction with the above discussion, a thematic analysis to the interview transcripts was applied using NVIVO software and coding themes to the semi-structured interview conducted requirements walk-through with the cancer survivors. It is of the author's

opinion that a thematic analysis is necessary to explore deeper into some of the insights gleaned from implementing the REREFM specifically to the development of psychosocial applications to help those going through or have survived cancer.

Three different themes emerged during the requirement walk-through. The first theme focuses on affirmation of functionality, where interviewee's affirmed Recovery Companion's primary functions based on direct experience. The second and third themes relate to the feeling of isolation the interviewees felt during the cancer experience and the importance of being your own advocate during the cancer journey, The following sections will elaborate on these themes in more detail.

6.3.1 Affirmation Based on Experience

One theme which often appeared during the requirements walk-through was the affirmation of functionality based off of the personal experience of the interviewees who survived cancer previously. This provides insights into the REREFM'S structural advantages when it comes to sociotechnical application development: providing a conduit to visualize, process and connect experience to functionality without the necessity of being in-person.

When it came to Recovery Companion's matchmaking feature based on treatment and diagnosis, it triggered an instant memory recall from interviewee F:

> *"I did start going to a support group, and there's some people very elderly, there's some very young as well, but the issues really are different and I also encountered some people that had very mild, not that cancer is ever mild but you know a lot less procedures, less surgery you know, not having the chemo then I went away feeling really depressed because I was one of the sickest one in the whole group of people wow that was a downer, so I stopped going"*

Because of a lack of relevant connection, interviewee F stopped going to support group, and understood how important the matchmaking feature could be because of this previous experience. Many of the interviewees noted the importance of the recording

device functionality for capturing information from doctor appointments. For instance interviewee F noted how many appointments she had to go through weekly:

> *"yes absolutely, yes that would've been fabulous and you have so many of them, it's not like just when you know you're going every 15 months, I mean you're going in several, at one point I was going in four times a week (to appointments) yeah that would've been extremely helpful"*

Interviewee B described the feeling of "chemo brain" during doctor appointments and the usefulness of having a recording device at the ready:

> *"I couldn't remember the information the doctor provided, lots of times I was in a haze you know, and a lot information to process at one time."*

Lastly, interviewee D

6.3.2 Isolation During the Cancer

One of the most prominent themes during the interviews was a feeling of isolation during the cancer experience. Although there is a lot of literature proving this premise scientifically, hearing the struggle of isolation was extremely impactful and set the foundation for just how importance providing a relevant connection is to those who have gone through cancer. As interviewee A described it:

> *"I really would like some support right now I got lonely, you get kind of lonely you know so yeah I would've welcomed more support, and doing this twice I guess I learned more things the second time around"*

Even with the support of family and friends, the sense of isolation is an omnipresent force because it makes an individual alienated from others purely based on an experience gap as interviewee F described:

> *"you really nailed the isolation thing I remember feeling people calling me and offering support and that was wonderful that I was cared for but I was on an island, I am on this island and no one gets it, through no fault of their own but to have someone who was going through similar, just someone I could reach out to*

going through a similar situation so helpful so less depressing I just felt so terribly isolated"

Lastly, interviewee E understood the necessity of feeling like you're not alone, even if a long time period has passed since diagnosis:

"I'm on a breast cancer newsletter that I get monthly, the stories, you think you're the only one whose gone through this even though you know you're not but some of the stories that I have read, it's just nice to be validated that it's okay to feel, even after eleven years it's okay to feel bad somedays you know"

Although this theme of isolation doesn't have direct relevance to the REREFM, it does show the willingness to engage in very emotional discussion through a remote setting, based on the comfortableness the interviewees felt throughout the interview, which encompasses the multimedia tools chosen for the REREFM.

6.3.3 Being Your Own Advocate

Another reoccurring theme during the interviews was the aspect of being your own advocate during the cancer journey. This gave the interviewees a sense of empowerment in their cancer treatment journey. As interviewee E described, being an advocate for yourself means deciding who is on your oncology team:

"I got so fed up, I only had radiation so I didn't' have chemo and they said because of my age my life expectancy would be eight years. I beat three years which is good, the one thing I did do though was I stopped taking my meds after the fourth year because I felt my bones were falling apart, the hair on my arms hurt if you can just imagine, they switched my medicine at year three um but you know I was fortunate and I had radiation which was fine to your earlier question during the time when I was first diagnosed to um when I was going in for surgery I actually fired my oncologist"

Interviewee B described advocacy in a way where the interviewee's life depended on it:

"I just wish I had known that I was my best advocate, I was my best advocate and I didn't know that. If I was experiencing something I thought I was bothering the doctor or the nurse and oh that's probably nothing but I ended up

having a couple blood clots and I didn't know that and those type of things I ended being up my own advocate and I didn't know that from the beginning."

This theme and consequently, insight into the cancer treatment experience is crucial for understanding the viewpoint of the individual going through cancer. Often they have to make decisions for themselves, and providing the tools to fill an information void where they can be the best advocate for themselves as possible makes the mission of Recovery Companion more defined.

7 Conclusion and Future Work

Chapter 7 concludes this thesis by providing an overview of the research. Section 7.1 contains general conclusions of this thesis and proceeds to Section 7.2, which answers each research question presented in Chapter 1. Section 7.3 reflects upon the research limitations and lastly, Section 7.4 describes the future work needed.

7.1 Conclusion

This research is concerned with the construction of a novel method artifact using DSR for eliciting remote user-feedback to emotionally-driven requirements that is effective for organizations and provides a positive user-experience for interviewees. This method is termed the Remote Emotional Requirement Elicitation Feedback Method (REREFM) and is applied to a use-case, Recovery Companion, an early-stage psychosocial support application for cancer patients and survivors being developed by the Tallinn-based organization Recov OÜ.

For this thesis, an overview is given of the challenges cancer patients experience pertaining to the isolation, anxiety and depression many feel during diagnosis, treatment and survivorship. After the presuppositions are established, a semi-structured expert interview with a cancer psychologist is conducted for formulating initial FR and NFRs through augmenting AOM with emotional goals.

Next, a method artifact is established for eliciting requirement feedback through process modeling and assigning multimedia tools to this process model. Subsequently, evaluating an artifact's utility is an important component to DSR, and thus a utility tree is established for the REREFM and different DSR evaluation characteristics, methods and qualities are taxonomized and chosen to evaluate the REREFM. A utility tree is constructed for the method artifact.

After the REREFM and DSR evaluation methods are established for measuring utility, an instantiation occurs through implementing the second, third and fourth stages of the REREFM with real-life users who have experienced cancer and with the head of the organization, Recov OÜ. Overall, the result of this thesis is the REREFM has utility for providing a positive user-experience for interviewees and for effectively capturing user-feedback for organizations with accounting for the limitations discussed in Section 7.3.

7.2 Research Questions

The meta research question composed for this thesis is: How to create a remote feedback method for emotionally-goal driven features by combining multimedia tools and evaluating method utility? As shown in Chapter 1, this question is distilled further into three sub-questions presented below.

7.2.1 RQ-1: How to Model Emotional Goals?

For RQ-1, The ascertainment of emotional goals for Recovery Companion is established by conducting an expert interview with a cancer psychologist and factoring presuppositions related to cancer support. The context-specific emotional goals ascertained were support and hope, while personal emotional goals were beneficence and empathy.

Next roles were established for Recovery Companion, which were counselor, matchmaker, companion and cancer survivor. Accordingly, the emotional, functional and quality goals of Recovery Companion were composed into a meta-model with their associated roles, through the POSE framework, which is a lightweight augmentation of AOM.

7.2.2 RQ-2: How to Combine Multimedia Tools for the REREFM?

For this question, a process model is constructed outlining the four different stages of the REREFM and descriptions provided for the actions contained within the stages. The first stage encompasses understanding the problem, modelling the emotional goals and composing requirements. The second stage establishes a remote interface with the user, reducing semantic discrepancies.

The third stage enables the of sharing the prototype visualization and the walk-through of the requirements to occur. The last stage analyzes user-feedback and incorporates the feedback into requirement documentation, forming a loop and restarting another round of user-feedback and elicitation.

Afterwards, multimedia tools are chosen with reasons given for their selection. The multimedia tools are assigned and then integrated into the REREFM process model for implementation based on their utility, architecture and being regarded as open-source. The multimedia tools selected are: OBS, Google Meet, YouTube and Figma.

7.2.3 RQ-3: How to Evaluate REREFM Utility?

The importance of evaluation in DSR leads to a devoted chapter to the subject. To answer RQ-3, a summary of different DSR evaluation attributes, types and methods is taxonomized into a cohesive structure. Next a utility tree is constructed for the REREFM in order to have attributes evaluated as to whether the REREFM has utility for effective feedback for organizations and a positive user-experience for interviewees.

Taking into consideration the previous two elements, a comprehensive argument is provided for choosing compatible DSR evaluation methods for the REREFM.The compatible elements were naturalistic, ex-post and summative, with method chosen as the artifact and case study implementation selected as the DSR evaluation method.

7.3 Limitations

This research contains a litany of limitations, of which the most prominent will be discussed. The first limitation is the sample size conducted was five individuals from the U.S. and Australia who have gone through cancer. Although the interviews were intensive

and in-depth lasting on average between 40-60 minutes, a larger sample size would provide greater validity to the efficacy of the REREFM..

Although qualitative research captures rich and complex information, such as the topic this thesis pertains to, integrating a quantitative approach to this method will bring a measurable amount of rigor compared to this qualitative — yet DSR-driven — research.

Another limitation is the lack of pre-test for understanding the technological literacy of users. In hindsight this would've captured if a user already had a high proclivity for technology already, thus influencing whether the multimedia tools are easy to use. However, as noted in the results, many older individuals are upskilling in remote technologies because of the CoVid-19 pandemic.

Lastly, but certainly not the end of the limitations for this research, is the REREFM specifically focuses on an emotional use-case involving those who have been through cancer. Its applicability to other emotional situations where socio-technical applications may provide solutions cannot be determined.

7.4 Future Work

With the establishment of a novel method for remotely capturing user-feedback of emotionally-driven requirements, there are a number of issues to be explored for future work. The is a potential opportunity to technologically combine all of these multimedia tools into one package, giving an organization a holistic architecture to produce and change requirements documentation, interface with users remotely; design and share a prototype; capture and analyze feedback; reduce semantic gaps and consequently create applications that have emotionality integrated into them.

Another issue for future work is scaling this method to capture large groups of people. For this thesis only one-to-one interactions were captured. Using this method on groups ranging from 5-20 people would present logistical challenges but also be a more effective way of ascertaining feedback quickly and from a substantial number of people. This

would also present an opportunity to study group dynamics when it comes to remote requirement walk-throughs for highly emotional socio-technical systems.

Additionally, future work may also explore a wider variety of utility factors for the REREFM, expanding upon the current eight. Especially from an organizational perspective where the quantification of captured feedback is necessary as opposed to the qualitative methodology implemented in this thesis.

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Appendix 1 – Interviewee List

Interviewee A: Male, Cancer Counselor and Cancer Survivor, Estonia, Audio Recording 02/04/2020

Interviewee B: Female, Cancer Survivor, USA, Audio Recording, 04/26/2020

Interviewee C: Female, Cancer Survivor, USA, Audio Recording, 04/26/2020

Interviewee D: Male, Cancer Psychologist and Cancer Survivor, Australia, Audio Recording, 04/27/2020

Interviewee E: Female, Cancer Survivor, USA, Audio Recording, 04/27/2020

Interviewee F: Female, Cancer Survivor, USA, Audio Recording, 04/29/2020

Interviewee G: Male, CEO of Recov OÜ, Estonia, Audio Recording, 03/05/2020

Appendix 2 – Interviewee Questions

Expert Interview:

- What helped you the most after diagnosis in terms of coping and finding information?
- What support was lacking during your cancer treatment journey?
- What has motivated you to work in the counseling/psychology field?
- How do you want people to feel after reading your blog stories?
- What benefits should an application provide for cancer sufferers?
- What emotions would you want to feel when using such a system?
- If the prototype used your blog as an inspirational tool for users, how would you want the blog to be presented? Visually or technically

Cancer Survivor Interviews for REREFM:

Please answer on a scale of 1-5,with one being the lowest and 5 being the highest:

1 Not at all, 2 not really, 3 undecided, 4 somewhat, 5 very much

- On a scale of 1-5, how much did the YouTube video help you be informed about Recovery Companion and the interview process?
- On a scale of 1-5, how much did you feel like you were able to express yourself during the interview? If so why?
- On a scale of 1-5, how visually or conceptually pleasurable was the prototype? What stood out to you the most about the prototype? 4
- On a scale of 1-5, how comfortable did you feel throughout the interview?
- On a scale of 1-5, how easy were the different multimedia tools to use during the interview? Google Meet, YouTube, Figma, Chat, etc.
- On a scale of 1-5, how useful were the multimedia tools used today?
- Based on your previous experience, do you see the prototype concepts having any value to those going through cancer?

CEO Interview for REREFM:

- On a scale of 1-5, how relevant was the captured feedback produced from the REREFM?
- On a scale of 1-5, how useful was the captured feedback produced during the REREFM?