

Value Based Requirements Engineering

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List of Abbreviations

GORE	Goal Oriented Requirements Engineering
HCI	Human Computer Interaction
IRS	Inland Revenue Service
IS	Information Systems
MIS	Management Information System
NFR	Non-functional Requirement
PD	Participatory Design
RA	Requirements Analyst
RE	Requirements Engineering
VBRE	Value Based Requirements Engineering
VM&E	Values, motivations and Emotions
VSD	Value Sensitive Design
WSD	Worth Sensitive Design

Abstract

Value Based Requirements Engineering

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Sarah Thew

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Whilst numerous studies have retrospectively reported the impact of negative user emotions, motivational problems or value clashes during software developments, few Requirements Engineering (RE) studies have considered the elicitation of users' values, motivations or emotions (VM&Es) and there is little advice for practising analysts as to how to deal with these factors.

This thesis explores the impact of users' VM&Es within RE work. The starting point was a review of the current state of analyst practice. A literature survey considered the RE guidance available to analysts on the elicitation and understanding of 'soft issues' such as VM&Es. In parallel, a series of interviews with 12 industry analysts sought their views on the relevance of users' VM&Es, the impact on requirements work, and approaches to identifying such information. This study identified behaviours adopted by experienced analysts that would be useful to promote to novice analysts, and documented the analysts' own requirements for a method to support them in eliciting VM&Es.

These findings informed the design of the Value Based Requirements Engineering (VBRE) method and website (www.vbre.org.uk), intended to support requirements analysts in identifying and considering the impact of such 'soft factors'. Research into RE method adoption highlights the importance of industry input, so a Participatory Design (PD) approach was taken in developing VBRE, iteratively evaluating and refining the method with input from practising analysts.

A series of complementary evaluations of the method are presented. An experimental study investigated the method's utility and usability with computer science undergraduate students, whilst a set of four case studies explored adoption of the VBRE method with industry analysts. The analysts used the method during their RE work, adapting the approach according to their circumstances and levels of experience. The participants credited the method with a positive impact on their RE work and the novice analysts reported feeling more confident of their abilities to handle 'soft issues'.

The key contributions of this work are:

1. An exploration of the views of practising analysts as to the relevance and impact of VM&Es within their RE work.
2. Development of an analysis method and support materials to aid analysts in identifying users' VM&Es.
3. A demonstration of the utility of adopting a PD approach to the development of RE methods.
4. An evaluation of the use of the method in industry, exploring the use of case studies to understand how novice and expert analysts adopt and adapt the VBRE approach.

This thesis is unusual in taking a PD approach to developing a solution for a RE problem: that analysts need to understand users' VM&Es and their impact on software projects. The VBRE method attempts to address this gap, and the positive reception given by the analysts involved in evaluation of the method indicates they see utility in the approach. Future work will focus on continuing to collaborate with industry analysts to understand their use of the VBRE method, identifying improvements to the method and website, and gathering examples of the method's impact.

Declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning;

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To Rich and Elodie

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S. Thew and A. Sutcliffe, "Requirements Elicitation: Understanding Users' Values and Emotions," in NordiCHI 2008 Workshop on New Approaches to Requirements Elicitation, Lund, Sweden, 2008.

S. Thew and A. Sutcliffe, "Elicitation of Values, Motivations and Emotions: The VBRE Method," in Workshop on Values in Design - Building Bridges between RE, HCI & Ethics, INTERACT 2011 13th IFIP TC13 Lisbon, Portugal, 2011.

Ethical Approvals

Ethical approval for the studies presented in this thesis was obtained from the University of Manchester Department of Informatics Ethics Board or the Manchester Business School Ethics Board.

All identifiable information about study participants, including names, organisations and project names has been removed.

Chapter 1 Introduction

There have been numerous studies which report the impact of negative user emotions, motivational problems or value clashes during Requirements Engineering (RE) e.g. [1-5], and so-called ‘soft’ issues, such as politics and people’s feelings are often cited as problems in the requirements engineering process [6]. However, few RE studies have considered users’ emotions, motivations or values and there is little advice for requirements analysts as to how to deal with these factors.

This thesis explores the impact of user values, motivations and emotions during the RE process. Whilst it can be difficult to gain insight into user values, motivations or emotions (VM&Es) since people rarely directly express this information, a series of interviews with industry analysts showed that experienced analysts are able to anticipate and act on users’ VM&Es. The results of this investigation inform the design of a method and toolkit, collectively referred to as Value Based Requirements Engineering (VBRE), intended to support requirements analysts in identifying and considering the impact of such ‘soft factors’. A series of complementary evaluations of this toolkit are presented, exploring its utility with computer science students and practising requirements analysis professionals. In this introductory chapter the motivations for the thesis are discussed and the key concepts of values, motivations and emotions are considered. The research questions the thesis seeks to address are introduced, along with the rationale for the methodological approach to the work. Finally an overview of the thesis contents is provided.

1.1 MOTIVATIONS FOR THE WORK

As the capabilities of software systems have advanced so has the potential for systems to have a wider organisational impact. All but the smallest developments can result in changes to the work of the people who interact with them, and users’ reactions to such changes are shaped by their own personal values, motivations and emotions[7]. Gowler [8] observed that systems must fit with users’ values and beliefs to be successful. The premise of this research is that both the process of RE and the end results can be improved with a clearer understanding of such information, which can be helpful in a number of ways, such as understanding conflicts between users, or between users and a

system, making design decisions or developing an understanding of users' long term goals and working practices. There are many published examples of occasions when users' values, motivations and emotional reactions have been pivotal to the success, or more often, the failure of software development projects. For example:

- The problematic London Ambulance Service dispatch system rollout [2, 9] is a well-known case study within the RE domain. It is apparent that during the attempted rollout staff experienced extreme emotional responses: stress, anxiety, fear, and that these emotions revealed operational issues around the running of an effective ambulance service, in particular the prioritisation of ambulance call-outs by handlers, which had not been considered in the design of the new system. In this instance the dispatch handlers' emotional reactions were not simply a consequence of resistance to change but also arose from a mismatch between operator values and the values implicit in the new system. The operators' values included a sense of responsibility for their patients, concern for the welfare of the ambulance crews, a need for control, and confidence in their ability to manage the caseload. These values implied actions the dispatch handlers expected the system to support, for example the ability to prioritise ambulances for children, or to reduce the workload of ambulance colleagues who had attended a harrowing case and needed a break. The dispatch handlers lost the ability to manage these concerns within the new system. Similarly the previous system had allowed the dispatchers to make use of their expert knowledge in running the system; again this expertise was overridden by the priorities of the new system: efficient resource allocation and response times.
- A study of an under-utilised management information system (MIS) within a Portuguese automobile company identified value and motivation clashes and resultant emotional difficulties as key factors alongside technical limitations[7]. Examples included frustration with the constraints imposed by the use of the MIS which limited both access to, and manipulation of the information within the system, senior managers who were highly motivated by career progression perceived these issues as impacting their own departments' performance and therefore their personal opportunities for advancement.
- Personal values played a role in the poor uptake of a wiki developed to allow healthcare workers to share experiences and best practices [5]. Alongside some

of the more predictable reasons for their unwillingness to use the system, such as concern about writing the wrong thing or nervousness at using a public forum, the healthcare workers explained that they were uncomfortable with the idea of reducing their close and very personal relationships with their patients to abstract ‘cases’ within the computer system (with the term ‘case’ being particularly problematic, in that it focuses attention on the problem not the person). Potential users were also concerned at lack of control over their online ‘self’ and the ways in which delicate interpersonal situations might be misinterpreted by online readers who wouldn’t be able to appreciate each patient’s context.

- A study of the roll out of laptops to the American Internal Revenue Service (IRS) illustrates the problem of mismatch between a technology choice and user values[1]. Accountants carrying out client audits were concerned with creating a professional and competent image in a charged situation. The IRS accountants visit taxpayers and their private accountants, to audit tax returns. The difficulties of this adversarial situation are compounded by the accountants’ awareness of a widely held opinion within the accountancy profession: ‘those who work for the IRS do so because they are not good enough to be able to get jobs elsewhere’. The IRS accountants were issued with laptops running tax analysis software, with the aim of reducing time spent completing and transcribing paper documentation. Despite the system providing faster, neater reports and error checking of tax calculations, the potential for embarrassment resulting from technical difficulties with the laptop was a substantial disincentive for many of the IRS accountants, who were concerned to maintain a positive professional image. Consequently uptake was slow and limited. The rollout of laptops arose from a misunderstanding about the focus of the accountants’ work: whilst a task analysis might imply the importance of efficient document creation and assessment of tax calculations, in reality the ability to maintain confidence and authority, and to impose tax adjustments are more significant and difficult tasks.

In all these instances, the concerns which affected uptake of the system were not purely technical, but were associated with the impact of the technology on the end users and stakeholders; for example, how the system might affect other people’s perceptions of them, or a mismatch between their values and the values implicit within the technology.

Could these problems have been avoided if the requirements analysis process had considered users' values, motivations and emotions in advance of the system development? Perhaps the team developing the healthcare wiki would have chosen to use different, less impersonal language when talking about patients or the software team may have opted to automate other aspects of the IRS accountants' work processes?

Hansen et al. observed that whilst the impact of social issues has long been discussed within the RE literature, there is a need for practical guidance to aid analysts in understanding and addressing such issues [10]. Despite the usefulness of understanding users' values, motivations and emotions, it can be difficult to get insight into information of this type, users rarely directly express such information and standard analysis techniques provide little advice to the Requirements Analyst (RA) beyond reminding the analyst to be aware of organisational or social issues. Some 'soft' issues and social relationships, such as responsibility and authority, are modelled in i* [11, 12] and extensions thereof [13], however user values, motivations and emotions have not been explicitly included in requirements processes to date.

Meanwhile reviews of computer science education have identified gaps in analyst training with regard to 'soft' skills [14]. Given these gaps, it is unsurprising that novice analysts often show a lack of political and social awareness [15], and recent studies have highlighted both the importance of effective communication between analysts and users, and communication issues as a major source of RE problems [16] [17]. Whilst it is true that these skills are often honed through 'on the job' experience, training and techniques can help equip the novice analyst with the right mind-set, tools and approaches, for example Regev et al. [18] have developed an RE training course during which students carry out the analysis and design of a system, interacting with end users and stakeholders (played by the course leaders) to gather and prioritise requirements. This approach intentionally exposes the students to the uncertainty, contradiction and conflict that are frequently encountered during software development.

1.2 DEFINING VALUES, MOTIVATIONS AND EMOTIONS

Section 1.2 discusses the concepts of values, motivations and emotions, their influence on our decision and behaviours and their relevance to RE.

1.2 a Values

Definitions of value vary from worth and desirability, to judgement of what is valuable or important in life (OED). The term ‘value’ has been widely considered within the RE community, primarily in the sense of worth or monetary value, for example, the e-value method which has been applied to business process analysis and socio-technical systems requirements [11, 19, 20]. Other studies have considered business value to the customer [21] and organisational values[22]. This work focuses on personal values, in particular the values users associate with their work roles, for example, a research scientist might value rigour and accuracy, resulting in a commitment to methodical and precise working practices, or value innovation resulting in an enthusiasm for creative working and data exploration. Kluckhohn’s definition of values [23]:

“a conception explicit or implicit, distinctive of an individual or characteristic of a group, of the desirable which influences the selection from available modes, means and of action”

has been adopted by other studies into values in general [24], and within the context of software development [25, 26], and is the chosen definition of values within this thesis. Values are abstract principles of the desirable or undesirable, that aid in decision-making. Our values guide our choices and behaviours, Kelly [27] describes them as:

“..ways of construing the world. They are what enables man, and lower animals to chart a course of behaviour, explicitly formulated, or implicitly acted out, verbally expressed or utterly inarticulate, consistent with other courses of behaviour.”

Until relatively recently it was believed that someone’s values were shaped by their early life experiences and would remain unchanged, and indeed our parents, upbringing and schooling do influence our values [27, 28]. However, whilst our values are stable, long-term constructs, more recent research suggests our values continue to be influenced by society and environment, and in particular, for many of us, our work environment. A number of studies, e.g. [28-30] have shown a relationship between our values and workplaces. Whilst we may be drawn to a particular role because we believe it matches our values, over time positive feedback can strengthen this relationship and these changes may manifest themselves in changes in a person’s values outside of work. However, whilst a person’s value system may be modified by work, work is unlikely to influence someone to entirely change their personal values. Dramatic differences in

values between a person and some aspect of their work are likely to result in strong emotions, stress and conflict[29].

Personal values appear to be tacit knowledge: we recognise them when we encounter them but trying to articulate them can be difficult. As noted by researchers in the information systems tradition, such knowledge is contextualised and can only be understood by reference to a situation [31]. The key to understanding values is through language, with reference to existing knowledge held by the individual. Elaboration and exploration is desirable when exploring a subjective, qualitative matter such as values, after all it is likely that one person’s understanding of a value such as ‘equality’ or ‘independence’ will manifest itself in quite a different way to someone else’s, and therefore the discussions and ‘war stories’ told by users during requirements interviews are potentially a good source of information about user values.

Keeney’s investigations into policy making suggest that values can be useful in decision making in a number of ways, including creating and evaluating of alternative designs, identification of hidden objectives and improving communications [32]. Similarly, understanding users’ values can help requirements engineers interpret the concerns held by individuals as well as predict their probable actions and responses to a project or new designs.

1.2 b Motivations

Motivations are long-lasting, high-level drivers, which guide our decisions and actions. The strength of a motivation will affect the intensity and persistence of behaviour. Intrinsic motivations are internal to an individual and based on their own interest or pleasure in carrying out a task, whilst extrinsic motivations are based on external factors such as the drive for financial reward, peer esteem or the fear of negative consequences[33]. Both can influence a person’s behaviours in the workplace.

An understanding of motivation can be helpful in interpreting stakeholder behaviours during the design and development process, for example, Boland and Day[34] observed the impact of stakeholders motivated by internal competition and ambition in their behaviour towards the requirements analyst, as well as their requests for requirements such as providing ways to monitor what other departments were doing. Emam and Madhavji’s study of RE practices in industry observed that user participation was a major issue in many of the cases they investigated [35]. Uninterested and unmotivated

users were unwilling to cooperate with either the IT team or other stakeholders or not prepared to make themselves available to the project. It is reasonable to argue that a better understanding of what motivates users could aid a requirements analyst in encouraging user participation in the RE process. Motivations can also provide a guide to identifying critical success and failure factors, and for identifying system requirements, particularly when systems can be customised or configured.

1.2 c Emotions

Emotion is a tacit construct; we recognise our own emotions as they arise, but find them hard to articulate and define. Investigations into the expression and elicitation of emotions have observed that people rarely speak directly about them; rather, they illustrate their emotions through stories or speech patterns [36, 37]. Creating narratives and scenarios facilitates understanding of our experiences, and is a natural way to share emotional reactions with others [38], so requirements interviews could be a good source of such stories. Emotions are intrinsic to our experiences of work and are believed to influence our decision-making processes in two ways[39]. Firstly “expected emotions” are our predictions about the emotions likely to arise as a consequence of decisions, for example the emotions anticipated as a consequence of requirements decisions, people are understandably inclined to make decisions they believe are likely to lead to positive emotions. The decision-making process is also influenced by “immediate emotions”, that is, the emotions being experienced at the time of decision-making. Immediate emotions influence both perceptions of the likelihood of a positive outcome and the time spent in making a decision. Furthermore, the link between positive emotions and creative thinking has been well characterised [40].

Orteny et al. [41] classify emotions as positive or negative responses to events, people or artefacts. They identify a set of ‘prospect-based’ emotions associated with anticipation of future changes. Expected or prospect-based emotions are likely to be a significant feature of software development; users appraise the event as desirable or undesirable and react accordingly. It is important to consider here, that reactions are based not on the actual state of affairs but on the users’ perceptions. Consequently, circumstances which create a particular emotion in one person will not necessarily create the same emotion in another; for example, the factors which create a feeling of

happiness, such as interpersonal relationships, reward or peer esteem, will vary between individuals.

Software developments have the potential to change working circumstances and therefore to have an emotional effect [42]; for example, a software system can reduce face-to-face communication, create situations by which people who have not previously worked together must now do so, or increase the availability of information which was previously ‘guarded’ by a stakeholder. These are situations which may cause anxiety for some people, or may be considered positive opportunities by others. Within the workplace, emotions can be both positive drivers for success and motivation, or can be distracting and disruptive. Bentley et al. discuss the potential to include requirements intended to promote positive emotion, recommending that such requirements should be formally documented as Non-Functional Requirements (NFRs) [43]. They note that, whilst there are techniques which may result in an analyst identifying such requirements, there are no techniques which specifically focus on positive emotions.

There are few examples of elicitation techniques designed to identify emotions although the Underlying Discourse Unveiling Method does provide some guidelines [44]. The state of the art is summarised by Ramos et al.’s [7] comment that:

“There is also a shortage of guidelines to help elicit emotions, beliefs, and values from the visible and shared constructions of human action and interaction.”

1.2 d Values, motivations and emotions: three interacting influences

This thesis focuses on values and motivations as two long term stable factors which influence our decision-making. As described above, whilst our immediate emotions may change far more quickly than our values or motivations, they can also influence the decision-making process and can act as signposts of underlying value and motivation issues[45]. Therefore this thesis considers the three interacting influences:

- Values can be a source of motivations, and a means of prioritising motivations. Clashes between stakeholders with differing values, or between stakeholders and the values embodied in a system can lead to negative emotions; congruence between values will lead to more positive emotions.
- Motivations help to determine our behaviours and opinions.

- Positive emotions arise from matches between user and system values or support for users' motivations whilst negative emotions can arise from clashes between user and system values, or conflicting motivations. Emotions also influence our behaviours and choices.

Our values and motivations shape our responses to events, and our responses and reactions may result in actions, but may also give rise to feelings and emotional responses. Information about users' values, motivations and emotions can guide software design, and the RE process, for example, determining which tasks are core to a users' motivations, either through intrinsic enjoyment, or extrinsic career aspirations could support more effective functional allocation, or embodying particular values such as 'responsibility' or 'security' within the system design.

1.3 THESIS RESEARCH QUESTIONS AND METHODOLOGICAL APPROACH

The research questions this thesis addresses are:

1. Do practising requirements analysts consider users' values, motivations and emotions when analysing system requirements?
2. Can a method (including associated support tools) improve elicitation and effective use of VM&Es by requirements analysts?
3. Is Participatory Design an effective way to develop new RE methods?

This work uses a mixed methods approach to investigate the elicitation of stakeholders' values, motivations and emotions. There is little existing research on current analyst practice around the elicitation of stakeholders' values, motivations and emotions, and therefore an exploratory, qualitative approach is taken to the interview study presented in chapter three. The findings of this study along with the learning from Chapter two's literature review provide requirements for a method for VM&E oriented requirements analysis: VBRE (Value Based Requirements Engineering).

It has been observed that Requirements Engineering research does not always have the hoped-for industry impact because researchers do not elicit the requirements of industry analysts [46] or fail to consider the utility of new methods in an industry setting [47]. Given that the author is a practicing analyst and keen to ensure the relevance of this research to industry RAs, a key consideration has been the involvement of practising industry analysts both in informing the development of the techniques proposed in this

work and in evaluating the utility and usability of these methods. A Participatory Design approach to method development was adopted, and several iterations of analyst feedback are used to refine and improve the method (presented in chapters four and five). Finally, a combination of qualitative and quantitative evaluations are presented, a controlled, quantitative evaluation with students (chapter six), a survey based website evaluation involving both students and industry analysts (chapter six), and a set of industry case studies looking at VBRE method adoption and adaptation in industry (chapter seven.) The rationale for the choices of methods is explored in greater detail in each of the relevant chapters.

1.3 a Terminology used within this thesis

Stakeholders and users' values, motivations and emotions are referred to frequently throughout this thesis. In order to avoid repeatedly typing out the phrase 'values, motivations and emotions' the abbreviation 'VM&E' is used.

The term Requirements Analyst (RA) is used throughout the thesis to refer to anyone carrying out requirements analysis work in the course of their role.

The term VBRE was previously used by Gordijn and Akkermans [20] to describe their approach to linking economic value to e-commerce software requirements. This thesis widens the definition of the 'Value' in VBRE to include personal values; an individual's implicit or explicit beliefs as to the desirable and undesirable.

1.3 b A note on Industry Analyst Participation

Much of the work in this thesis involves the participation of industry analysts who consented to take part in interviews, evaluations and other PD activities. This section clarifies any overlap in participation by analysts in various components of the study:

Chapter 3: Interview study with 12 industry analysts.

Chapters 4 and 5: One of the participants from chapter 3 participated in the PD work.

Chapter 6: Questionnaire evaluation of VBRE website with six industry contributors; none of these participants had any other involvement in design or evaluation of the method.

Chapter 7: Diary case study with four industry analysts: one of these participants also contributed to the analyst interviews in chapter three.

1.4 THESIS OVERVIEW

Figure 1-1 summarises the content of this thesis.

1.4 a Chapter one: Introduction

This chapter discussed the motivations for this research, considering the reasons why users' values, motivations and emotions impact the RE process. The terms 'values', 'motivations' and 'emotions' were discussed and the research questions to be addressed by this thesis were presented.

1.4 b Chapter two: Literature Review

Chapter two begins with an overview of the RE literature, focusing on approaches to the social and political aspects of requirements elicitation, and consideration of personal values, motivations and emotions. Requirements engineering studies that have specifically considered users' values, motivations and emotions are discussed, considering the elicitation methods and any use made of value, motivation and emotion information. The links between values, motivations and emotions and non-functional requirements (NFRs) are explored, reviewing the extent to which such information is currently modelled, and reflecting on the ways 'soft' information can inform the NFR modelling process. Given that an aim of this work is to develop a method which is acceptable and valuable to industry analysts, the RE method adoption and adaptation literature is also considered, identifying recommendations for user assimilation of methods.

Chapter three: An Investigation into current Industry Practice

A series of interviews with 12 industry analysts explores their views on the relevance of users' values, motivations and emotions, the impact on their RE work, and the adoption of techniques or strategies to aid the analyst in identifying such information. Differences between novice and experienced analysts were apparent, both in the appreciation of the impact of users' values, motivations and emotions, and in the explicit use of techniques to identify this knowledge. The investigation identified behaviours adopted by expert analysts that would be useful to promote in novice analysts, and documented the analysts' own requirements for a method to support them in eliciting values, motivations and emotions.

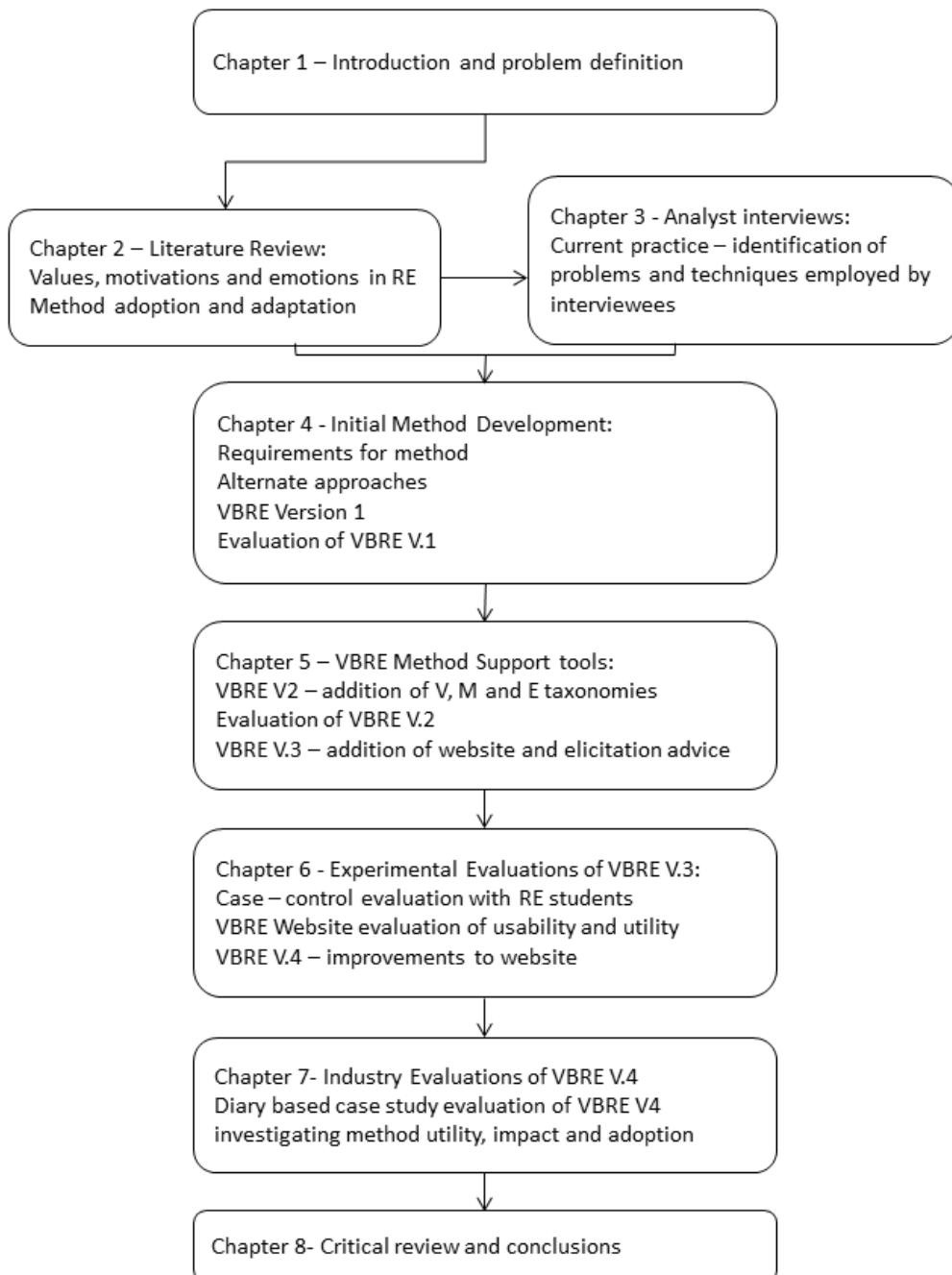


Figure 1-1 Summary of thesis content

1.4 c Chapter four: Value Based Requirements Engineering: Initial Method Development

Chapter four summarises the learning from chapters two and three as a set of requirements for a method which aims to support analysts in understanding users' values, motivations and emotions. The chapter evaluates existing approaches to this problem and discusses the rationale for adopting a Participatory Design approach to developing a method to address these requirements. The first version of the Value Based Requirements Engineering method is presented. The chapter describes the use of the method in two case studies, considering the impact of the method within the case studies and the acceptability and usability of the method. Feedback from this initial evaluation identified several potential improvements to the method.

1.4 d Chapter five: Development of VBRE Method Support Tools

Chapter five describes the development of tools to support the analyst in carrying out VBRE analysis. In response to the experiences of analysts using the first version of the method (chapter 4), a set of taxonomies of values, motivations and emotions as they relate to the RE process was developed. Chapter five then describes the experiences of analysts testing the addition of these taxonomies to the method. As a consequence of this second evaluation, the taxonomies were further extended and transformed into a website, the remainder of this chapter describes this website.

1.4 e Chapter six: VBRE Experimental Evaluation

Chapter six presents two experimental evaluations of the VBRE method and website. The first scenario based evaluation investigated whether the use of the method would improve the ability of final-year RE students to detect VM&E. The second evaluation assessed the content and usability of the VBRE website via a questionnaire, consulting undergraduate computer science students and practicing requirements analysts. The learning from the evaluations was used to refine the VBRE website, and this chapter details those improvements.

1.4 f Chapter seven: Industry Case Study Evaluation

One of the goals of this thesis was to develop an approach that was accessible to working analysts; therefore an evaluation exploring the use of the VBRE method in the context of industry software projects was important. A series of case studies working

with practising analysts investigated the use of the VBRE method and website in their own projects. The case studies enabled the investigation of several questions:

- The utility and usability of the method and associated tools in working practice
- The impact (if any) of the VBRE method in the projects under study.
- How the method is adapted for use in ‘real-life’
- Whether the method and website are used in the same way by novice and expert analysts?

The analysts chose to adopt and adapt the method, according to their circumstances and levels of experience. It was apparent that the more novice analysts chose to follow the method in a ‘by the book’ manner, whilst the more experienced analysts made use of the process and a high-level summary of the taxonomies provided by the front page of the website but were less inclined to use the detailed advice on the rest of the website. Inevitably, including the method as a part of their requirements work meant some additional work for all the analysts, but the consensus was that the amount of time required was acceptable given the positive impact on the requirements elicitation and analysis process.

1.4 g Chapter eight: Critical Discussion and Conclusion

Chapter eight reviews the work presented in this thesis and reflects on the four key contributions:

1. An exploration of the views of practising analysts as to the relevance and impact of VM&Es within their RE work.
2. Development of an analysis method and taxonomies to aid analysts in identifying users’ VM&Es.
3. A demonstration of the utility of adopting a Participatory Design approach to the development of RE methods
4. An evaluation of the use of the method in industry, exploring the use of case studies to understand how novice and expert analysts adopt and adapt the VBRE approach.

The extent to which the contributions address the thesis research questions set in chapter one is reviewed, and the contributions are considered within the context of existing

research. The limitations of the work are considered and areas for future research are outlined.

Chapter 2 Literature Review

2.1 INTRODUCTION

This literature review begins with an overview of the major user centred requirements engineering literature, focusing on their guidance around the personal, social and political aspects of requirements elicitation, and their consideration of user values, motivations and emotions. Requirements engineering studies that have specifically investigated users' VM&Es are discussed, considering the elicitation methods and the use made of value, motivation and emotion information. Given the apparent parallels between values such as 'security' and 'privacy', and non-functional requirements (NFRs) the links between values, motivations and emotions, and NFRs are explored, reviewing the extent to which such information is currently modelled, and reflecting on the ways 'soft' information may inform the processes of identifying and modelling NFRs. Finally, given that this study aims to develop a method of use to practicing analysts, the issues of RE method adoption and adaptation are reviewed in order to identify factors likely to promote or discourage method use.

2.2 METHODS AND APPROACHES FOR THE ELICITATION OF SOFT ISSUES

Academic studies of industry projects frequently identify poor communication as a cause of RE problems [10, 39], whilst the importance of understanding the social and political context of a software development project is referred to in many of the major RE texts. In this section these approaches are reviewed, with particular reference to methods and advice given to analysts in identifying and analysing such issues.

The need to tailor the requirements process to organisational culture is discussed by Kotonya and Sommerville in 'Requirements Engineering: Processes and Techniques' [48]. The effects of politics, power and culture on the requirements process are considered, and some examples of potential impact are given, illustrating how such factors can complicate the requirements process. They mention a number of methods intended to aid the analyst in coping with the associated complications, including Soft Systems Methodology and ETHICS. However their main focus is on viewpoint oriented requirements methods, which encourage analysts to consider the different perspectives

of various stakeholders (people or systems). Whilst they don't provide any specific guidance on identifying VM&E, their work on viewpoints has been expanded to include the concept of 'concerns': high-level issues such as 'security' or 'user friendliness' that are generally non-functional, loosely defined and cut across multiple requirements [49]. Some of these concerns potentially map to value terms, however Sommerville et al's work focuses on the analysis of concerns to understand the impact on system requirements, rather than initial elicitation.

Robertson and Robertson [6] include 'Cultural and political requirements' in a list of non-functional requirements and comment that people from different professions tend to have different cultures, though there is little discussion about what the implications for a software project might be. When discussing understanding users they mention the need to understand the user's attitudes to their job and to technology, as well as considering the potential impact of factors such as religious observances and political correctness. The authors recommend reflection as a way for analysts to gain such understanding, but give no further details as to how this might be practiced.

Contextual Design [50] is a requirements analysis method rooted in ethnography. It is a user centred approach requiring analysts to spend time with users whilst they go about their daily work, observing, note-taking and asking questions to clarify understanding. These notes are then consolidated via 'interpretation meetings' and a variety of different models describing the work are developed, including descriptions of peoples' interactions and norms. The approach also specifically includes a step for capturing of 'insights' that have occurred to analysts during the process of building the work models. Contextual design is intended to be used within a team setting, and ideally has a team of analysts able to devote time to it. This is frequently not the case on small-medium sized software projects, where there may only be a single analyst involved. The approach certainly allows for discovering information about users' VM&Es, and specifically emphasises understanding user intent, but does not particularly promote identification of users' VM&Es. Consequently although the method is not particularly focussed on identifying non-functional information such as values, it may uncover them along the way.

Participatory Design (PD) is a user centred approach to software design and development, founded on close collaboration between stakeholders and the development team throughout the project lifecycle [51]. The method aims to ensure that analysts gain

an understanding of users' goals, activities and problems, whilst in parallel, users understand technical possibilities and limitations. The approach makes use of a variety of techniques which share the goal of better understanding and addressing users' needs by closely involving users in the design, development and testing of software. Characteristic practices include the use of iterative prototyping, prioritisation of engagement and communication activities, a desire to understand the context in which the software will be used, and attention to socio-technical issues. User participation can take many forms for example: contributing to design workshops, co-creation of prototypes, review of outputs or hands-on testing[52]. The method supports the development of close relationships between users and analysts, and therefore could reasonably be expected to make it more likely that the analysts understand users' VM&Es, however to date within the PD literature there has been little direct consideration of the elicitation of VM&Es. An exception is recent PD work looking at the relevance of stakeholders' and analysts' values to the development of interactive digital artefacts for museums [53]. During this study the researchers investigated stakeholder values and worked to develop consensus within the stakeholder group to agree a shared set of values to be embodied in the resulting exhibits. The authors highlighted the difficulties of identifying values, and the need for additional techniques to aid in this approach.

Checkland's Soft Systems Methodology is an attempt to deal with the complexity of real world social situations[54]. The 'system' in question does not refer to the computer system under study but rather to the wider socio-technological system. The approach involves two streams of analysis, the first a process analysis, the second considers cultural and political circumstances, and attempts to support judgements about how to accommodate conflicting interests of stakeholders. Different views of the situation are modelled, including the norms, roles and values within the social system, and the distribution of power within the political system, with the proviso that the analyst must accept that the reality of the situation is socially constructed, and that we can never entirely know another person's thoughts or assume that they will be revealed through their words. Rather than accurate, formal models as a final output of the RE process, the Soft Systems models are tools intended to 'stimulate, feed and structure debate', enabling the analyst to better understand the social and political context of a software development. Checkland comments that direct questioning is unlikely to help when

trying to find out about a social situation and that reflection is the correct approach, but there is little else in terms of elicitation advice for the analyst.

Interviews are the most commonly used and considered to be the most effective means of requirements elicitation [55, 56], however analyst training tends to focus on technical aspects of the work rather than providing interview support [56], and there is little advice on the specifics of managing interviews. Gause and Weinberg [57] provide more detailed advice on managing the interview process, considering the problem of ambiguity in question handling, in particular discussing users' emotional reactions. They focus on the issue of understanding whether users are comfortable with the requirements elicitation process, or feel they are constrained from answering freely. They also recognise that it may not be possible to get a clear answer to this question, particularly in circumstances when users do feel uncomfortable. In such circumstances they recommend "*looking for their answers buried in the answers to other questions.*" but do not provide more detailed guidance, recommending the use of a facilitator to handle political conflicts. The need for analysts to be aware of users' emotional reactions is mentioned; however they limit this discussion to the need for designers to be aware of user satisfaction feelings.

The complexity of the human dimensions of requirements engineering is discussed by Sutcliffe [58] who observes that even with very honest users it can be difficult to get a clear and complete set of facts; every person involved has their own viewpoint, tacit knowledge and unconscious attitudes. Furthermore the issues of tacit knowledge and the ambiguity of language further confuse such situations. Sutcliffe considers trust and power to be key variables in understanding the social context in which a software project is operating, and recommends the use of discourse analysis to support negotiations with users, but does not provide further advice on eliciting users' views on trust, power or other VM&Es.

In general, across the mainstream requirements texts, it is apparent that the authors recognise that analysts need to be aware of the human, social and political dimensions of their projects and the need to understand users' values, emotions and motivations is tacitly recognised. However, these recommendations to consider soft issues are not supported by more detailed elicitation advice. Eason [59] discusses this, remarking that:

“Many people involved in applications development, both technical specialists and potential users, are now aware that information technology is a great force for organisational change. Unfortunately the tools they have for systems design do not allow them to control this force.”

2.3 RE STUDIES OF VALUES, MOTIVATIONS AND EMOTIONS: ELICITATION TECHNIQUES

There have been a number of studies that have investigated the incorporation of values, motivations and emotions into different stages of the requirements and design process. This section begins by reviewing the more generalised techniques and then focuses on approaches that provide more explicit advice on identifying VM&E.

Ethnography is a practice originating from the social sciences, requiring the researcher to spend a substantial period of time based in a particular society or environment, with the aim of developing a rich understanding of the practices, behaviours, values, motivations and emotions of members of that society [60]. Ethnographic techniques are regularly used in Information Systems research as a means of gaining a rich picture of the wider human and social impacts of technology [61] and there is interest in the use of ethnographic techniques in RE work. Somerville et al. [62] discuss the problems of understanding actual working practices, versus the prescribed protocols described in manuals, and the difficulties expert users have in articulating their skills. They highlight the usefulness of ethnography in addressing issues of understanding experts' tacit knowledge. Similarly, Jirotka et al.'s investigation into trust and inter-team working in breast examination units [63] show that ethnographic techniques can be used successfully to deepen understanding of socio-technical aspects of users' requirements. However, as acknowledged in [62] the approach makes substantial demands on the project team in terms of both manpower and time. Furthermore ethnographic techniques are less suitable in domains where there is little collaborative or easily observable work. Finally, whilst use of ethnographic techniques could be expected to increase the likelihood of an analyst identifying users' VM&Es, the approach does not specifically focus on this information.

Goguen argues that it is impossible to completely separate the formal rule based representation of requirements from the informal socially situated world, and that requirements engineers need better tools to help them cope with this complexity,

including a means of understanding participants' values[64, 65]. He recommends discourse analysis as a way of extracting values, providing examples from a nursery rhyme and a study of workers in a sales department. The value information is then presented as a 'value tree', a way of understanding by examples, what particular value labels mean to different users, with the suggestion that such trees could be used to make trade-offs between conflicting values. This approach encourages analysts to focus on social interactions, recommending that analysts should 'immerse' themselves in the data, and make use of stories and jokes as sources of values. The value tree is a potentially useful way to explore the meanings of values, and highlights the need to understand what value labels represent to individual participants in the RE process. However, it is perhaps not reasonable to expect most requirements analysts to be familiar with the process of discourse analysis and the examples given are fairly small and simplistic, especially when contrasted with Goguen's emphasis on the complexity of requirements work on large software projects.

Within the Human Computer Interaction (HCI) tradition a number of researchers have considered the impact of values on system development, including Friedman's Value Sensitive Design (VSD) [66] and Cockton's Worth Centred Design (WCD) [67]. WCD is so named in order to widen considerations beyond commercial value to include anything the users consider worthwhile. The framework covers the need to explore the users' requirements worth, but does not include guidance as to how these requirements should be elicited, beyond recommending the use of ethnography, interviews and prototypes. VSD makes a distinction between 'personal values'; those held by an individual, and 'moral values'; those concerned with human welfare and justice, specifically: accountability, autonomy, freedom from bias, privacy and universal access. The approach considers the implications of these moral values on system design. For example VSD based consideration of 'autonomy' [68], describes 'users having the right level of control over things at the right time', and the implications of this for system functionality (i.e. does the system have the required feature?), complexity (is it easy to access the required feature?), fluidity (can users review and refine features?) and misrepresentation (is the user deceived by the system? e.g. inappropriate use of an avatar). VSD makes explicit links between particular values and system functions, but has been criticised for focussing attention on a known set of values, rather than encouraging the context sensitive elicitation of values from stakeholders[69].

Work by Flanagan et al. [70] develops Friedman's VSD work using a practical example. They present a case study of educational game design, using values as a guide during the design process. They consider various sources of values: project goals, stakeholders, the computer games community, the project team, and consequently discuss a number of values which impact the design, including equality, power and collaboration. Examples of conflicts between the project goals and system design are provided, along with advice as to how such conflicts can be explored and resolved via prototyping and storyboarding. The work provides a good example of the ways values can impact system design, but beyond a list of potential sources, does not provide much advice as to how to identify and understand the values affecting the project.

Mumford made use of values to interpret the outcomes of several software projects, developing the techniques into a method: ETHICS (Effective Technical and Human Implementation of Computer Based Systems) [25, 71]. The studies investigated the values of analysts, users and senior managers involved in software projects at a number of companies. Participants were asked to complete a questionnaire giving their opinion of the current values of the company and department they worked for, and their idealised version of the values they felt the department and company ought to hold. They were also asked to rank a list of values to reflect their own priorities and principles in their working life. This information was used, along with interview data from the participants, to determine users' preferences for working conditions and requirements for job satisfaction, and to reflect on and interpret the progress and success of the software projects, for example the redesign of a system to support bank clerks. Mumford's investigations showed that the bank clerks were generally a responsible, educated and sociable group, who derived job satisfaction from working with their colleagues and customers and from having some control and accountability for their work. The software redesign placed little emphasis on these aspects of the work; instead tasks became more controlled and routine. The researchers correctly anticipated that this would lead to employee discontent. The study provides examples of the link between personal values and job design and argues that an understanding of users' values might improve project decision making in areas such as user autonomy and task allocation. In terms of acceptability and usability, both the questionnaire and the task of ordering values do not seem overly time consuming or complex. However the analysis of the questionnaire data and relation to job design is more complicated, and may not be

acceptable or practical for application during industry RE work. Whilst questionnaire based approaches are a practical and effective way of gathering shallow information from a large pool of participants, the use of a questionnaire to discover values has a number of limitations. Firstly, the set of values under investigation is limited by those chosen by the author of the questionnaire, and there is usually little scope for users to elaborate on their answers. Similarly, opportunities for the analyst to explore users' answers in greater detail are limited, or may be non-existent if the questionnaire is anonymised. Consequently questionnaires may not provide sufficient rich and detailed information to be useful to a requirements engineer.

Koch et al. argue that analysts directly asking users' about their values is inappropriate and therefore suggest an alternative use of value questionnaires, asking users to complete a questionnaire in order to provide a tailored user interface based on users' values[72]. They recommend that users fill in a questionnaire about their attitudes towards workplace tasks before using the system for the first time, and that users' personal values could then be derived from the results. A value appropriate variant of the user interface would then be provided to the user. This approach has yet to be tested beyond a small case study by the authors, and the means by which the software team would impute the correct values from an attitudes questionnaire and then derive appropriate user interface features is unclear.

Ramos and Berry's guidelines for requirements engineering are grounded in their constructivist perspective on the RE process[7]. They argue that requirements engineers should not expect a single 'strong' version of reality but need to be prepared to work with stakeholders to understand each participant's values and beliefs, and to jointly construct the new system. Furthermore they state that the presentation of system innovation and associated organisational change as a rational, controlled process bears little relation to the reality of such change, where stakeholders may be inflexible, anxious and unwilling participants. Their guidelines provide high level advice about the processes of knowledge creation, knowledge representation and requirements invention, identifying the goals of each stage, the products, methods and the role of participants, as well as guidance on the choice of stakeholder representatives. They also encourage the analyst to consider not just the words used by each stakeholder, but to consider vocal characteristics, expressions, gestures, posture and clothing. The authors acknowledge

that the advice they provide is brief and that more detailed guidelines for analysts are required.

There has been little work within the RE community on techniques to identify stakeholder motivations and emotions, though some of the methods outlined above aim to encourage general reflection by the analyst on human issues and could result in the analyst considering motivations and emotions. Browne and Ramesh acknowledge the issue of stakeholders' conscious motivational biases, for example participants may be motivated by personal or financial gain [73]. They recommend that discussions should be held with stakeholders to identify their motivations prior to starting the RE process, although they do not provide any details as to how the analyst should go about this.

Research on the relevance of emotion to RE has tended to look either at the need to define and document affective requirements, or the impact of emotions during the RE process. Examples of the former include investigations into the use of 'emotional timelines' in computer games[74], and approaches to formalising and designing emotional requirements [43]. In these instances, rather than uncovering the emotions of stakeholders, the task is to define emotions the software user should experience; for example, a games player feeling fear and excitement or a student feeling interested and happy using educational software.

With regard to exploring the impact of emotions on the RE process, affect grids were used by Colomo-Palacios et al.[75] to monitor the emotions of both developers and users during the software development process. Affect grids are a two-dimensional attempt to assess emotional response in terms of pleasure and arousal. Perhaps unsurprisingly the study found that levels of high arousal and low pleasure were predictive of requirements conflicts. Throughout the RE process participants repeatedly filled in a grid based scale reporting on their levels of energy and pleasure. It is unclear from this study as to whether this tool could be used outside the confines of a research paper, it is possible that both users and developers would object to having their emotions monitored in this way. Ethnographic methods have been used to understand stakeholder emotions during the course of an academic study monitoring an industry software development, however as discussed earlier, whilst an effective research technique, the use of ethnography in industry is problematic [4]. Several studies have remarked on the need for analysts to be aware of users' emotions [76, 77], Apshvalka et al. recommend that analysts need to be:

“attentive to recognise stakeholders’ emotional states to avoid possible threats.”

These different approaches to the use of VM&E within RE and system design provide some useful examples about how this information can impact projects. Mumford’s research uses values to better understand users’ reactions to a software development, whilst Flanagan’s work provides an example of a pre-emptive attempt to use values to inform decisions about the user interface. However, the approaches lack appropriate support for an industry analyst in terms of the discovery of values, motivations and emotions; the methods discussed here are reasonable for research purposes but somewhat complex and time consuming, and likely to be inappropriate for industry RE work.

2.4 VALUES, MOTIVATIONS & EMOTIONS AND NON FUNCTIONAL REQUIREMENTS

Non-functional requirements (NFRs) describe desired qualities of a system such as security or usability. Whilst the concept of NFRs is widely recognised within the RE community, there is little consensus over its exact definition [78]. However, it is apparent from the numerous definitions and lists of NFRs, e.g. [6, 79] [80], that there is some overlap with terms used to denote personal values. Some value terms map closely to NFRs, e.g. trust, security, safety. Other values, e.g. esteem, sociability, aesthetics, map less directly but may be associated with NFRs such as usability and cultural issues. Other value terms such as innovation or curiosity do not map clearly to NFRs and might link more closely to functional requirements, for example, a belief in the value of altruism might suggest a willingness to use functionality that enables sharing or peer support. This section reviews the existing research into eliciting and analysing NFRs and considers the relationship between NFRs and VM&Es.

There is relatively little guidance on the elicitation of NFRs. Miller provides perhaps the most substantial work on the subject, cataloguing around 2000 questions intended to aid analysts in identifying NFRs when interviewing stakeholders [79]. The questions are focused on issues such as system performance, adaptability, extensibility and error recovery. Similarly, the Volere template aids the analyst by providing a list of NFR categories, e.g. ‘look and feel’, ‘cultural’, ‘legal and political’ [6]. The nature of this elicitation advice would indicate that NFRs are not equivalent to values, the templates and questions are intended to identify detailed properties of the system, rather than more abstract values or motivations such as sociability, ambition or safety.

The i* modelling language can be used to explore the ways systems can be configured in order to support NFRs. i* is widely used within RE research and assumes that actors involved in a transaction have strategic goals and do not just interact in terms of information flows or actions, but also through intent. The creation of i* models of goals, including agents, tasks, and resources, with agent attributes and different types of relationships, allows analysts to explore the opportunities and vulnerabilities of their designs. i* models can include non-functional requirements [80], referred to as soft goals: “a goal without a clear-cut criterion for achievement, thus requiring further refinement and judgement”, for example ‘quality’ or ‘flexibility’[81]. Hui, Liaskos and Mylopoulos investigated the use of i* to model ‘soft goals’[12]. The study looked at the customization of software for individuals, and developed a framework which explores the users’ goals, e.g. ‘improve communication’, their preferences, e.g. ‘preferred medium of communication’ and their skillset, e.g. the ability to use their preferred mode of communication. Hui et al.’s research concentrates on the modelling and representation of goals and assumes that the analyst has already elicited and analysed users’ goals. However the work provides little explanation as to how the detailed goal analysis might be carried out; the authors suggest running focus groups or questionnaires but do not explore this area further; though this is perhaps understandable given that the method is focussed on the modelling of NFRs. Although the work does not provide any advice that might support identification of VM&Es, the technique might be used after VM&Es have been identified, in order to identify the implications of users’ values and motivations upon a system, or to infer values or motivations based on the users’ stated goals

i* has also been extended to model trust and power relationships between people and the fit of technology within groups [13], with the aim of providing a tool to enable analysts to explore different socio-technical system designs. The extension includes facilities to model team members’ perceptions of each other and of the group, including assessments of the levels of trust, power and commitment. This allows the analyst to identify potential imbalances in relationships, and to explore ways of remedying such discrepancies. This use of i* demonstrates the worth of modelling concepts such as power and commitment which could be considered to be values, and raises the question of whether it would be useful to model the impact of other VM&Es. Power, trust and commitment are values likely to be relevant to many socio-technical system design, but

other values could be important to specific projects: for an example an assessment of levels of altruism and cooperation within a system dependent on people's willingness to share information, or an estimation of safety vs. risk taking in a system for monitoring stock market behaviours. Secondly, knowledge of users' values and motivations may have the potential to inform the decomposition, specification and prioritisation of NFRs.

Goal Oriented Requirements Engineering (GORE) considers the uses of stakeholder goals throughout the RE process, from eliciting and analysing requirements, through to documentation and prioritisation. Both functional and non-functional goals are considered, and many of the non-functional goals given as examples could also be construed as values, e.g. security, cooperation[81, 82]. A review of GORE research observed that identifying goals is not always straightforward[83] and it is plausible to envisage users' values and motivations may provide an additional means to identify goals. Similarly, a goal based approach could be used to trace links between users' high level values or motivations and specific pieces of functionality, Anton et al.'s review of privacy recommends the use of goal based specifications for this purpose [84], linking users' values around privacy to goals, and then to functional requirements. Their review recommends the use of scenarios and metaphors to explore users' conceptions of privacy and security.

Within the GORE tradition, the decomposition of stakeholder goals into underlying requirements has been extended to consider relationships between actors and goals [85]. The relationships represent the abilities of actors to satisfy goals, and the willingness of actors to work together, for example, their inclination to cooperate or to delegate the completion of goals to other actors: this could operate as a representation of trust within a group of users.

Whilst existing techniques to identify NFRs are focussed on a detailed understanding of the desired qualities of the system, and are perhaps unlikely to aid the analyst in identifying users' VM&Es, it is clear that there is some overlap, at least in terminology, between values and NFRs, and that values may have a role to play in identifying and specifying NFRs.

2.5 RE METHOD ADOPTION AND ADAPTATION

Several researchers have highlighted the failure of RE research to impact industry practice. Davis and Hickey observed that the low rate of uptake of new methods and

technologies is frequently blamed on poor communications between academia and industry, or on a failure on the part of industry analysts to engage with the research literature[46]. They dispute these reasons, and encourage academic researchers to engage with industry analysts to better understand analysts' requirements for methods, in particular highlighting the need for situational research and analysis of RE communication processes. Berry and Lawrence comment that a focus on the 'Engineering' aspect of Requirements Engineering has led researchers to concentrate on technical problems, and a failure to consider the wider operating context, including the stakeholders' views and the social structure [86]. Moody makes a similar criticism of Information Systems (IS) research, remarking that IS is an applied discipline which should carry out research which meets the needs of industry practitioners, and that methods should have industry input and validation if they are to be adopted[87]. Hansen and Lyytinen comment that the RE research community has not kept pace with the changes in industry requirements practices[10]. Their study of challenges facing industry analysts identifies a number of social issues including managing the relationships between business and the IT team, and conflict resolution. They call for the development of practical guidance to aid analysts in addressing socio-technical issues.

A number of studies have investigated the causes of this failure to transfer research to industry and identified factors likely to increase method uptake and impact. Research looking specifically at the transfer of RE methods into industry identified a number of barriers, primarily that much RE research is done without significant involvement from industry, as well as a lack of industry training in new methods, the inherent complexity of applying methods to real world problems and difficulties in integrating new methods with existing practice [88, 89]. More general research on technology transfer identified similar issues, as well as the difficulty of demonstrating a clear advantage of a new method over current practice, and also that much academic method validation is carried out on small test cases which do not account for the complexities of real world problems [90]. All of these studies highlight the need for academic RE researchers to work with industry partners to give their research credibility and to ensure the relevance of the research to industry problems. Compatibility with current practice is also a significant factor when deciding whether to adopt a new technique [90]. Sawyer, Sommerville and Viller looked specifically at how to integrate new RE techniques into existing industry

practice observing that the success or failure of integration of new tools into existing practice is crucial to determining whether a new technique or tool will be adopted[91]. This study commented that the RE community underestimates the difficulties of introducing new techniques, and that industry analysts need to understand both the benefits and the costs of a new method before they will consider trialling it. Secondly, they recommend that new methods allow for flexibility in the ways in which they are adopted and adapted into existing practice. This observation corresponds with research into industry adoption of agile practices, which demonstrated the significant extent to which methods are adapted by industry users. Cao and Ramesh's study of 16 software development organisations who described themselves as 'Agile' found that each organisation used its own version of Agile, mixing and matching a variety of practices[92]. These findings agree with other studies of method adoption: an industry report on the adoption and adaptation of Agile practices which found that the majority of respondents integrate components from multiple methods to create a custom process suitable to their own circumstances [93]. Similarly, a set of four case studies investigating the adoption and adaptation of object-oriented RE methods found that each organisation had developed their own methods based on a combination of the 'cookbook' method and their experiences of what was most useful to their particular circumstances[94].

It is clear that industry involvement is critical to effective RE method development, both in developing a set of requirements for any new method, and in evaluating proposed solutions. Furthermore, when evaluating new methods with industry partners, researchers should anticipate and allow for method adaptation.

2.6 SUMMARY

This chapter has reviewed the current advice to analysts on the elicitation and understanding of users' values, motivations and emotions; whilst the need to consider such information is widely acknowledged within the main RE texts, there is little detailed advice or support for industry analysts. Academic studies of values, motivations and emotions have used a variety of techniques including questionnaires, ethnography and discourse analysis, but it is doubtful whether these techniques could translate to industry RE practice.

A review of NFR research concluded that techniques used to elicit stakeholders' views on NFRs are unlikely to identify values or motivations, but identified several opportunities to make use of information about users' VM&E.

The literature on RE method adoption and adaptation emphasises the importance of industry involvement and the development of flexible methods that can integrate into existing industry practice.

Chapter 3 Current Analyst Practice

3.1 INTRODUCTION

Chapter two's literature review established the relevance of users' values, motivations and emotions to the requirements process, and demonstrated there was a shortage of advice or methods to support analysts in eliciting this information. The investigation presented in this chapter explores these topics with practising requirements analysts. Semi-structured interviews were used to elicit analysts' views on the relevance of users' values, motivations and emotions on their work, and to investigate their approaches to eliciting and using this knowledge.

This chapter begins by describing the study goals, the rationale for taking a qualitative approach to the study, and the activities undertaken to try to ensure validity. Next the study method is described in detail, including the interview analysis process, the approach to recruitment, and a summary of the characteristics of the participants. The results and discussion section provides an overview of the key themes, and goes on to expand on the findings and their relevance to this thesis.

3.2 STUDY GOALS AND DESIGN

Whilst there have been a number of studies exploring the skills and competencies of effective requirements analysts and asking analysts about their experiences of their work, to the best of the author's knowledge there have been no studies specifically seeking analysts' views on eliciting and making use of users' values, motivations and emotions. This chapter presents a set of interviews intended to address the first of the thesis research questions set out in chapter one:

RQ1. Do practising requirements analysts consider users' values, motivations and emotions when analysing system requirements?

This research question was broken down into the following four questions which informed the design of the interview guide:

- 1a. Do analysts have an interest in understanding users' values, motivations and emotions as a part of their requirements work?

- 1b. What are analysts' experiences of projects where users' values, motivations and / or emotions have positively or negatively affected the outcome?
- 1c. Do analysts actively attempt to elicit this information, and if so, how?
- 1d. Do interviewees have examples of instances where they have made use of this information, and what was its impact on the requirements process and /or outcomes?

The goal was to gather information about analysts' experiences, examples of good practice, gaps and issues, and therefore an approach which allowed for the collection of rich detailed answers from the analysts was required. To that end, a qualitative approach was adopted, consisting of a thematic analysis of a series of semi-structured interviews. The use of semi-structured interviews ensured the key research questions of the study were covered, and provided basic consistency between the interviewees, but allowed some flexibility to explore topics of interest with the subjects as and when they arose[95, 96]. A limitation of this approach is that both the interview itself and the analysis demand a substantial time investment from the participants and the researcher, therefore the number of participants that can feasibly be included is lower than might be achieved using a more structured approach such as a questionnaire. However, given that requirements analyst's views on 'soft skills' are not well characterised in the literature, the semi-structured interview and thematic analysis enables an inductive exploratory analysis of the research questions; in contrast a questionnaire based approach would provide limited opportunities to explore the topics with respondents.

The thematic analysis process uses codes to study qualitative data in a structured manner, allowing the discovery and analysis of themes[96, 97]. Given that thematic analysis introduces a layer of interpretation into the analysis, it is important that mechanisms are in place to support a rigorous and transparent analysis. This investigation has followed guidance on good practice in the design and reporting of qualitative information systems research [97, 98] and the construction of themes [99], including the use of the research questions to derive the interview format.

In this study, interviews were audio-recorded and transcribed, then coded using NVivo Qualitative Analysis software [100]. The codes are short phrases embodying concepts within the text, e.g. 'Elicitation Technique' to identify sentences or paragraphs in each interview when an analyst described an elicitation technique. The use of codes allows an exploration of the frequency and patterns with which concepts occur and the codes act

as place markers linking back to the original text. There are a variety of approaches to developing the set of codes, or ‘coding schema’ for a study, and the approach adopted depends on the purpose of the study, from a deductive hypothesis driven approach where sets of codes are defined in advance based on the hypotheses to be tested and strictly applied, in contrast to a purely inductive Grounded Theory approach[101], where all codes are defined during the analysis process and no preliminary coding schema is prepared. This study adopted an approach informed by [96, 102-105], where an initial set of codes are defined based on the semi-structured interview plan. This set of codes is applied during the analysis of interviews, and extended with new codes to capture greater detail and relevant but unanticipated findings. The approach provides some steer to the analysis to ensure the initial research questions are addressed but provides some flexibility to explore new ideas.

3.3 METHOD

Figure 3-1 summarises the approach taken to designing and executing the study. Having defined the research questions the study would address, the first step was to develop an interview plan, followed by an initial list of codes. As outlined above, this code list was derived from the interview plan. The plan and code list were then reviewed by the author’s supervisor, and both were revised based on this feedback. The author then commenced interviewing volunteers according to the plan. Each interview was transcribed and coded using NVivo, during coding the initial set of codes was applied and extended with additional codes as the analysis proceeded.

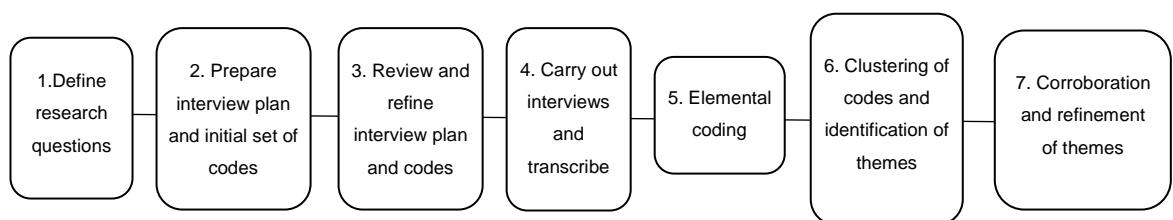


Figure 3-1 Overview of the study method

On completion of a first pass of coding of all the interviews, similar codes were then grouped into clusters around particular themes of interest, e.g. codes such as ‘Users don’t want to be responsible’ and ‘User’s perception of status’ ‘were grouped under an ‘Users’ VM&E’ theme. In some instances codes were included in multiple themes. A subset of these themes relate to the original research questions, and in addition, new

themes identified during the course of the analysis emerged. Appendix B provides two examples of the application of codes to interview quotes.

Finally the themes and underlying codes were reviewed by the interviewer in conjunction with her supervisor in order to identify inconsistencies in coding and refine the themes.

3.3 a Interview Plan

A semi-structured interview script was developed to address the research questions outlined above. The core questions were:

1. Are you aware of users' values, motivations and emotions?
2. Do you have examples from projects when users' values, motivations or emotions have impacted the work – positively or negatively??
3. Do you choose to make use of information such as users' values, motivations and emotions? If so:
 - a. Do you have examples from projects when this knowledge has proved useful?
 - b. How do you gather this information? Do you use any particular techniques?
 - c. Do you document or share these soft 'requirements' with others involved in the project? If so, how?
4. Would you make use of a method to help identify users' values, motivations and emotions?

The full interview script is provided in appendix B: additional questions gathered details of the participants' educational background, training in requirements engineering and current work. Whilst the core interview script was followed with all participants, respondents were encouraged to expand on their views and share any experiences they felt were relevant.

3.3 b Recruitment

Interviewees were recruited through personal contacts, requests for volunteers at conferences and or postings on computer science and requirements engineering related

forums. Interviewees were screened with a short questionnaire to ascertain their job role and experience, followed by a longer interview for volunteers who considered requirements analysis to be a core component of their role (40% or more). As far as possible, participants were chosen to give a set balanced for gender and experience, and with a wide range of educational backgrounds.

UK based analysts were interviewed either in person or over the phone (one of these analysts then followed up an in-person interview with an email.) Two of the users were based abroad and were interviewed initially by email, with follow up phone conversations. All interviews were audio-recorded and transcribed.

3.4 RESULTS AND DISCUSSION

The results and discussion section is organised as follows:

3.4a An overview of the participants' educational background and work experience.

3.4b High-level summary of the top-level themes identified during the thematic analysis.

The following sections then examine the four research questions in detail, looking at the relevant top-level and sub-themes. Tabular summaries breaking down the main themes into the underlying codes are provided, followed by a discussion and illustrative quotes from the participants:

3.4c Do analysts have an interest in understanding users' values, motivations and emotions as a part of their requirements work?

3.4d What are analysts' experiences of projects where users' values, motivations and / or emotions have positively or negatively affected the outcome?

3.4e Do analysts actively attempt to elicit this information, and if so, how?

3.4f Do interviewees have examples of instances where they have made use of this information, and what was its impact on the requirements process and /or outcomes?

3.4g Making use of Users' VM&E in requirements definition.

3.4h Making use of Users' VM&E in running the requirements process.

3.4i Documenting and sharing knowledge of users' VM&Es

3.4j Analysts' views on the development of a method to support elicitation of users' values, motivations and emotions.

3.4 a Participants' Education and Work Experience

Table 3-1 provides a brief summary of key characteristics of the participants. All identifiable information including participant, company and project names has been removed from this table and throughout the chapter. Participants are referred to using an alphabetic analyst id (column 1). Twelve analysts were interviewed, with 1-20 years' experience, and varying degrees of RE training ranging from 'on-the-job' learning to higher degree level courses. They worked in a wide variety of industries, including pharmaceutical research, finance, education, new media and local government, and had a variety of job titles: business analyst, informatician and user experience consultant to list but a few. Despite the variety of job titles, all reported that requirements analysis was a significant activity within their role. The user groups with which the analysts worked also varied, with some having a long standing relationship with a group of internal customers, others working with many different external or internal customers.

All of the analysts interviewed for this study were educated to at least undergraduate degree level. Six of the participants held undergraduate qualifications in Computer Science, whilst five of the remaining analysts held degrees in other specialisms related to the domain for which they developed software, e.g. biology, chemistry. These analysts had switched career path from being end users of software into a business analysis role. One analyst had a background in law and information science, and although not currently involved in developing software for these domains felt her background provided relevant transferable skills in problem analysis and requirements documentation.

Three of the analysts with a background in computer science had received some training in requirements analysis as a component of their degree. Of these, two expressed the sentiment that this training had not prepared them for the realities of working as a requirements analyst, whilst one had studied a sandwich degree with time spent in industry, this included some exposure to requirements analysis. Of the remaining three, two believed that they had completed their degree studies before requirements analysis would have been considered a component of a computer science degree and one

Chapter 3 – Current Analyst Practice

described a curriculum which emphasised mathematics and artificial intelligence and did not include study of any end user focussed disciplines.

Table 3-1 Summary Characteristics of the Analysts

Analyst Id	No. of years' RE experience	Industry sector	Gender	Educational Background	Requirements Engineering training	Location
A	7 years	Software Development support tools	M	Computer Science BSc	Module of degree, on the job	Germany
B	3 years	Pharmaceuticals	F	Bioinformatics BSc	On the job	UK
C	9 years	Computing	F	Law BA, Information Sciences MA	Formal training within company, on the job	USA
D	9 years	Pharmaceuticals	F	Computer Science BSc PhD Chemistry	Formal training within company, on the job	UK
E	1 year	Healthcare	M	Nursing BSc, Health Informatics MSc	On the job	UK
F	1 year	Healthcare	M	Computer Science BSc	Module of degree, on the job	UK
G	15 years	Various (Contractor)	M	Computer Science BSc	On the job	UK
H	20 years	Various (Contractor)	F	Computer Science BSc	Occasional formal courses via workplace, on the job	UK
I	15 years	Finance	F	Computer Science BSc	Formal course via workplace, on the job	Germany
J	6 years	Bioinformatics	F	PhD Bioinformatics	On the job	UK
K	4 years	Petrochemicals	M	Chemistry BSc, PhD Chemistry	On the job	UK
L	5 years	New media	F	Graphic Design BA, Information Science MA	On the job	UK

Once in industry and working as requirements analysts, all the analysts reported that their main means of requirements analysis training were, not surprisingly, on-the-job training and mentoring (either formally or informally) from more experienced analysts. The main focus of most internal on-the-job training was developing an understanding of their organisations' approach to requirements analysis. Several of the interviewees also

reported more formal requirements analysis training undertaken whilst in industry, again this was training in particular approaches to analysis or software development, either the company's own internal method or preferred external approach such as UML. One analyst described attending a course in 'Interviewing Skills', involving role playing of stakeholder interviews, and considered this one of the most useful pieces of requirements analysis training they had received.

3.4 b Top Level Themes

Table 3-2 provides an overview of the main themes identified during the analysis. These themes correspond to the interview questions plus additional themes identified during the course of the analysis. The themes are discussed in more detail below; the final column of the table directs the reader to the relevant sections of the chapters.

Table 3-2 Summary of occurrences of top-level themes across all twelve interviews

In this table, and in the similar tables in this chapter, two figures are provided. The first is the total number of occurrences of the theme across all 12 interviews (1-n). The second is the number of unique interviews in which the theme occurred at least once (a number between 1-12).

Top Level Themes	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)	Discussed in chapter section:
Elicitation Techniques	111	12	3.4e, 3.4f
Identification of user or users VM&E	75	12	3.4d
Making use of VM&E information in running the RE process	62	12	3.4h
Participants' education & work experience	44	12	3.4a
Difficulties understanding or acting on users' VM&E	37	11	3.4c, 3.4e
Requirements for a VM&E elicitation method	27	12	3.4j
Documenting or sharing knowledge of VM&E	27	12	3.4i
Making use of VM&E information in requirements definition	21	10	3.4g
Issues in analyst - user relationships	19	12	3.4c
Relevance of users' VM&E to RE	12	12	3.4c

3.4 c Do analysts have an interest in understanding users' values, motivations and emotions as a part of their requirements work?

Participants were asked whether they thought users' values, motivations and emotions were relevant to the requirements analysis process, and whether they made use of this type of information in their work. All the analysts acknowledged the usefulness of understanding users' VM&E, though many of the interviewees went on to say that they found identifying and acting on this information problematic. This section looks at the analysts' reflections on the relevance of users' VM&E and the problems they reported.

It was noticeable that when asked 'Are you aware of users' values, motivations and emotions?' the starting point for the majority of analysts was a description of their experiences of negative user emotions such as anxiety or anger. They gave many examples of user behaviours associated with negative responses, such as unwillingness to participate in the requirements analysis process and combative meetings. Clearly these situations had made an impression on the analysts concerned:

Analyst E "Some of the users were very angry about the plans, we felt they were being unfair."

Analyst F "There wasn't anywhere to document it, and I didn't raise it at our [project team] meetings, so it just got ignored until it blew up."

Many of the analysts remarked that they had not considered users' values, motivations and emotions until they became aware of unhappy users. Emotional reactions can be a signifier of an underlying clash of values or motivations; section 3.4 below looks in more detail at some of the examples analysts gave of occasions when negative user reactions signalled deeper motivational issues or values clashes.

Perhaps understandably given their experiences of unhappy users, analysts were very conscious of negative emotional reactions to projects. They talked about the need to understand users' values and motivations as ways to ensure the project was acceptable to users, so that they could 'sell' the software or participation in the requirements process. However, although all the interviewees remarked that they knew this information was important to a successful project, many went on to say they found gaining this understanding, and then acting on it was sometimes challenging. Table 3-3 below documents the different problems identified by the analysts in making use of information about users' values, motivations or emotions.

Table 3-3 Breakdown of the theme “Difficulties understanding or acting on users’ values, motivations and emotions”

Difficulties understanding or acting on users’ VM&E	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)
Not knowing what to do with information	12	11
Issues caused by dismissing users’ VM&E	8	5
Belatedly identifying a motivation issue	7	7
Ignoring users’ negative emotional reactions	6	6
Belatedly identifying a value clash	4	4

Some analysts commented that they had lacked awareness of the need to consider human issues when they first started work:

Analyst D “The training courses I’ve been on have always been about tools and management, change control and so on, which is important, but there isn’t enough emphasis on understanding your users.”

Analyst G “At that time,[his undergraduate education] I would definitely count as very introverted, very techy, scared of these funny 3D things called people, and therefore the courses that I took through my undergrad degree were the techy courses. None of these funny people type courses. But actually, I’m more of a people person than that, it turns out.”

The most frequently cited issue was the problem of not knowing what to do with information about users’ values, motivations or emotions. In the majority of cases analysts described becoming aware of an emotional reaction, but did not know what to do:

Analyst E “I volunteered to be interviewed by you because I know I struggle with this stuff. I mean I can tell if a meeting is starting to go wrong or someone is getting upset, but I’m not sure what to do.”

Analyst B described being aware of the dynamics of relationships within a project, and the effect of emotional ties but was not sure how to address the impact on her work.

Analyst B “I believe this lady genuinely cares about the people she works with, and often mixes work discussions with informal chats. She displays a motherly relationship towards myself and the developer, but I believe the motives are genuine. The developer has a much closer relationship with her than with the other domain leads and on

occasion, has placed more priority on her requests than requests submitted by other members of the team.”

Analyst A described a project early in his career during which he had been confused by users' behaviour. The project had floundered, and it was only when looking back at events that the analyst realised that although his user group had been told to support the software project, none of them wanted the project to go ahead.

Analyst A: ”It was not very direct. On the table, they were cooperative and friendly to us, they showed us around and invited us to meals, so they were giving us the impression that they wanted to cooperate but they just provided requirements that contradicted this impression?”

Several of the analysts recognise the ability to pick up this information is an important but intangible part of their job, and commented on how hard it is to pin down exactly how to access this information.

Analyst D: “I have one colleague who is particularly good at this kind of thing, picking up on what's going on. I don't know exactly what she does; she just knows the right thing to do.”

Analyst B: “I was invited to a business analysis practitioners' meeting.. ..All of us recognised that ultimately the qualities of a good BA came down to building trust with the users and understanding their values. We all agreed however, that such qualities are difficult to quantify and so we just moved on to the skills that were easier to measure and break down into smaller components and techniques.”

Analyst B: “But I wasn't really paying much attention to the emotions that came out during my interactions with them[the users] and there were many. I wouldn't even know what to do to act on it! One thing I know is that the project goes a lot more smoothly when all members of the team feel they are getting something out of it. Not just the product, but some sort of recognition of their values.”

3.4 d What are analysts' experiences of projects where users' values, motivations and / or emotions have positively or negatively affected the outcome?

All of the analysts volunteered examples of projects where users' values, motivations or emotions had an impact on the project, this section looks at the specific VM&E identified by the analysts. Table 3-4 summarises the values, motivations and emotions

the analysts felt had impacted their projects. A distinction is made between situations where users' values, motivations and emotions have been a factor within a project but the analyst did not anticipate this until problems arose, versus situations where analysts have purposely and proactively made use of such information within their work. There were many more examples of analysts belatedly identifying soft issues as a problem within their project, only a small number of analysts described considering users' values, motivations or emotions in advance of any difficulties, the latter are discussed in section 3.6.

Table 3-4 Values, motivations and emotions identified by the analysts as relevant to their project(s)

Values, motivations and emotions identified by interviewees as impacting their projects	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)
Expertise	10	5
Ownership	9	4
Status	8	5
Anxiety	8	5
Anger	7	4
Peer Esteem	6	3
Resistance to change	5	5
Mistrust	5	3
Independence	3	1
Responsibility	2	2
Openness	2	2
Lack of confidence	2	1
Happy	2	2
Willing to collaborate	2	1
Security	2	2
Innovative	1	1
Ambitious	1	1

Examples of emotions signifying underlying problems

Many of the analysts told stories about situations where they had failed to consider the motivations and values of end users, and the consequent strong negative emotions expressed by users. One of the most experienced analysts observed that she and her colleagues notice negative emotions but aren't always willing to explore the causes:

Analyst C: "Well I think we do [notice users' emotions] but we don't explicitly do it, so we don't really know what we're doing with it, we run across them, we say 'oh that guy

got really angry about something' but then we just back off instead of trying to explore what it is that led to that and what's underlying that we need to consider."

One of the novice analysts, E, described working on a project to develop a new patient records system at a hospital, a project which was eventually closed before delivering the anticipated benefits. E believed the project's failure was in large part, down to the project team failing to anticipate the motivations of the clinicians who would use the system. The language he used to describe the project meetings indicates the strong emotions felt by both the users and the software team:

Analyst E "We could have saved so much heartache and heartbreak if we'd done a better job with that group [referring to the clinicians]."

Analyst E talked about the consultants feeling they should have been consulted much earlier in the software design process, as they believed they were the domain experts. Analyst E agreed that belatedly asking the consultants to review a design, rather than seeking their views before creating the new design was a mistake, the consultants had already heard about the project and decided not to support it because they had felt excluded.

Similarly analyst J talked about working on a project that was intended to promote information sharing for a community of users who had never previously shared their data, the results of scientific experiments. The software team had not anticipated how strongly users would reject this proposal, and were taken aback at the bad reaction when they asked for volunteers to contribute to the requirements work:

Analyst J: "We had all the researchers at a meeting and the project manager gave a talk about the system and all the benefits it would bring, and I thought it had gone really well. Then when the audience got to ask questions, it was the worst. Basically they'd all been signed up by their managers but everyone was refusing."

This poor reaction led the software team to explore the concerns raised by the users and to understand the motivations behind the scientists' unwillingness to share: they were concerned about career progression and felt sharing their data would allow other researchers to make capital from their work.

Positive emotions

However, whilst all the interviewees acknowledged the usefulness of understanding users' negative emotions there was little mention of positive emotions, only two of the analysts described occasions when they recalled users reacting positively to a piece of software development, e.g.:

Analyst B [describing a user the analyst considered unusually emotional]: "She [the business representative] tends to put a lot of emotion into her feedback, using phrases like: "you've made me very happy".

Analyst C: "Our new system was saving these guys hours, more control, more information, they loved it. I went to give a training course and they'd already taught themselves."

Positive emotions could also be considered signals to aspects of a job that a user particularly values, and might object to being automated. Encouraging analysts to identify the aspects of a job that a user feels positively about might aid in prioritising which aspects of a process to automate.

Working with user motivations

Several of the analysts said that they make a point of trying to anticipate whether users will be willing participants in the requirements process, and what might motivate people to participate. One of the analysts remarked that this was something he had learnt to do after a difficult experience on one of his first projects:

Analyst A: "The way I ran some of my earlier work, I was naïve. I thought if the company's management had said – we'll have a new system and we'll all work the same way – then that was what would happen, and of course it wasn't. Everyone wanted to carry on doing things their own way."

Another interviewee described a project to develop a software system to operate across several universities. Initially users viewed participating in the software development as a chore and a distraction from their own work, however the requirements team were able to develop a 'project champion' role which gradually gained status and gave the champions opportunities to further their own careers, this motivated further volunteers.

Analyst H described the problems caused by the conflicting motivations of senior and junior members of a school's teaching staff. She was involved in developing an intranet

for the school, which included an area allowing teachers to upload lesson plans, worksheets and other teaching resources. This requirement was requested by the school's departmental heads who were keen to see their teaching staff sharing resources, viewing it as a way to protect against staff sick leave or departures and as a means of sharing best practice. However, on further discussion with some of the more junior department members, it became clear that many of the teaching staff felt a strong sense of ownership over their own teaching materials, and were concerned about sharing materials with colleagues: some members of staff were anxious about criticism, whilst several of the teachers were motivated by career progression and were not happy to share their own work with colleagues they viewed as rivals for promotion.

Understanding values

Analysts were less directly aware of understanding users' values and often took some time to think of examples of their stakeholders' values, but many of the projects they described included examples of systems either conflicting or agreeing with users' values. In some instances this was intentional, the system was being introduced in order to promote different values and resultant actions, e.g. to encourage altruistic behaviour in competitive users. In other cases the clash was not intentional. Analyst H discussed developing a system she was involved in implementing for social workers. She commented that the social workers felt that secretarial work was low status and 'not part of their day job', implying that they valued other aspects of their jobs. Consequently they were concerned at the prospect of a new computer based system for case management they would be expected to use, and had not been motivated to participate in the requirements work for the project, or use the resulting system.

Several of the stories the analysts recounted included examples of system requirements embodying values which were either in conflict or agreement with users' values, for example promoting the sharing of information between groups who valued privacy and ownership of their data. One of most experienced analysts, C, described difficulties in defining requirements for a system integrating several existing internal project management systems from different areas of an organisation, because each group felt a strong sense of ownership for their own system and was unwilling to consider alternative approaches.

Many of the analysts described their users valuing their own expertise and wanting this to be respected by and reflected in their software systems. Two of the analysts' examples demonstrate the impact of this:

Analyst D: “One of the groups of physicists I work with is exceptional, they still almost exclusively work at the command line, they don’t like to use Windows. They aren’t really that keen on working with IT either but sometimes they need our help! They like being different to our average users. We were looking at storage management solutions with them and their reasons for rejecting some of the suppliers seemed to come down to not wanting a GUI because that’s for normal people.”

Analyst B described a situation where the development team had initially been confused by user preferences for what appeared to be an inefficient user interface design, before realising that the users valued the sense of discovery and intellectual challenge provided by the interface:

Analyst B “We ended up going with a design that seemed more laborious [for the user] to the development team – but the scientists just liked it better because they like to explore the information. The first design, which presented it all to them on a plate just felt like they weren’t getting their hands dirty or doing any research.”

3.4 e Do analysts actively attempt to elicit this information, and if so, how?

Analysts were asked whether they used any particular techniques to gather information about users' values, motivations and emotions. Responses to this question fell into one of three distinct categories:

- A. Two analysts reporting that they don't have any methods to try to elicit users' values, motivations or emotions, and they felt unable to ever identify this type of information about their users.
- B. Five analysts reporting that they don't have any methods to try to elicit users' values, motivations or emotions, but that they sometimes serendipitously learn about users' values, motivations or emotions.
- C. Five analysts reporting that they actively attempt to gain an understanding of users' values, motivations and /or emotions.

Both the novice analysts and many of the intermediate analysts fell into either group A or B. Group C was composed of analysts who described their own approaches to

understanding users' VM&E, developed through experience. Table 3-5 groups the responses by the experience levels of the analysts, and the discussion below elaborates on these findings:

Table 3-5 Summary of analysts' self-assessed ability and approaches to eliciting users' values, motivations and emotions.

Analyst experience level	Group A: Never able to pick up on users' values, motivations or emotions	Group B: Sometimes able to pick up on users' values, motivations and emotions, but don't actively look for this information in advance	Group C: Actively attempt to anticipate users' values, motivation and emotions
1-4 years – Novice (n=4)	2	2	0
5-9 years – Intermediate (n=5)	0	3	2
10 or more years – expert (n=3)	0	0	3

It is not surprising that the most experienced analysts had more methods at their disposal, developed through time and experience. Two of the most experienced analysts, analysts I and H, described their own methodical approaches to try to increase their ability to pick up on users' emotions and values, both included attempting to:

- Reflect on potential motivational issues or clashes between the project's aims and users' values before meeting with users.
- Look out for evidence of these anticipated problems in interactions with users – considering body language as well as what people said.

Analyst I: "I gather the information by observation of both the person's behaviour versus their words and by their interactions with others. I try not to discuss my suspicions until I have had a chance to test them. I test them by changing my behaviour to reflect the way that I sense the other wishes to be treated. If it works, in other words I see the results I expect, I continue with more of the same. If it doesn't, I go back to observing until I detect a pattern."

Analyst I: "I like to look back through my notes after an interview and think about what was going on - I'm too busy in the interview writing and thinking about the questions... sometimes I look back and there's so much more there."

Analyst H: “Body language is very informative. You can’t directly ask someone how they feel, the secretaries were very anxious about their jobs, but it was apparent from their body language and our conversations. I think they would have been very defensive if I’d asked them directly.”

Analyst H: “I make a point of trying to work out what an interviewee is not telling me – sometimes that means they’re not telling me something for a reason, often times they’re not doing it on purpose. I try to think about their body language as well as what they said during the interview, tense? Defensive? Why are they feeling that?”

It is clear that, with experience analysts develop the ability to think about the human aspects of their projects, and develop their own methods to help them anticipate and elicit this information. It is notable that none of the analysts described directly asking users’ about VM&Es, rather they reflected on the user’s words, behaviour and body language. Three other participants (two novice and one intermediate) made comments to the effect that they would not consider directly asking a user about VM&Es:

Analyst F “I can’t imagine just asking someone, I’m there to talk about computers.”

However it may not always be necessary to use any elicitation techniques or reflection, one of the analysts remarked that she did not have to make any effort to understand her users’ emotions!

Analyst D “The lot I’m working with at the moment, if they’re not happy, I know about it!”

3.4 f Do interviewees have examples of instances where they have made use of this information, and what was its impact on the requirements process and/or outcomes?

This section looks at occasions when analysts described acting on their knowledge of users’ values, motivations and emotions. It should be noted that, although there are many examples of the ways analysts had made use of their learning about users’ VM&E, the majority of these cases were based on learning about users’ VM&E that had taken place after the requirements process had run into problems. There were two main categories of use, firstly: in making decisions about requirements and secondly, in running the requirements elicitation process. These two categories are discussed in this

section, followed by discussion of the ways in which analysts document and share VM&E knowledge.

3.4 g Making use of Users' VM&E in Requirements Definition

Table 3-6 contains a summary of the different ways analysts described using VM&E information to inform requirements.

Table 3-6 Summary of the ways analysts use users' values, motivations and emotions in defining requirements

Making Use of Users' Values, Motivations and Emotions in requirements definition	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)
Identifying values/motivations the system should support	11	7
Choosing not to implement a feature / system because of a VM&E clash	5	5
Determining how to divide work between the end user and the system	3	2
Deciding how to present information back to the users	2	1

Most of the examples the analysts gave focussed on using information about users' values and motivations to identify new features, such as:

- Medical researchers were uncomfortable with a system intended to enable the sharing of experimental results, two new features were added to encourage uptake:
 - Fine-grained sharing controls to allow control over which results were shared.
 - The ability to see who has viewed your shared data.
- Automation of a manual book-keeping system: the book-keeping staff were concerned at deskilling and felt that their jobs were at risk (their jobs had previously required excellent handwriting.) The requirements scope was extended to include automation of a number of tedious end-of-month auditing tasks with the aim of encouraging the staff to support the system.

Two of the analysts talked about using knowledge of users' values or motivations to determine which aspects of a system should be automated. Analyst C observed that:

Analyst C: “We certainly have situations where the most rational technical decision or implementation may be the worst decision from the perspective of the people that have to work with the system, and knowing that up front is really essential, and I know there are situations where things like that have been missed during elicitation because people say, “well we need to be efficient, we need to be effective” and if there still are going to be people there you have to make sure that whatever is efficient and effective actually works for them”

3.4 h Making use of Users’ VM&E in running the requirements elicitation process

Table 3-7 lists the different ways analysts described making use of users’ VM&E during the elicitation process. Examples include making adjustments to the requirements elicitation process, such as bringing together users’ with differing values in order to encourage awareness of other viewpoints, reaching out to users who were excluded from the requirements process or changing the pace of the software project to give anxious users time to adjust and contribute:

Analyst H “Listening to body language and people’s feelings -sometimes you have to slow a project down to let people become ready for it, or take time out to get consensus”

Table 3-7 Making Use of Users’ Values, Motivations and Emotions in running the requirements elicitation process

Making Use of Users’ Values, Motivations and Emotions in running the requirements elicitation process	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)
Modifying the format of the RE work	23	12
Awareness of analyst image	11	6
Taking charge of the RE process	7	6
Targeting “difficult” users	6	5
Giving control to users	6	6
Identifying the need for additional RE work	5	4
Motivating stakeholders to participate in requirements work	4	4

The most frequently cited approach was the use of meetings or workshops to bring together stakeholders in order to address conflicts between users. Analysts talked about wanting to encourage users to understand each other’s points of view, to build trust and to reach compromise:

Analyst L “If you’re in the middle of two lots of people, and they’ve got issues with the other groups’ requirements, it’s sometimes helpful to get them all together to understand each other.”

Analyst C “It was often the first time that people from one part of this giant process talking to someone from another part and actually in a room with them... I think if we hadn’t done that and brought people together to talk about it everyone would have said “no this is the way we do it because this is the way our data has to come out” and someone else would say “well this is the way data has to come in” so it was part group therapy and part RE, but it was getting everyone to say this is the way the system needs to be.”

Analyst D “The chemists, and the biologists, they both think they’re the most important, and I’m trying to bring them to compromise”

Many of the analysts also talked about being aware of their own image and about creating positive impressions with users. Some of these examples focussed on physical appearance: two female analysts talked about purposely dressing in a more masculine fashion in order to appear more senior or to work with a group of male users. In contrast, one analyst talked about dressing more casually in order to integrate with a group of laboratory scientists. Other examples focussed on projecting particular values to users, wanting to appear open and friendly, or to be viewed as neutral.

Analyst G “First off, establish that we’re not on anybody’s side. We’re neutral, our objective is to get the best possible solution within the constraints of the organisation, and we’d actually agreed that line with the chief exec beforehand. One major advantage with highly political chief execs is that they’ll often let you do that kind of thing, whether they actually agree with the wording or not!”

The subject of control of the requirements analysis process was frequently mentioned, analysts gave instances of occasions when they had asserted their control, for example in addressing conflicts between users, managing workshops or actively selling the system to users:

Analyst G (talking about running a workshop): “If you’ve got a loud mouth you have to find a way of shutting them up, if you’ve got someone who has said for the 17th time that their requirement is absolutely critical and must be in, and you can see everybody else rolling their eyes.”

In other examples analysts attempted to get buy-in from users or to reassure anxious users by giving some of the control of the requirements process to the users:

Analyst C: “Sometimes it’s the low power, low hierarchy people who get left out of the workshop, like the receptionist. And actually they are critical, you’ve got to get to them.”

Analyst H “They were very worried, and to try to help them feel more in control we gave them all the options, got them to decide how to order the work, the requirements work and the roll-out.”

Analyst I “I worked with a lady a number of years ago that had the reputation of being a dragon. No one seemed to be able to deal with her. She always found fault with the requirements, often for the most unreasonable of reasons. When I was assigned to work with her, one of the first things that I noticed was that she wanted to feel in control, that she was the person who had the final say in whatever happened to the application. She wanted to be catered to, to feel important and to be treated as such. The first thing that I did was to begin writing the requirements in the way that she wanted them written. After that, I made her feel that she was in the driver’s seat, that she was the person in control. After that, it was easy to influence and negotiate with this person whenever needed.”

Many of the analysts had talked about wanting to understand users’ motivations in order to encourage participation in the requirements process. Analyst G described using past knowledge of hospital consultants to find ways to motivate participation in a new project:

Analyst G “Before we started I knew from previous projects that it’d be hard to get the consultants to come to the meetings, I’d have to get them interested.”

One of the expert analysts described an early project she had worked on, when reassuring anxious users and finding ways to motivate them was critical:

Analyst H “I was working on a book-keeping system, the first time this office had ever had computers... All the women that work there had been employed because they had beautiful copper-plate handwriting – and now they were going to change to keyboards, so you can imagine how worried these women were! I had to work really hard to understand how they were feeling and how we could help them find value in the new system”

3.4 i Documenting and sharing knowledge of users' VM&E

Having discussed ways in which the analysts made use of their knowledge of users' values, motivations and emotions within their own requirements work, the analysts were then asked about sharing this information with others, and whether they create any formal documentation of this information as part of their analysis outputs. Table 3-8 below lists the codes for note taking and sharing identified from the interviews, the number of analysts reporting that they use each activity, and the total number of mentions for each code across all interviews.

Table 3-8 Documenting and Sharing Information about users' values, motivations and emotions

Activity	Total number of occurrences of the theme across 12 interviews	No. of unique interviews in which the theme occurred (1-12)
Don't keep formal records of users' values, motivations and emotions	12	12
Taking personal notes	5	4
Getting advice from team members	2	2
Selling ideas to the project team	2	2
Would consider formally documenting such information	2	2
Written discussion of users' values, motivations and emotions in emails	2	2
Strongly against any formal records	2	2

None of the analysts include information about users' values, motivations and emotions in any of their formal requirements or project documentation and two interviewees observed that there are no appropriate sections within their current document format. Whilst two of the analysts interviewed felt that, as long as it was done with some discretion and anonymity, it would be useful to include more structured records of this type of information, two were concerned that it might be problematic:

Analyst J “I just, I think it could cause some offence. We've not got many users and work with them on lots of projects. It could be taken the wrong way. It'd depend what you wrote, but, no, I'm not comfortable with that idea.”

However several of the analysts described making informal notes about users' values, motivations and emotions in their own records. One of the analysts observed that, if a user or group of users has expressed concerns over some aspect of a project, they will acknowledge that in the interview record which is sent back to the user:

Analyst G “If someone has made a point of telling me they’re not happy then I’ll always mention that in my notes, along with whatever action we’re going to take. I don’t want them to think I’m not going to do something and I think it’s reassuring to show that I’ve written it down.”

Four of the analysts talked about feeding back their views on users’ values, motivations and emotions to their project team, in two cases this was specifically to justify the addition of features to the software which the analysts felt were necessary to persuade users of the worth of the project:

Analyst C “The developers aren’t usually there in the workshops so if I work up an idea of something new because it’s what it’ll take to get the users on board, I’ve got to explain why to the devs.”

One of the analysts mentioned that he found dealing with the ‘soft’ side of requirements work difficult, and that he would talk to a specific project manager to get their advice when he felt he had noticed problems in his interactions with users. Similarly another analyst talked about discussing users’ motivations with the software team – in order to get advice on how to proceed with a problematic situation.

3.4 j Requirements for a method to support VM&E elicitation

At the end of the interview the analysts were asked for their thoughts on a method to support analysts in eliciting VM&E. Whilst the majority were in favour of the idea of more support in eliciting soft issues (see table 3-9), two of the analysts did not feel they needed any assistance, and one analyst remarked that he would not be comfortable making use of any VM&E elicitation method.

Table 3-9 Analysts’ responses when asked if they would use a method to help identify users’ VM&E.

Would you make use of a method to help identify users’ values, motivations and emotions?	Analyst response (n=12)
Would consider using a method	9
Don’t need a method as would just directly ask users about VM&E	1
Happy with current approach	1
Wouldn’t use any method as would feel uncomfortable	1

Many of the analysts went on to add comments or requirements about the nature of any method (table 3-10.) Almost all of the analysts were concerned about time pressures and

that any new method should add as little as possible to their workload. Six of the analysts made the point that any new method would have to fit in with what they were already doing, or should encourage review of existing notes. Other analysts had more concrete requests such as advice on running interviews or workshops. Several of the analysts had already observed that they felt uncomfortable interviewing users about soft issues (see 3.5), and similar concerns were raised by four analysts about any new method:

Analyst A “It’d have to fit in with what we already do.”

Analyst K “People would think it’s weird to be asked about how they feel in a meeting about a software project.”

Table 3-10 Analyst comments on the nature of a method to aid in identifying users’ VM&E

Analyst feedback on the nature of a method to help identify users’ VM&E	Analyst response (n=12)
Minimal time demands	11
Must be compatible with current requirements elicitation work	5
Would not directly ask users about VM&E	4
Mustn’t need lots of documentation	1
Would like a questionnaire to give to users	1
Would like help on running workshops	1
Could get a lot of information from reviewing existing interview notes	1
Would be useful to listen back to interview recordings (would never transcribe interviews)*	1
Interview advice would be useful	1
Would be interesting to hear what other analysts do	1

***Prompted by conversation about the author’s use of voice recordings and transcription during these interviews**

3.5 SUMMARY

This study explored the challenges analysts face in developing an understanding of the values, emotions and motivations of their users, and investigated the techniques adopted by experienced analysts to address these challenges. The findings from this study are in accord with chapter two’s literature survey: analysts recognise that stakeholders’ values, motivations and emotions are relevant to the requirements elicitation and analysis process, but vary in their ability to identify and make use of this information. Whilst a minority of the analysts are confident eliciting and acting on users’ VM&Es, the majority of analysts reported that they often only observed such information by chance,

and did not always know what to do with this information, therefore guidance on both identifying and acting on knowledge of stakeholder VM&Es is required.

The techniques used by experienced analysts to identify users' values, motivations and emotions provide some pointers for the development of a reflective method to support novice analysts in identifying and acting on users' VM&E. Two of the expert analysts described using reflective techniques to identify users' values, motivations and emotions; developing hypotheses about what may be happening within their projects, and considering their interactions with users. Furthermore the study has identified other issues around elicitation of users' values, motivations and emotions: any approach must be acceptable to analysts who are concerned about asking sensitive questions of their users, must fit in with existing requirements practice and must not place unrealistic demands on analysts in terms of time taken to apply the technique. Chapter four makes use of this learning in proposing a method to support analysts in the identification of users' values, motivations and emotions.

Chapter 4 The VBRE Method

4.1 INTRODUCTION

Chapters four, five and six describe the development of the Value Based Requirements Engineering (VBRE) method. The method was conceived in response to learning and requirements gathered from requirements analysts in chapter three, and from the RE literature. The method was then refined through cycles of testing and refinement, figure 4-1 provides an overview of the iterative development and evaluation process, and indicates how the development process has been organised into thesis chapters. Chapter four firstly describes the aims of the method and the requirements it must address from the analysts' perspective, and secondly presents the initial version of the method and the first round of method evaluation.

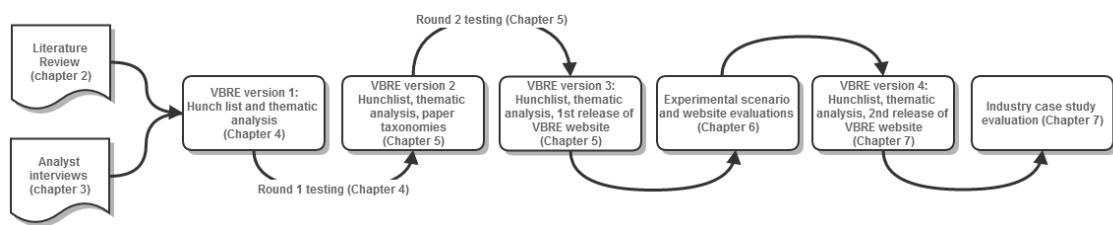


Figure 4-1 A summary of the iterative development process for the VBRE method

4.2 VBRE METHOD AIMS AND RATIONALE

The second research question of this thesis asked:

“Can a method improve elicitation and effective use of VM&E by requirements analysts?”

Both the RE literature and the findings from the interviews with analysts presented in chapter three indicate that more experienced analysts have an increased awareness of users' values, motivations and emotions. In particular, the research reported in chapter three observed that:

- Novice analysts commented that it would not usually occur to them to think about users' values, motivations and emotions, until there were problems in their project, and

- Expert analysts described taking time to reflect on users' values, motivations and emotions.

In similar studies in the literature, major differences in problem identification skills and political and social awareness between novice and expert users have been reported [15], as have the need for improved analyst communication skills and the importance of rapport building [18].

This suggests that novice analysts could benefit from adopting some of the behaviours described by the expert analysts in Chapter three: periodically reflecting on the values, motivations and emotions expressed by users, and asking questions to explore these aspects of the users' work and attitudes towards the project. The analyst interviews also identified requirements that any method aiming to support analysts in working with VM&Es, would need to address in order to be acceptable and of practical value:

- Minimal additional demands on time: analysts generally have limited time with users and are usually busy themselves; therefore to have any chance of being adopted by analysts, any technique should place as few demands on their time as possible.
- Culturally acceptable to analysts: a number of the analysts interviewed in Chapter three did not wish to directly question users' about their values, motivations and emotions. Reasons for not doing so included belief that direct questioning would be inappropriate and discomfort at asking questions about 'soft issues' when they perceive themselves to be working within a technical role. Furthermore whilst there is good evidence to show that users' values, motivations and emotions can have a significant impact on the outcomes of a project, investigations into such information are not traditionally part of the remit of a software development project. Therefore consideration also needs to be made to the nature of an investigation into stakeholder values, motivations and emotions for both the analyst and the stakeholder. When carrying out academic research both the researcher and the participants in a study are generally not concerned about the long-term consequences of such a study. In contrast, both requirements analysts and their stakeholders are concerned with obtaining their preferred outcomes for a project and usually, with maintaining some longer term relationship such as further project work or software support.

Attempts to encourage analysts to consider such information should be sensitive to the on-going nature of the analyst and user relationship.

- Should not require any special expertise or skills beyond those that could be expected of a requirements analyst. This work makes assumptions about what might reasonably be expected of an analyst based on the list of core analyst skills described in the International Institute of Business Analysis' document: 'Business Analysis Body of Knowledge' [106]. These include the ability to develop effective relationships with stakeholders, elicit and communicate requirements and consensus building.
- Should build on and/or integrate with existing established and commonly used RE practices such as interviews, observation, workshops, iterative design [55].

Furthermore, any approach to examining users' values, motivations and emotions 'in the wild' needs to be open-ended and context sensitive, since the circumstances of every project and every user will be different. Analysts need support in thinking about and looking for evidence of VM&Es in the particular context of their own projects, but may also need prompting about potential values, motivations and emotions they might wish to consider, therefore any approach should not prescribe particular courses of action or conclusions but rather encourage analysts to determine what is appropriate for their own project, considering alternate explanations and challenging initial assumptions.

4.3 APPROACH TO METHOD DEVELOPMENT

Chapter two's review of the RE method adoption literature highlighted the importance of industry involvement in the development of new methods, therefore a commitment was undertaken to work in close conjunction with industry during development of the VBRE method. Involving industry users in method development research generally takes one of two formats: Participatory Design or Action Research. Both approaches emphasise the importance of stakeholder involvement and a comparison of the two techniques notes that the main difference is in intent: Participatory Design focusses on developing tools to address a specific problem, whilst Action Research tends have a wider focus, looking to understand the broader context as well as to gain understanding of specific issues from stakeholders [107]. From a more practical point of view, Action Research generally requires the researcher to be immersed in the situation, and co-located with the subjects, whilst Participatory Design involves frequent user

involvement through cycles of iterative prototyping, aiming to include multiple stakeholders with differing backgrounds and levels of expertise. Given that the intent of this thesis was to develop a method to address a specific problem, and furthermore, that securing short-term input from a number of analysts from different organisations was more feasible than a long-term engagement with one or two organisations, a PD approach was adopted. This approach also allowed for consultation with a number of analysts at different stages of their careers and in different industries. The involvement of industry analysts in the evolution of the method took several forms:

- Testing the method during requirements analysis work and providing feedback
- Reviewing content
- Participating in experimental evaluations

Chapters four through six detail the development of the method, reporting on analyst feedback and method refinement. It should be noted that, in a departure from a purely Participatory Design approach, chapter six reports on experimental evaluations of aspects of the method, this enabled a case-control evaluation of method utility in a more controlled setting (see chapter six for further discussion on combining classroom case-control and industry case study evaluations.)

4.4 METHODS FOR ELICITING VALUES, MOTIVATIONS AND EMOTIONS

As discussed in chapter 2, a variety of techniques have been used to investigate values, motivations and emotions of users within Information Systems and RE research, including ethnographic analyses[7, 63], questionnaires[25] and discourse analysis[65]. Many of these techniques have been used extensively by academic researchers, however, for a variety of reasons they are less accessible to practicing requirements analysts. Some approaches require special expertise, e.g. discourse analysis, whilst others may be impractical due to time constraints either on the analyst or due to limited access to users, e.g. ethnography. Questionnaire based approaches do not have either of these limitations, since, when well designed, they are quick to administer, and can be straightforward to interpret. However, questionnaires limit the study to a predefined set of values, motivations and emotions covered by the questions. Using a predefined set of questions limits the freedom of the analyst to explore the meaning or significance of a particular value, motivation or emotion to a particular user and in the context of a particular project. Finally, one of the findings of the analysis in chapter three was that

analysts were uncomfortable with any approach that required direct questions about soft issues to users, therefore questionnaires about users' values, motivations and emotions are unlikely to be considered acceptable.

Qualitative thematic analysis is a method that supports the discovery and analysis of themes within a dataset, by coding snippets of data with meaningful tags, and then looking for patterns or 'themes' within the tags. The technique is not attached to any particular theoretical framework, rather it is considered a building block within other analytic traditions such as Grounded Theory, Discourse Analysis or Narrative Analysis. The approach does not depend on any specialist skills or knowledge and is considered an accessible starting place for a novice qualitative researcher. Can such an approach be adapted for use by requirements analysts to aid them in investigating the values, motivations and emotions of their own stakeholders? Requirements analysts routinely collate large amounts of unstructured text data suitable for qualitative analysis in the form of interview and meeting notes or transcripts; therefore this approach could make use of materials the analysts are already collecting. Indeed guidance as to how to go about thematic analysis frequently stresses the importance of a researcher becoming familiar with their data and recommends that the researcher carries out their own data collection [102, 108].

A method that encourages analysts to perform some sort of thematic analysis focussing on identifying evidence of users' VM&E from interview and meeting notes could be considered a more structured implementation of the approach described by expert analysts in Chapter 3: reflecting on the project and people involved; anticipating potential issues; looking for evidence of those issues. The method can commence with a step that encourages analysts to record their 'hunches' about the values, motivations and emotions they believe are at work within in a software project and then to look for evidence to support or contradict those hunches emulates the behaviours described by the expert analysts.

4.5 THE VBRE METHOD – VERSION ONE

The first version of the VBRE method is summarised in figure 4-2 below and is composed of two elements:

- A reflective analysis process which could be incorporated into standard requirements elicitation work, and which encourages identification of users' values, motivations and emotions.
- A 'hunch list' which details the analyst's thoughts on relevant users' values, motivations and emotions.

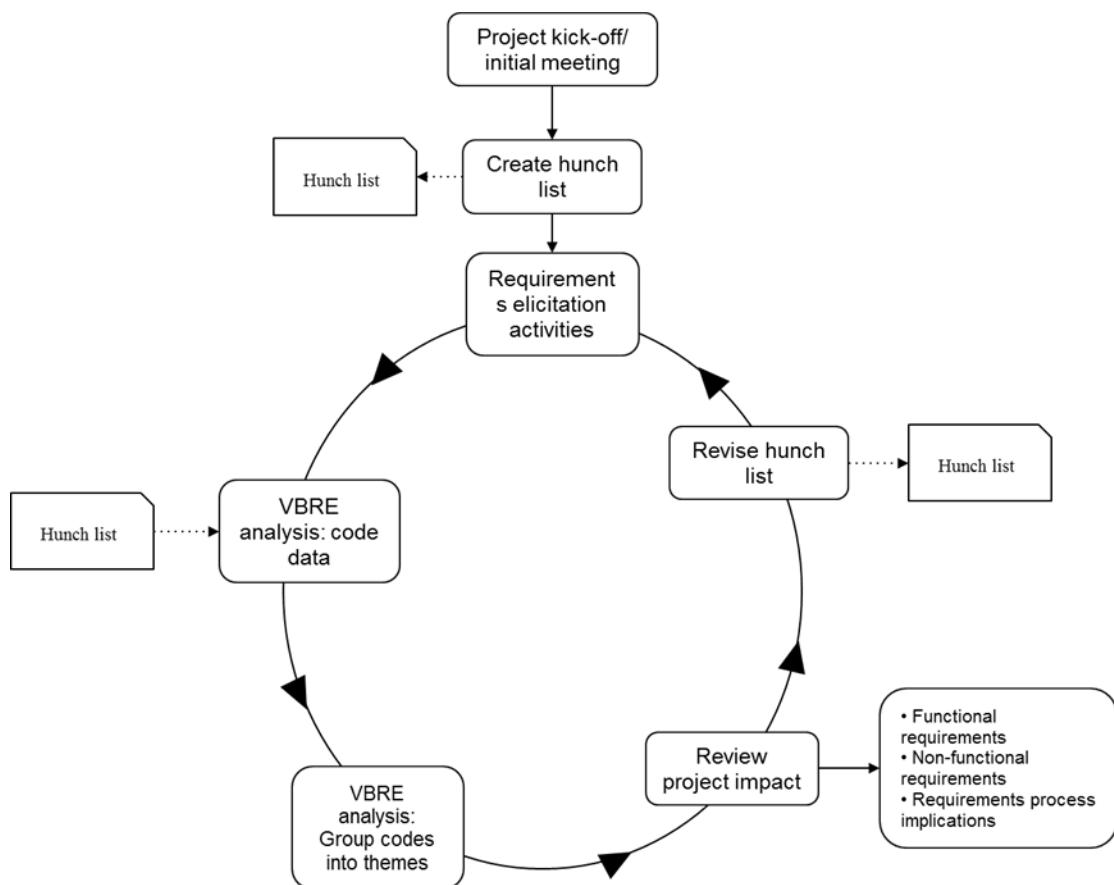


Figure 4-2 VBRE method version one

The technique aims to provide sufficient advice and prompts so that the analyst has some structure and guidance, without being prescriptive or 'rules-based'. The aim is to encourage the analysts to reflect on the circumstances of their own project. The method has six steps:

1. Create hunch list

The analyst begins by recording their own hunches about values, motivations and emotions they believe are relevant to the project. This list may be informed by past projects, previous interactions with the users or features of the project that are likely to be important or controversial, for example:

- Users who believe significant aspects of their roles will be negatively affected by the introduction of a system.
- A requirements process which will require collaboration between groups of stakeholders who hold significantly different levels of power within an organisation, e.g. hospital consultants and reception staff.
- The introduction of technology which will significantly alter means of communication, e.g. enabling home working or automated monitoring of staff productivity.

This ‘hunch list’ is the starting point for the analysts’ exploration of the values, motivations and emotions relevant to their project and will evolve over the course of the requirements analysis to become a record of their growing understanding.

2. Carry out routine requirements elicitation activities

The analyst then starts their standard requirements work: interviews, meetings, workshops etc., using their customary approach and questions, documenting their findings in transcripts or summary notes. In the course of standard RE work these notes are analysed for users’ functional and non-functional requirements, VBRE simply provides an alternative way to analyse these notes from the viewpoint of stakeholders’ values, motivations and emotions and consequently does not require the analyst to gather any additional material from stakeholders.

3. Code the requirements elicitation outputs

At intervals the analyst will review the outputs of their elicitation work for evidence of the expression of values, emotions or motivations. How frequently the analyst chooses to carry out a VBRE analysis of their elicitation outputs is left for the analyst to decide. An analyst working in an unfamiliar situation or with unfamiliar stakeholders may choose to carry out a review after each elicitation activity; an analyst working in more familiar surroundings may opt to carry out a review less frequently.

The review consists of a thematic analysis of the elicitation outputs. The most thorough, but time consuming approach to this analysis is to transcribe audio recordings, these transcriptions are then marked up by the analyst, relevant pieces of text are highlighted and named with short ‘codes’ which summarise the analysts’ opinion about the value or emotion being expressed.

4. Grouping codes into value, motivation and emotion themes

Once the initial coding is complete, the analyst then begins to group their tags, looking for codes which express similar values, motivations and emotions. Alternatively, and

more pragmatically analysts may only transcribe short quotations they find informative, or simply either listen back to their recordings or reflect on meeting notes. The approach taken will vary based on analyst expertise, time pressures and whether circumstances will allow audio recordings. Any tags which do not apparently fit into a group straightforwardly are saved, as they may do so later. The initial focus of the analyst should be on organising data for individual users. As the project develops the analyst may begin to see shared values, motivations and emotions between roles, workgroups and so on. The method evaluation presented later in this chapter includes a detailed example of a VBRE analysis using transcribed meeting notes.

5. Review any impact on the requirements and RE process

Following this analysis the implications for both the project process and the design are reviewed. These may be functional and non-functional software requirements, but also recommendations for functional allocation, work design or for the RE process itself. Furthermore the analyst may have spotted evidence of previously unidentified values, motivations and emotions that he or she may wish to investigate in further requirements elicitation work.

6. Revise hunch list

The analyst's hunch list may then be updated, each cycle of analysis adding in new understanding and new questions the analyst would like to explore to the original hunch list. The developing list of hunches serves two functions: firstly providing a source of topics for the analyst's on-going elicitation work, and secondly, over time, growing to create a rich picture of the project's values, motivations and emotions.

Having completed one cycle of the analysis, the analyst then repeats this process with a new set of interview or observation data, beginning the updated version of the hunch list.

4.6 VBRE METHOD EVALUATION - FIRST ITERATION

This section describes the first iteration of VBRE method evaluation, testing the method within two projects: the author's own requirements work, and a commercial project. The evaluation process is described, and the impact on both projects is discussed. A worked example of a VBRE analysis is included. Finally the chapter discusses the

learning derived from the evaluation and the refinements required to improve the VBRE method.

4.6 a Evaluation Method

The aims of the evaluation were to investigate:

- The usability of the VBRE method: how was it used in practice?
- The utility of the VBRE method: did the use of the method impact the project?

The evaluation was carried out by the author and a second external industry based analyst (here after referred to as analyst A), during requirements analysis work on two software projects, looking at the development of geographic information software for public health analyses (Case Study 1), and software systems to support the outsourcing of work to a foreign partner (Case Study 2), respectively.

The analysts kept diaries of their experiences of using the method, given that both analysts were not working exclusively as requirements analysts on a single project, diary entries were only made on days when the VBRE method was used. The diary was not formally structured but the analysts agreed to record their thoughts on the practicalities of using the method, and any impact on their projects.

4.6 b Case Study 1 - GIS Systems for Public Health

The author was employed as the Requirements Analyst on the Adaptive Visualisation Tools for e-Science Collaboration (ADVISES) project to develop Geographic Information Systems (GIS) for use in the analysis of public health problems [109]. The intended user groups for this project were UK National Health Service Public Health analysts, and academic researchers working in public health and epidemiology. The author audio-recorded and transcribed ‘fly on the wall’ style meeting observations and used this material for testing the VBRE method, discussing her findings with the wider ADVISES project team. Below a worked example of one of the cycles of VBRE analysis is provided.

VBRE – Example Analysis Cycle

This section provides an example of the application of one cycle of the VBRE method, following the six steps outlined above.

1. Create hunch list

The author's initial hunch list is shown in table 4-1. This is a list of the values, motivations and emotions she considered potentially relevant to the project. The list was drawn up based on prior knowledge of the stakeholders from earlier project work, and from discussions with the software project team – the list was project-wide rather than specific to an individual user.

Table 4-1 Initial hunch list written by the author for the ADVISES project

ADVISES Hunch List version 1	
Logic	
Order	
Control - importance of data security and control, knowing where everything is at all times – but also want freedom to share when appropriate	
Accomplishment and Achievement	
External profile raising of the group?	
Collaboration	

2. Carry out routine requirements elicitation activities

The ADVISES project adopted a variety of approaches to requirements elicitation[109]. In this example, the author had recorded a discussion between two medical researchers talking about their current and upcoming epidemiology research. This was an instance of a regular meeting between the two researchers held on a weekly basis. Their meetings were an opportunity to update each other on their progress, discuss new ideas for research, and talk about the direction of their work. A particular focus of this analysis was gaining understanding of the epidemiologists' values with regard to their research and understanding how they might impact the software development. Table 4-2 shows an excerpt of the transcript from this meeting (the dialogue has been edited to remove identifiable data.)

Table 4-2 Excerpt of transcribed dialogue from a meeting observation carried out during the ADVISES project

Epidemiologist 1	Epidemiologist 2
	Initiates discussion about MRI for neonatal research (shows a magazine article). Research group in Hammersmith – interesting as not aware of another group doing neonatal imaging research (not sure if this is a good or a bad thing?), who else is doing MRI in babies?
Interesting as in a good position to do this kind of work – and I'd like to develop links with Experimental Medicine given the upcoming rearrangement of schools.	
	What data is routinely collected in babies?
[X] next door does intensive care monitor research, [K] does normal neonates, gestation and diabetes, early CV disease signs and metabolic disease in babies. If anyone knows how to get measurements it will be [K].	
[Gives summary of [K]'s work] Important action is to make contact with ____ and ____ and find out about MRI in babies and fat distribution.	Who is [K]?

3. Code the requirements elicitation outputs - tagging evidence of potential values, motivations and emotions

The transcribed meeting notes were then analysed by the author, looking to identify snippets of the interview which suggested something about each researcher's values, motivations and emotions. During this process the hunch list serves as a reminder of values, motivations and emotions that were previously identified as potentially interesting, although the researcher also highlights phrases or words that might indicate previously unconsidered values, motivations or emotions. As well as highlighting the relevant snippet the author also provides a short 'code' to summarise what is interesting about the highlighted text.

Table 4-3 Excerpt of meeting transcript including VBRE annotation

Epidemiologist 1	Epidemiologist 2	Codes – Epidemiologist 1	Codes – Epidemiologist 2
	Initiates discussion with advert from RAD magazine – Toshiba – leads to conversation about pig models of foetal growth and atherosclerosis.		looking for new ideas
[A] interested in measurement by ultrasound of fat distribution – suggests User 2 follows up with [C, a researcher in their department]		Developing working relationships within their department	
	Initiates discussion about MRI for neonatal research (2 nd magazine article). Research group in Hammersmith – interesting as not aware of another group doing neonatal imaging research (not sure if this is a good or a bad thing?), who else is doing MRI in babies?		Concern about being first in a research area – tension between conservatism vs innovation
Interesting as in a good position to do this kind of work (1) – and would like to develop links with Experimental Medicine given the upcoming rearrangement of schools.(2)		1. Potential of work – for development of science, 2. positioning of department	
	What data is routinely collected in babies?		
[X] next door does intensive care monitor research, [k] does normal neonates, gestation and diabetes, early CV disease signs and metabolic disease in babies. (1) If anyone knows how to get measurements it will be [K].(2)		1. Internal and external department contacts 2. Comment on [K]'s professional expertise	
	Who is [K]?		
Gives summary of [K]'s work (1) Important action is to make contact with _____ and _____ and find out about MRI in babies and fat distribution. (2)		1. Further elaboration on [K]'s expertise 2. Importance of developing contacts	

Table 4-3 provides an excerpt of this annotation; the entire marked-up meeting observation is provided in appendix C. Phrases and code pairs for epidemiologist 1 are highlighted in yellow, phrase and code pairs for epidemiologist 2 are highlighted in

blue. Where a speaker's turn includes more than one coded phrase the phrases are numbered. Names of people, institutions, projects and other identifiable information have been removed.

4. Review the list of codes grouping them into value, motivation and emotion themes

Having reviewed and coded the entire interview, the codes relating to each of the researchers were grouped into value, motivation and emotion themes. Tables 4-4 and 4-5 below show the groups of codes against values, motivations and emotions for each of the researchers.

Table 4-4 VBRE Code Analysis – Epidemiologist 1

Codes	Value
Developing working relationships in [Department name] Internal and external department contacts Importance of developing contacts Developing contacts, promotion of collaboration. Development of an external collaboration Encouraging making contact with external party. Encouraging collaboration Encouraging contact Maintenance of external relationships Concern about maintenance of a relationship	Collaborations – lots of interest in new connections and maintenance of existing relationships.
Potential of work – for development of science, Long term goal	Personal goals – self-esteem, curiosity, learning, innovation
Expressing concern about research group's direction Positioning of research group	Achievement, peer esteem, power creation
Comment on [K]'s professional expertise Further elaboration on [K]'s expertise Providing evidence for [H]'s expertise	Developing trust in collaborators
Sharing of expertise Helping User 2 in data collection Sharing technical expertise Checking for potential study design issues Suggestion of additional research ideas Feedback	Team work, collaboration, altruism
Work planning Prioritisation of own workload	Organisation, control
Encouraging speed Impatience	Achievement
Importance of being thorough	Organisation

Table 4-5 VBRE Code Analysis – Epidemiologist 2

Codes	Value
Looking for new ideas Research development Benefits of external collaboration – opportunity to look at other data	Innovation
Concern about being first in a research area – tension between conservatism vs innovation	Caution, risk aversion?
Request for help Question about expertise Sharing technical expertise	Collaborative working – between User 1 and 2
Forward planning, ensuring have correct and sufficient data Preparation for potential (as yet, completely unplanned) studies – long term planning Forward planning	Planning, organisation, thoroughness
Thoroughness over speed Thoroughness – checking approach is valid Progress report – not wanting to rush to analysis work without preparation Importance of being thorough	Thoroughness
Reassurance to User 1 on work progress Work planning – reassurance to User 1 on timescales	Collaboration, trust
Professional standing Waiting to get a good paper	External esteem
Concern about best way to present information Use of pictures to communicate a message Concern about presenting to non-experts	Education, peer esteem

5. Review project impact / software impact

Based on this and similar VBRE analyses of other meeting observations, patterns of particular values, motivations and emotions started to emerge. In particular a very strong sense of the importance of peer esteem, creativity and innovation and collaborative working to researcher 1, and of thoroughness and risk aversion to researcher 2. Understanding the different priorities of the two researchers had a direct impact on the decision making within the software development project, helping to prioritise different functional and non-functional requirements, to anticipate potential anxieties and concerns, and influencing project process, e.g.

i) Modifying functional requirements based on user values

Researcher 1 expressed a requirement around the ability to share data online. However, based on the understanding developed about researcher 2's values the requirements analyst anticipated that this requirement would not be acceptable to researcher 2, who is very risk-adverse and concerned about maintaining control over his data, and was likely to provoke some anxiety. The author consequently modified the proposed requirements

to allow flexible control over what might be shared before suggesting the requirement to researcher 2. This modified requirement was then presented back to both users and was acceptable.

ii) Proposing new functional requirements based on user values

User 2 is highly risk adverse, and, in particular, stressed the dangers of naïve users misinterpreting data and visualizations in journals. The project team realised that it would be technically possible to build warnings and alerts into the system to warn novice users when they might be about to do something that was not statistically sound and proposed this to users 1 and 2.

6. Revise hunch list

The final stage in this VBRE cycle is to revise the hunch list based on learning from this iteration. The updated list is shown in table 4-6. The hunch list was not substantially changed following this cycle of analysis: ‘order; was unpacked into ‘planning’ and ‘thoroughness’, collaborations was updated to indicate a strong focus on external collaborations, and a new item was added as a reminder to the analyst to consider the importance of innovation and creativity to the researchers.

Table 4-6 Revised Advises hunch list

ADVISES Hunch List version 2
Order – planning and thoroughness
Control - importance of data security and control, knowing where everything is at all times – but also wanting freedom to share when appropriate
Accomplishment and Achievement
External profile raising of the group?
Collaborations – strong focus on external collaborations
Innovation and Creativity?

4.6 c The author's experiences of using the VBRE method, version one

Method Usability: The method provided a more systematic way to reflect on users' values, motivation and emotions. Previously it's been my experience that I've noticed this type of information passively and serendipitously, but hadn't taken a structured approach to actively looking for this knowledge.

Transcribing and marking up the text was extremely time-consuming and too heavyweight to be of practical use in industry projects when time is limited

Method Utility: The project did benefit from the analysis, both in terms of the requirements elicited, and the approach and methods adopted. However, I was also concerned that my hunch list didn't seem to change much over the course of two rounds of analysis, to some extent this was because I knew the stakeholders concerned before the start of the interviews and observations, but equally, I thought the method might benefit from a more generic list of values, motivations and emotions, which might encourage me to think about less obvious issues.

4.6 d Case Study 2 - Outsourcing

Analyst A is an experienced requirements analyst working in the Information Management department of a large multinational organisation. She trialled the first iteration of the VBRE method in her current requirements engineering work, a project looking at outsourcing data processing work to an external organisation based in another country.

Analyst A used the VBRE method to analyse four interviews. The materials gathered by analyst A are not presented here as they are company confidential. However, analyst A provided feedback on the use of the method and its impact on the project via her diary.

Adoption of the method

Analyst A felt that audio recording and transcribing complete interview text would be too time-consuming. Consequently she opted to make audio recordings of meetings, then listened to the recordings, and only transcribed and coded phrases that she considered significant.

The first observation made by analyst A was that simply writing down a hunch list was valuable:

"I do have a lot of this stuff in my head, writing it down made me more aware of it, made me question whether all of it was really true, or whether I was making assumptions, and made me more observant of what else was going on."

This trial was Analyst A's first experiences of using audio recording in interviews and she was surprised that most users did not object to being recorded. She found it useful to listen to the interviews:

"I picked up on lots listening back that I hadn't got the first time around."

But also remarked that it was time-consuming.

"I don't think I'd do this on every project, or even all my meetings in a project. It'd be worth doing where I'm working with new people or I have an inkling there might be a problem I need to look at."

Analyst A found it difficult to identify values, motivations and emotions when listening to the interview recordings and commented that she would like a set of prompts to help her think about what she should consider:

"values are quite intangible"

"Ready to start coding - realised I don't really know what I am looking for - what code will I use? Time for some suck it and see."

Impact on Analyst A's requirements work

Analyst A found that carrying out the analysis allowed her to notice social issues more quickly than she might otherwise have:

"I am interested in how much I have learned from a single interview by listening to it a couple of times. I am able to pick up on things I would not normally get this early e.g. tension between different departments."

And also observed that using the method had made her more conscious of stakeholder values, motivations and emotions:

"Again I am much more aware of the value/emotional content, which in this context where work is being outsourced to China is an important part of the interaction."

"Being aware I am interested in looking for emotional response made me ask more "touch-feely" questions than I would normally use with a scientist."

"I like knowing that there's an extra step in my requirements gathering when I'm going to change hats and think about this stuff."

Impact on the outsourcing project

On completion of her VBRE analysis, Analyst A had identified the following values, motivations and emotions as being relevant to her project:

- Innovation : positive attitude towards novelty and new opportunities, willingness to do something new and different
- Frustration (-ve): process moving slowly.
- Scientific Expertise/Arrogance (+ve/-ve): Willingness to compromise over the "right" way to do things, communicating the problem rather than the solution. Distrust at other stakeholders' levels of expertise.
- Denial/Resistance/Anxiety: security and loss of control.

Analyst A reported finding it difficult to know how to make use of this information : she felt acting on it was important to the success of the project but wasn't sure how to go about it:

"Now I need to work out how to use this data I am capturing. I can't just write it up and let people read it - it is too raw, but allaying some of the fears people are expressing will be critical in the success of the project."

Her approach was to add an additional section to her report to the Project Manager covering non-IT issues including security, potential cultural clashes, project confidence and the opportunity to build on stakeholders' willingness to innovate. She attributes this decision to the use of the VBRE analysis:

"During late summer I made a presentation to the Project Manager of the entire project concerning "Non-IT" issues coming out of Business Requirements. This was a direct consequence of my looking for value and emotional responses from my interviewees. I don't think I would have spotted the trends here otherwise."

4.6 e Evaluation Findings

Method Usability

Both the author and analyst A found the application of the method time-consuming. The author audio recorded meetings and then analysed transcripts of the recordings. Unsurprisingly, transcription was the most time-consuming component of this approach, and is unlikely to be a practical option for most industry analysts who are under greater time pressures. Analyst A audio recorded interviews and then made notes as she listened to the recordings. Whilst this is less time-consuming than transcribing recordings, clearly, listening back to a recording of an hour long meeting in this manner will require at least one additional hour. Whilst analyst A found this opportunity to listen to interviews useful, she commented that, given the time constraints she works within, she would be inclined to only use this approach in projects which she anticipates will be controversial, or when working with people she does not know well.

Method Utility

Both the author and analyst A identified values, motivations and emotions that were relevant to their projects as a consequence of using the method. It is clearly impossible to say whether either analyst would have identified these factors without the use of the method and given that both are experienced requirements analysts it is reasonable to assume that at least some of this information would have been identified without use of the method. However, analyst A in particular felt that using the method focussed her attention on people issues within her project.

Both analysts felt that it was difficult to think of values, motivations and emotions unprompted; both for the creation of hunch lists and when analysing interview outputs. There was concern that there was a risk of focussing only on the values, motivations or emotions that the analyst had initially identified as relevant based on their own expectations, and that the provision of a universal list of VM&Es might usefully prompt the analyst to think more widely.

Method Refinement

The key items of learning from the first evaluation were:

- As anticipated, carrying out the VBRE analysis does, inevitably add time to the requirements analysis process. However both analysts were able to identify

useful information about users' values, motivations and emotions without the need to collect any further materials beyond those which would normally be collected during the course of a requirements analysis. Furthermore, analyst A was able to do so without transcribing interview text.

- The need for some means of encouraging an analyst using the method to think beyond the values, motivations and emotions which are most immediately relevant, and consider other possibilities.

4.7 SUMMARY

Chapter four presents the requirements for a method to support analysts in reflecting on stakeholders' values, motivations and emotions, and describes the VBRE method which was developed to address these requirements. The chapter discusses the evaluation of the method during the requirements analysis work within two projects, concluding that whilst application of the method was time-consuming, its use did help both participants identify VM&Es that were relevant to their projects. An interesting conclusion was that both participants felt that the method could be improved by the addition of a mechanism to encourage thinking beyond their immediate hunches, to consider VM&Es they had not initially identified as relevant. Chapter five goes onto explore the means by which this extra support might be provided.

Chapter 5 Development of Method Support Materials

5.1 INTRODUCTION

Chapter five describes the development and evaluation of tools to support the analyst in carrying out VBRE analysis. In response to the initial experiences of analysts using the method (chapter four), a set of taxonomies of values, motivations and emotions were developed with the aim of encouraging the analyst to consider a wider range of VM&E than their initial hunch list. The development and content of these taxonomies are described below. Chapter five then describes the experiences of the author and novice analysts in testing and reviewing the addition of taxonomies to the method. As a consequence of this second review the taxonomies were further extended and transformed into a website. The final section of this chapter describes the structure and content of this website.

VBRE Taxonomies

Chapter five describes the development of a set of VM&E taxonomies to act as prompts and checklists during VBRE analysis. The three taxonomies provide requirements elicitation advice: potential sources of learning about each term and process implications. The content from the taxonomies was derived from literature reviews, and the experiences of the author, her supervisor and experienced requirements analysts. Figure 5-1 provides an overview of the taxonomy development process.

The level of guidance offered when dealing with ‘soft’ issues is inevitably limited, so whilst the final taxonomies provide indicators, the focus is on enabling the analyst to reflect on and explore the complexities of their own situation, the taxonomies are intended to serve as prompts to widen thinking, rather than provide prescriptive rules.

Taxonomy Development Process

The first step in developing the VBRE taxonomies was to investigate existing sets of values, motivations and emotions developed by other researchers. It quickly became clear that finding universal taxonomies would be impossible, as the examples below show, researchers working from different viewpoints developed their taxonomies for different purposes and consequently the values included differ. The language used is

can be confusing; sometimes the same term is used in different taxonomies for different purposes, on other occasions different terms appear to overlap in meaning. Consequently, a three step process of taxonomy development was adopted, involving consultation with industry analysts, in order to develop taxonomies relevant to requirements analysis:

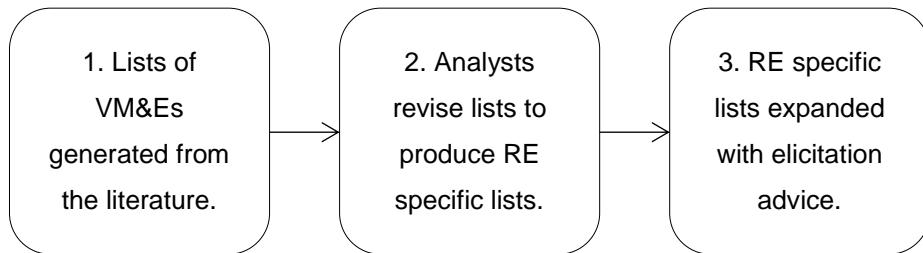


Figure 5-1 Summary of taxonomy development process

1. Lists of values, motivations and emotions developed with a focus on the work place, or ideally, on Information Systems were identified from the academic literature.
2. None of the lists identified in step 1 were RE specific, and therefore these lists were reviewed in a workshop with three industry analysts. The analysts were asked to assess the relevance of the lists; deciding to include or exclude each entry and also to identify any values, motivations or emotions they felt were missing.
3. Once a list of terms was agreed, the list was expanded with elicitation and process guidance by the author and reviewed by her supervisor.

The process of taxonomy development is described below, followed by the completed taxonomies.

5.1 a Developing Initial Lists of Values, Motivations and Emotions

There have been numerous attempts to produce broad taxonomies of personal values (e.g.[23, 24, 110, 111].) A small number of taxonomies have been developed specifically to focus on the implementation of information systems, including Mumford's taxonomy of terminal values [25], and Friedman's work on Value Sensitive Design [112]. The latter taxonomy is limited in scope, focusing solely on moral values as goals the system should embody, whilst Mumford's work considers values to be properties of systems and stakeholders, and is a more inclusive list, therefore it was felt

that Mumford's taxonomy would make the most appropriate starting place for an RE specific set of values.

5.1 b Taxonomies of Terminal and Instrumental Values

Mumford's taxonomy was itself based on the earlier work of Rokeach[110], who developed a comprehensive general taxonomy of values based on a search of the literature, and interviews with colleagues, students and members of the public. Rokeach organised values based on whether they are ‘terminal’ or ‘instrumental’. Terminal values are a person’s objectives, the things he or she wishes to achieve, instrumental values are the person’s preferred modes of behaviour. Rokeach’s terminal and instrumental values are listed in table 5-1.

Table 5-1 Rokeach’s lists of terminal and instrumental values

Rokeach’s Terminal Values	Rokeach’s Instrumental Values
True Friendship	Cheerfulness
Mature Love	Ambition
Self-Respect	Love
Happiness	Cleanliness
Inner Harmony	Self-Control
Equality	Capability
Freedom	Courage
Pleasure	Politeness
Social Recognition	Honesty
Wisdom	Imagination
Salvation	Independence
Family Security	Intellect
National Security	Broad-Mindedness
A Sense of Accomplishment	Logic
A World of Beauty	Obedience
A World at Peace	Helpfulness
A Comfortable Life	Responsibility
An Exciting Life	Forgiveness

Mumford’s focus was on understanding users’ objectives for their working lives, and made use of Rokeach’s list of terminal values in her work on values as they related to the workplace and to technology changes, but did not consider his list of Instrumental values. She modified Rokeach’s original list of terminal values to focus on work situations, generating the list shown in table 5-2. Given that understanding users’ preferred modes of behaviour is also relevant to requirements elicitation, the starting point for this review was Rokeach’s list of instrumental values alongside Mumford’s set of terminal values.

Table 5-2 Mumford's list of terminal values relevant to the workplace.

Mumford's Terminal Values

An absence of conflict (with individuals, groups)
A stimulating life in work (challenging, exciting)
A sense of accomplishment (making a contribution)
A successful life in work (well-paid, status conferring)
An attractive environment
Equality of opportunity
Emotional security (support from colleagues and superiors)
Freedom (independence, free choice)
Happiness (contentedness)
Psychological health (freedom from anxiety)
Good relationships (cooperation, help)
Pleasure (an enjoyable life in work)
Self-respect (self-esteem)
Social recognition (respect, admiration)
Friendship (close companionship)
Wisdom (a mature understanding of life)

5.1 c Motivations

A list of motivations was developed based on Maslow's theory of need[113] and Herzberg's motivators[114]. Maslow's theory is based around a hierarchy of needs, with the higher level needs only becoming drivers once the more basic needs are addressed:

- Physiological Needs
- Safety Needs
- Social Needs
- Self-esteem
- Self-fulfilment

Maslow's lower level motivators such as physiological needs and health were not included in the initial list of motivations, as it was not felt that these are likely to be issues within software development projects. Herzberg's theory of motivators is focussed on the workplace, and suggests that in the workplace the higher level needs related to self-esteem and self-fulfilment are more closely tied to job satisfaction than factors such as work place safety or reward. He lists motivators such as recognition, achievement, responsibility, advancement and work interest as being important to the creation of job satisfaction. This is not to say that issues such as pay and working conditions are not important, but that these 'hygiene factors' contribute much more to

job dissatisfaction when absent, than they do to job satisfaction when present. Table 5-3 contains the initial list of motivations generated by combining Herzberg and Maslow.

Table 5-3 VBRE Initial list of Motivations drawn from Herzberg and Maslow

Motivation	Source
Achievement	Herzberg, Maslow
Altruism	Maslow
Curiosity	Herzberg
Peer-esteem	Herzberg
Possession	Herzberg
Power	Herzberg
Recognition	Herzberg
Self-efficacy	Maslow
Self-esteem	Maslow
Sociability	Maslow

5.1 d Emotions

As previously discussed, the RE literature is relatively limited on the subject of emotions. The impact of emotions during the RE process is acknowledged [76] and the means of defining requirements around the creation of particular emotions within applications such as computer games has been discussed [115] [43]. However, there has been little systematic work on the different emotions and their significance for the RE process. In contrast a review of the psychology literature identified multiple vocabularies of emotions, using a variety of criteria as a means of categorisation, see Table 5-4 for a summary.

The decision was taken to use the OCC Categories as a starting place for a taxonomy of emotions relevant to RE. Given that a goal of this work is to attempt to provide concrete guidance for analysts, the FRSE concept of emotions as points in a four dimensional space was felt to be fairly intangible for an analyst without a background in psychology, and the Ekman ‘Big Six’ did not give a large set of emotions as a starting place for the analysts who would be carrying out the review. This left the OCC categories and Action Tendencies vocabularies. Given this work’s focus on understanding the causes of emotions associated with the process of software design and its outcomes, there is utility in both of these vocabularies given their focusing on emotions as responses to various cues. The OCC vocabularies were selected in preference to Frijda’s work as their categorisation of emotions as positive or negative responses to events, people and artefacts is relatively straightforward to appreciate. Therefore Ortony, Clore, Collins work on emotions was used to generate a base list of event-based emotions focussing on

reactions to situations, objects and agents (table 5-5), to be reviewed by the industry analysts.

Table 5-4 Vocabularies of Emotions

Title	Rationale	Reference
“Big six” Basic Emotions	Based on an investigation of facial expressions common to all human cultures	Ekman – Universals and Cultural Differences in Facial Expressions of Emotion [116]
FSRE Categories	Based on concept of a four dimensional emotion space: valance (assessment of pleasantness), potency, arousal and unpredictability	Fontaine et al – The world of emotions is not two dimensional. [117]
Action Tendencies	Set of emotions causing action responses, e.g. emotion ‘fear’ is related to the action tendency ‘avoidance’.	Frijda - The Emotions [118]
OCC Categories	Based on an ‘appraisals’ model: positive and negative responses to events, people, objects.	Ortony et al. - The Cognitive Structure of Emotions [41]

Table 5-5 VBRE base list of emotions drawn from OCC

Emotion
Anxiety
Approval
Disapproval
Disgust
Distress
Fear
Frustration
Happiness
Pleasure

2. Review of the Initial Lists by Analysts

The initial lists of values, motivations and emotions were reviewed in a group discussion involving three industry analysts. The first of these contributors was the experienced analyst: Analyst A who had previously evaluated the first version of the VBRE method (as described in Chapter four), the other two analysts were colleagues of Analyst A, with respectively 3 and 7 years’ experience of working as requirements analysts. The analysts worked as a group to determine whether a term was relevant to RE, if not, whether an alternative term was preferred, and to suggest any terms that might be missing. The analysts were provided with three distinct lists of values, motivations and emotions, though there were instances where the same term appears in more than one initial list, e.g. pleasure is both a terminal value in Mumford, and an emotion based on the Ortony, Clore, Collins list. In these cases the term was initially included in both lists, the analysts were encouraged to group terms, or remove overlapping terms if they felt there was duplication between the lists.

Workshop Discussion and Outcomes

The analysts' decisions are summarised in the tables below. Appendix D provides a detailed record of the rationale behind the changes the analysts made. Key decisions were:

- There was a significant amount of overlap: terms that appeared in both lists, and terms which were felt to be synonyms of each other. The analysts chose to remove duplicates or near-duplicates.
- The distinctions between values, motivations and emotions, and between terminal and instrumental values was felt to be somewhat irrelevant to the day-to-day work of the analysts - particularly given the occurrence of some terms in both lists.
- The analysts decided to add an additional term 'trust' which they felt was an extremely important factor in the development of software projects.

Table 5-6 Results of Analysts' review of the terminal values list

Mumford's Terminal Values	Analyst Review Decision
An absence of conflict (with individuals, groups)	Keep
A stimulating life in work (challenging, exciting)	Rename to 'Challenge'
A sense of accomplishment (making a contribution)	Rename to 'Accomplishment'
A successful life in work (well-paid, status conferring)	Rename to 'Success'
An attractive environment	Keep
Equality of opportunity	Rename to 'Equality'
Emotional security (support from colleagues and superiors)	Rename to 'Security'
Freedom (independence, free choice)	Remove
Happiness (contentedness)	Rename to 'Contentedness'
Psychological health (freedom from anxiety)	Rename to 'Freedom from anxiety'
Good relationships (cooperation, help)	Rename to 'Cooperation'
Pleasure (an enjoyable life in work)	Keep
Self-respect (self-esteem)	Keep
Social recognition (respect, admiration)	Keep
Friendship (close companionship)	Keep
Wisdom (a mature understanding of life)	Rename to 'Experience'

Table 5-7 Results of Analysts' review of the instrumental values list

Instrumental Values	Analyst Review Decision
Cheerfulness	Remove
Ambition	Rename to 'Ambitious'
Love	Remove
Cleanliness	Rename to 'Ordered'
Self-Control	Keep
Capability	Rename to 'Capable'
Courage	Rename to 'Courageous'
Politeness	Rename to 'Polite'
Honesty	Rename to 'Honest'
Imagination	Rename to 'Imaginative'
Independence	Rename to 'Independent'
Intellect	Rename to 'Intellectual'
Broad-Mindedness	Rename to 'Open minded'
Logic	Rename to 'Logical'
Obedience	Rename to 'Obedient'
Helpfulness	Rename to 'Helpful'
Responsibility	Rename to 'Responsible'
Forgiveness	Rename to 'Forgiving'

Table 5-8 Results of Analysts' review of the motivations list

Motivation	Analyst Decision
Achievement	Keep
Altruism	Keep
Curiosity	Keep
Peer-esteem	Keep
Possession	Remove
Power	Keep
Recognition	Remove – overlaps with motivation: peer esteem and value: social recognition.
Self-efficacy	Keep
Self-esteem	Keep
Sociability	Keep

Table 5-9 Results of Analysts' review of the emotions list

Emotion	Analyst Decision
Anxiety	Remove
Approval	Remove
Disapproval	Remove
Disgust	Keep
Distress	Remove
Fear	Keep
Frustration	Keep
Happiness	Keep
Pleasure	Remove

5.2 THE VBRE TAXONOMIES

The analysts' lists of values, motivations and emotions were then used at the basis for the three VBRE taxonomy tables described below.

5.2 a VBRE Values Taxonomy

The taxonomy of values and their consequences for process guidance are illustrated in table 5-10. Column one contains the list of values selected by the analysts for inclusion in the VBRE Taxonomy. The ‘potential sources’ and ‘process /design implications’ in columns two and three are derived from the author and her supervisor’s RE experience, and from the literature around personal values, and suggests some interview subjects which may encourage a user to discuss their conceptions of particular values. The process implications in column three vary from organising the team composition in response to aesthetic needs (i.e. include aesthetically aware designers), specialisation of the RE process to include safety and risk analysis [119, 120], to more general heuristics for project team management such as the need for fewer controls when trust is high, or the converse when mistrust is discovered. Sensitivity to moral values indicates the need for honesty, openness and fairness in all parts of the development process. Value analysis might alert the analyst to potential stakeholder conflicts, for example stakeholders who regard security as very or not important.

When a value is absent the only consequence is usually not to invest in efforts to promote it, e.g. for aesthetics, security or creativity. However, the absence of, or negative responses to values which may be necessary for the smooth operating of a new system or way of working, e.g. trust or openness may suggest the need for corrective action or incentivisation, either within the project process itself, or the system.

Table 5-10 Values: potential sources and implications for RE

Analyst Values	Potential sources	Process / design implications
Responsible Trust	Relationships with other individuals /groups. Privacy policies	less control, improved confidence
Cooperation Forgiving Helpful Absence of conflict Independent Polite Friendship	Relationships with others Awareness of others – office politics	improved cooperation shared awareness
Equality Honest Open-minded Courageous	Behaviour towards others Opinions of others' behaviours	openness and honesty in team
Imaginative Intellectual Logical Experience Challenge Self-control	Work processes, problem solving	Creativity workshops, brainstorming, task allocation
An attractive environment	Self appearance reaction to images, shapes, art and design	Design as a priority, storyboards
Security Ordered Contenderness Obedient Capable	Data management policies Attitudes towards change	hazard / threat analysis
Success Social Recognition Ambitious Accomplishment	Opinions of others, awards / recognition, promotion	Roles and team organisation

5.2 b VBRE Motivations Taxonomy

The taxonomy of motivations, with guidance on potential sources and implications for RE process and design is shown in table 5-11.

Table 5-11 Motivations: potential sources and implications for RE

Motivation	Potential Sources	Process / Design Considerations
Power	Discussions around control / freedom to organise work	Work organisation, responsibility, control hierarchy
Possession	Degree of ownership of work, control of work environment and processes	Resource control, monetary incentives, marketing,
Achievement	Rewarding aspects of job, recognition in workplace, demands of work	Goal oriented, to project aims
Self-esteem	Confidence in work, interest in / ability to work independently	Link personal & project goals, praise personal achievement
Peer-esteem	Relationships with colleagues, recognition in workplace	Team composition, social feedback & rewards, praise
Self-efficacy	Confidence, ability to make changes, time management, independence	Confidence building, training, skill matching
Curiosity, learning	Skills development, creativity, willingness to innovate	Extensible systems, self-tutoring
Sociability	Relationships with colleagues, coaching / mentoring	Collaboration in work organisation
Altruism	Coaching/mentoring, willingness to support others	Cooperation in work organisation

Motivations are related to personality, and can be considered as long-lasting, high-level personal goals [121]. They are important for understanding stakeholder groups and for individual-level requirements when systems can be customised or configured. Motivations are not easy to detect, and users may be sensitive about direct questioning, so elicitation guidance from the description in column 2 can only provide hints to guide interview questions, some of which are suggested by the motivation type itself, i.e. questions about interest in learning, or willingness to help others. Column 3 suggests implications for personal goals and needs for each motivation type; for example, self-efficacy, curiosity and learning point towards the need for extendable systems where the user can take control and customise or program additional functionality. Altruism and

sociability suggest people who will collaborate and cooperate in group working, both in the delivered system and in the system development process. Motivations of self- and peer-esteem can indicate designing systems to suit individual needs; for instance, in e-commerce, marketing tools can be customised to praise customers [122] and thereby improve their self-esteem (positive well-being).

5.2 c VBRE Emotions Taxonomy

Emotions can give useful feedback about reactions to project plans and designs, especially since emotional responses are stronger than ordinary opinions and may therefore indicate significant problems leading to user dissatisfaction or system rejection. The VBRE set of emotions and their consequences are given in table 5-12.

Emotions can be detected via body language, voice tonality and facial expressions. Strong emotions are hard to miss (e.g. anger) but others are less obvious, e.g. a frown could indicate frustration, anxiety or just being puzzled. Pleasure, joy and happiness are all positive responses, so no remedial action is needed, but the analyst should consider the sources for these positive emotions and consider the potential impact of the project, might the project negatively impact stakeholders' positive emotions? Fear is usually an overt response but it may be tacit, for instance when a new system threatens someone's job security. Tacit fear may be manifest in a lack of cooperation, non-committal replies, missing meetings, and avoiding eye contact during meetings. Anxiety is a milder form of this emotion, potential causes include uncertainty, unwillingness to change and fear of the consequences of a new system on a person's job, self-esteem, and self-efficacy. Frustration may lead to the stronger emotion of anger expressed overtly; more often frustration is not so obvious. The causes may be lack of involvement in the requirements analysis process, being marginalised at the expense of other stakeholders, or not having one's contributions or values discussed. Frustration in the long term may be manifest in stress, leading to illness and absenteeism; in the short term users may be uncooperative and uncommunicative. Frustration can be related to depression, which is a more extreme response to lack of involvement and being marginalised. Finally, disgust and revulsion are strong emotional responses which are usually explicit. The implications are usually obvious from the users' reference to a design feature, and this response may be encountered more frequently when aesthetic values and self-image/esteem motivations are important.

Table 5-12 Emotions, their potential causes and implications

Emotion	Potential Sources / Causes	Process / Design Implications
Fear	Design is personally threatening, negative consequences	Review & remove threats
Pleasure	Design is rewarding, positive	Note for future reference – ideally avoid changing aspects of work / software that are viewed positively
Anxiety	Specification may be confusing, consequences not clear, little involvement	Explain specification, use scenarios, reassure users
Frustration	Irreconcilable conflict, barriers, value-interest clashes, values ignored	Revisit stakeholder analysis
Disgust	Design has complete clash with values/culture	Radical design review
Depression	Lack of involvement in process, values ignored	Re-engage users, improve communication & motivation

5.3 VBRE METHOD ITERATION 2

Following our initial experiences of trialling the method, the VBRE taxonomies were developed with the intention of providing additional guidance and structure for requirements analysts in employing the VBRE method. The taxonomies can be used at a number of stages during the VBRE analysis process. Figure 5-2 highlights three potential points at which they might be used:

1. Creation of the initial hunch list.
2. During VBRE analysis of the outputs of requirements elicitation activities, e.g. interview recordings or workshop notes.
3. When considering the potential impact of any values, motivations or emotions identified by the VBRE analysis.

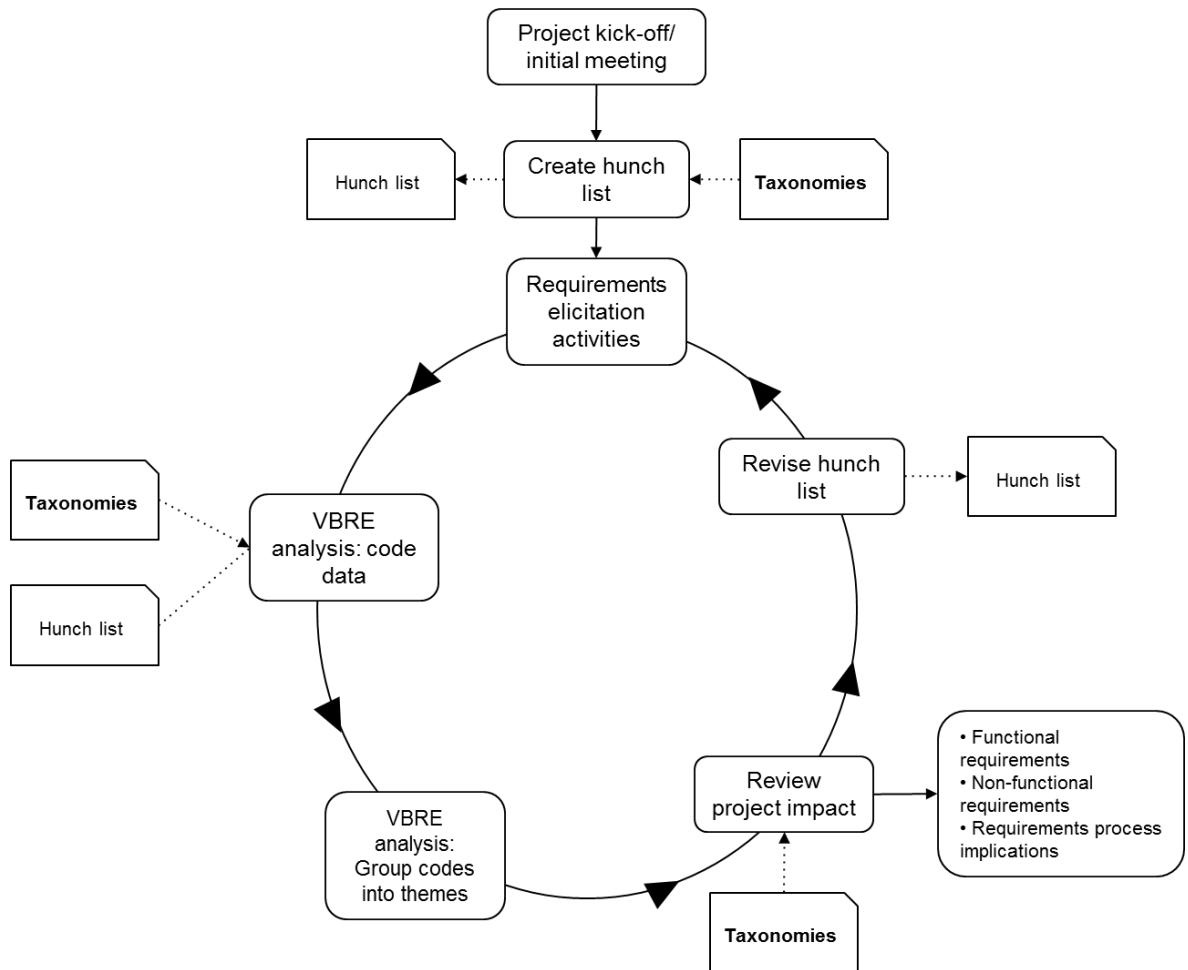


Figure 5-2 VBRE method version 2, showing the use of the taxonomies at three stages of the process

5.3 a Evaluation of the VBRE Method plus Taxonomies

As in the evaluation of the first iteration of the method presented in chapter four, the aim of this evaluation was to investigate:

- The usability of the VBRE method – how was it used in practice?
- The utility of the VBRE method – did the use of the method impact the project?

The method was again evaluated by the author during the course of her employment as a requirements analyst, and by Analyst A, the industry analyst who participated in the initial evaluation presented in chapter 4. The author continued to make use of the taxonomies and method in support of the ADVISES project, whilst Analyst A presented the method and taxonomies as part of an internal RE training course to novice analysts. Table 5-13 summarises the two approaches to the evaluation and data collection.

Table 5-13 VBRE Version Two evaluations

	Evaluation Method	Domain	Data collection
Author	Use of the VBRE method plus taxonomies during the course of requirements work	Public health software development	Diary of method use
Analyst A	Training novice analysts	Pharmaceutical software development	Training course feedback

5.3 b Case Study 1 – ADVISES - GIS Systems for Public Health

In Chapter four the author made use of the first version of the VBRE method during the course of requirements analysis work for the ADVISES project. The project was developing mapping software for use in epidemiological analysis of public health data, consequently the author was using one-to-one observations of researchers carrying out data analysis, in order to understand their research processes. Given that epidemiological analysis is a cognitive, complex process, the author observed each epidemiologist at work, interacting with the statistical analysis packages, with the epidemiologist narrating their workflow and findings.

As well as documenting the processes of medical data cleaning and statistical analysis, the author was interested in exploring several values and motivations which had been identified during the first VBRE analysis presented in chapter four. Table 5-14 below presents the state of the ADVISES hunch list at the end of the first round of VBRE analysis (as previously discussed in chapter four).

Table 5-14 ADVISES hunch list at the end of the first round of analysis

ADVISES Hunch List version 2
Order – planning and thoroughness
Control - importance of data security and control, knowing where everything is at all times – but also want freedom to share when appropriate
Accomplishment and Achievement
External profile raising of the group?
Collaborations – strong focus on external collaborations
Innovation and Creativity?

The author reviewed her notes from the observations looking for evidence to support or contradict the content of her hunch list, and making use of the VM&E taxonomies (tables 5-10, 11, 12), to look out for additional values, motivations and emotions.

Whilst the observations were superficially similar: the epidemiologist interacted with their research software, taking notes as they worked and logging each stage of their

results, the researchers approached their work driven by quite different motivations and values. Epidemiologist A discussed the importance of data driven analysis - essentially ‘playing’ with a dataset and “*following where the data leads you*”. He described “*not planning too much*” and used his analyses to help him find patterns in the data that might either be “*some connection that’s not been considered before, or might just be faces in the fire.*” During the post-observation interview he emphasised the value of collaborating with others during exploratory analyses: “*someone else spots a different pattern, maybe they know something else about the area of research and so they focus on different variables or relationships.*”

In contrast, epidemiologist B worked in an extremely methodical manner, planning out what he intended to do in advance, using a feature of the analysis software to then record every action, and never deviating from his original analysis plans. When asked about this structured approach to his work he observed “*If you can’t do it again, what was the point of doing it at all?*” Epidemiologist B also described his anxiety that he might ever find himself unable to return to earlier work and understand what he had done, and his concerns about data ownership, he preferred to store the data he was analysing on a separate hard drive rather than on his networked computer.

It was notable that whilst earlier analyses had flagged ‘achievement and external profile raising’ as potentially important motivations for the epidemiologists in these one-to-one interviews there was no emphasis on peer esteem. Instead for epidemiologist A there was a much stronger emphasis on collaborative working and epidemiologist B was concerned about ensuring the reliability and correctness of his data and analysis should he ever be challenged about it.

Table 5-15 ADVISES hunch list after the second round of analysis

ADVISES Hunch List version 3
Order – planning and thoroughness
Anxiety
Control - importance of data security and control, knowing where everything is at all times – but also want freedom to share when appropriate
Accomplishment and Achievement
Collaborations – strong focus on external collaborations
Innovation and Creativity
Fun – playing with data

5.3 c VBRE version two – ADVISES Project Impact

The ADVISES hunch list was updated following the author’s additional VBRE analysis (Table 5-15), with the addition of a new motivation: fun, and a new emotion: anxiety.

The VBRE analysis exposed the differing and potentially conflicting priorities for the two epidemiologists, a strong sense of the importance of control and security, versus the need to support the freedom to innovate and collaborate.

Modifications were made to the ADVISES requirements to support controlled data sharing. The analysis software was web-based and initially designed to allow users to upload and store datasets online. In order to reassure users anxious about data security, new functional requirements were added such that users could opt to only upload data temporarily; in these cases data was only stored for the duration of the analysis session. From a non-functional point of view, identification of security issues led to the development of governance advice around the types of data that could be shared versus those that should be kept locally.

Epidemiologist A’s emphasis on creativity and pattern matching led the software team to investigate ways in which software design can promote creativity, and then to build features into the system to support creative working [123]. There were also process implications, the software team included an assessment of creativity during interface testing; looking at how users explored and played with the system, and whether users enjoyed using the system.

5.3 d Analyst Training Feedback

Analyst A included a presentation of the revised version of the VBRE method as part of an internal half day RE training course she was leading, which covered elicitation techniques, e.g. conducting interviews and workshop facilitation. The attendees were four novice analysts with backgrounds in computer science: a degree in computer science or a related subject, and several years’ experience working as programmers. The course covered the basics of running requirements workshops and looked at good interview practice. As an addendum to the usual course content, analyst A presented the VBRE method and taxonomies, asking the novice analysts for their views on the content of the taxonomies and relevance to their own work. It should be noted that the author was not present at the workshop, the novice analysts’ feedback was audio-

recorded and reported to the author by Analyst A. Their views and comments are summarised below.

Taxonomy Content and Structure

The novice analysts liked the structure provided by the method and taxonomies, anticipating that having lists of values, motivations and emotions would make reflecting on difficult projects more tangible. Similarly, whilst they felt they would be unlikely to always use the method as defined in the VBRE method diagram above (figure 5-2), they liked the idea of having a process to remind them to try to consider people issues in advance.

Two of the analysts commented that they were not used to thinking about the end users of the system – or at least not until problems had emerged:

“Normally focus on the data, the format, what needs to happen to it, it’s harder to think about values”

“You come across this when you realise something is up, I don’t know if I’d be able to anticipate problems.”

However, the analysts found some of the concepts, specifically: altruism, forgiveness and curiosity, were hard to relate to their real-life experience. The analysts felt that more detailed guidance would be helpful. They requested better explanations of each term, and wanted advice on how to explore these subjects with users, for example: interview questions or examples of how a particular value might impact a project.

The feedback included comments about problems associated with wholesale adoption of the method for every interview:

“Don’t think anyone would do this process for every single interview. More likely to follow it once or twice till you’d got the hang of it, then just look at the lists.”

“Transcribing interviews is not practical, too time consuming”

Finally they felt that having the taxonomies on paper was cumbersome and that they would prefer computer-based reference materials, specifically, they felt a website would be preferable.

5.3 e VBRE Evaluation Iteration 2 Conclusions

Whilst only limited value can be placed on the analysts' training course feedback since the author was not present, their comments accorded with the author's issues in using the paper taxonomies:

- Paper based taxonomies are unwieldy.
- Some of the content of the taxonomies is difficult for users to relate to their own software projects; extending the taxonomies with fuller descriptions, examples and support for exploring soft issues with users would make the concepts more tangible.

Consequently the decision was taken to extend the taxonomies with elicitation advice and to develop a website as an alternative way of presenting the taxonomies and advice. These improvements are outlined below.

5.3 f Extending the Taxonomies with Elicitation Advice

Based on feedback from the evaluations, several extensions were made to the taxonomies:

- Provision of a short description of each value, motivation or emotion term.
- Examples of interview questions to help elicit users' VM&Es. Given that the intent of the method is to encourage analysts to reflect on the circumstances of their own projects, there was some concern that providing interview questions might appear overly prescriptive, therefore the website makes clear that not all questions will be appropriate to all circumstances, and the analyst is encouraged to select and adapt suitable probes.
- Scenarios are provided to illustrate the impact and relevance of different V, M and E, for example the relevance of trust to the development of a system to support remote working. Scenarios often illustrate multiple values, motivations and/or emotions and so links are provided to other relevant VM&E to encourage the user to consider other factors that may be at work in their project.
- Process and project advice: suggestions about project processes and software design issues that might be relevant given the presence of a particular term. Again, as per the interview questions, there is a balance to be made in providing advice about what to do in the event of identification of a particular value,

motivation or emotion, and providing an unrealistic ‘instruction’ manual for analysts. Furthermore it is unlikely that any website could ever cover all possible circumstances and issues, hence this content was intended to provide broad considerations rather than specifics.

The content of the extended taxonomies was derived from the author and her principal supervisor’s experiences of requirements analysis, and from the RE and psychology literature. Having extended the taxonomies with additional advice and support, it was clear that a paper-based approach was not sufficient, and, as per the analysts’ feedback, a small website was developed with the goal of making the extended taxonomies easier to navigate.

5.4 THE VBRE WEBSITE

The VBRE website (<http://www.vbre.org.uk>) structure is show in figure 5-3. The website was built using the Cake PHP framework, site content being stored in a MySQL database [124, 125].

The main user journey through the system is based around the homepage, and individual ‘Term Pages’ for each VM&E. Each term page includes elicitation advice, in the form of scenarios, interview questions, and process and product advice. The home page and term pages are described in more detail below. Alternatively rather than viewing the elicitation advice by term, the user can view by type of advice, with three pages listing all scenarios, all interview questions and all process and product advice.

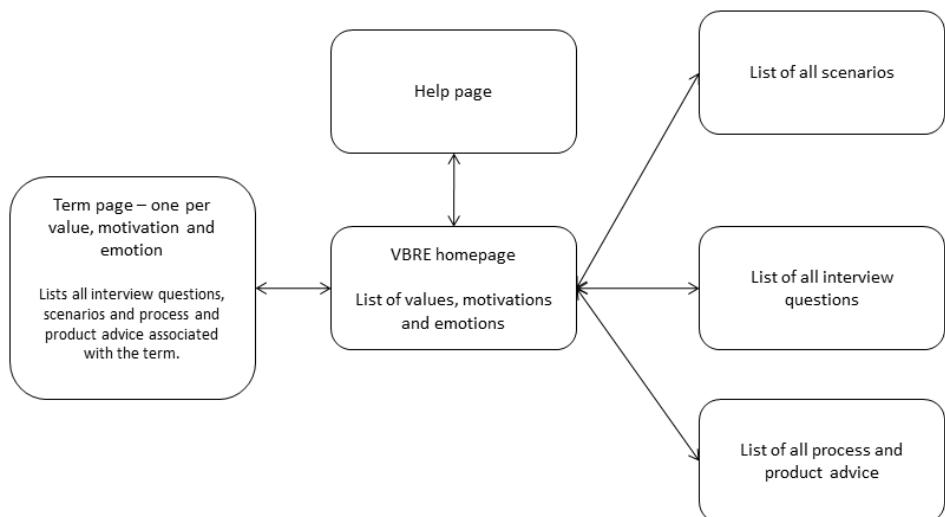


Figure 5-3 VBRE website site map

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The homepage is structured around a table of values, motivations and emotions, with content drawn from the taxonomies (see figure 5-4 below for a screenshot). This provides the main navigation for the site. Analysts are encouraged to start their exploration of their own project by reviewing this table, and considering which terms might be relevant, and a list of prompt questions is provided to help this thought process. Values, motivations and emotions are shown in different shades of green.

The screenshot shows the 'Getting started' section of the VBRE website. At the top, there is a breadcrumb navigation: Home > Terms > Terms. Below this, a heading 'Getting started' is underlined. A text block explains the purpose of the page: 'The first step is to think about the values, motivations and emotions that might be at work within a project. This isn't an easy question to answer, and your understanding will grow as the project continues, but you can begin by looking through the list of values, motivations and emotions below and thinking about which might be relevant to your project. You can also ask questions to help you start thinking about the personal and social aspects of your project, for example:'. Below this text is a bulleted list of questions:

- Will the new system increase or decrease communication between users or others affected by the system? Will the medium of communication change?
- Will end users have to learn new skills to be able to use the system?
- Will the new system result in more or less supervision of the end users?
- Will the system automate aspects of peoples' jobs that have not previously been automated?
- Do you have experience of similar system implementations? What was the impact of those systems on the end users?

Below the questions, a note says: 'Once you've identified a list of terms that you think are relevant to your project you can click on their entry in the list below – you'll find suggestions for potential interview questions to ask stakeholders, example scenarios that help you consider the ways the value, motivation or emotion might play out within a project and advice about its potential impact on both the design of the software and the way you run your requirements process.'

Below this note is a large table divided into four quadrants:

Absence of Conflict	Accomplishment	Achievement	Altruism
Ambitious	An attractive environment	Capable	Challenge
Contentedness	Cooperation	Courageous	Curiosity
Depression	Disgust	Equality	Experience
Fear	Forgiving	Freedom from anxiety	Friendship
Frustration	Happiness	Helpful	Honest
Imaginative	Independent	Intellectual	Logical
Obedient	Open-minded	Ordered	Ownership
Peer-Esteem	Pleasure	Polite	Power
Responsible	Self control	Self respect	Sociability
Social recognition	Success	Trust	

Below the table, there are links: '<< previous | next >>'.

Under the heading 'What do the colours mean?' are three explanatory boxes:

- Values – long term abstract conceptions of the desirable and undesirable that guide our decision making and behaviour.
- Motivations – long lasting, high-level personal goals
- Emotions are subjective reactions and responses to people, events and objects.

Below these boxes is a note: 'Values, motivations and emotions can all impact our thoughts, actions and decisions, and consequently are of interest to a requirements analyst trying to understand a group of users. Often the terms used to describe these states can be ambiguous, for example 'pleasure' is categorised here as a motivation, but can also be used to refer to a value and an emotional state. However, whilst it is useful to understand the meaning of the terms value, motivation and emotion, it is more important to focus on what's happening within your own project than worry about the terminology!'

Figure 5-4 VBRE website homepage

Each value, motivation and emotion has a ‘term page’ of detailed content linked from the main navigation table, which includes a definition of the term, example interview questions, scenarios to help the analyst consider the ways the value, motivation or emotion might be important to a project, and advice about its potential impact on the requirements process or software design. An example page for ‘Trust’ is shown in figure 5-5.

Chapter 5 – Development of Method Support Materials

Trust (Having confidence or faith in something or someone)

Interview questions

This section is intended to give you some ideas as to how to explore or identify a particular issue. Not all the questions will always be appropriate or pertinent to your project

- How well do you /team get along with external groups?
- Which team members do you work most closely with?
- How closely do you work with your colleagues?
- How much freedom do you have to make changes to your job?
- Have you made changes or improvements to your work processes?
- Do you feel you are trusted to work independently?
- Do you feel your company / manager supports innovation?
- Are you able to make changes to your work processes?

Scenarios

Scenarios are examples of the ways different values, motivations and emotions can play out within software development projects.

Process Consolidation	Three regional offices of a charity have independently developed their own methods for running and tracking their projects. Their Head Office has decided everyone should use the same system and asked an external company to investigate.	Read more
Data Curation	A system is to be developed which will allow wider access to an existing data archive which could previously only be accessed via requests to an individual who acted as data curator.	Read more
Staff Monitoring	A company which works on several projects at a time for different clients has decided to introduce monitoring of staff time allocations in order to track progress and to learn about the accuracy of the estimation process.	Read more

Done

Figure 5-5 Screenshot of the ‘Trust’ term page

5.5 SUMMARY

Chapter five describes the development and evaluation of tools to support analysts in carrying out VBRE analysis. Firstly a set of RE specific value, motivation and emotion taxonomies were derived from more general VM&E taxonomies. The use of the taxonomies to complement the VBRE reflective analysis method was evaluated by the author in her project work, and reviewed by industry analysts during a training course. Following this evaluation, the taxonomies were extended with additional guidance for the analyst, including definitions and interview advice and then developed into a website.

Chapter 6 Experimental Evaluations of VBRE Method and Materials

6.1 INTRODUCTION

Chapter six describes the approach adopted to evaluate the VBRE method and presents two experimental evaluations of components of the VBRE method and website:

1. An experimental evaluation carried out with final year RE students, which investigated whether the use of the VBRE method and website would impact their ability to detect values, motivations and emotions.
2. A survey based evaluation of website content, usability and utility consulting the RE student participants from (1) and industry analysts

The lessons from these evaluations were used to refine the navigation and appearance of the VBRE website, and this chapter concludes by detailing the improvements.

6.2 EVALUATING THE VBRE METHOD

Assessments of new RE methods frequently take the form of either experimental evaluations run in academia (often with undergraduate student participants) or industry based case studies. Both approaches have advantages and disadvantages; whilst controlled experiments can enable an assessment of the impact of the method across a large set of participants and comparison of ‘with’ and ‘without method performance, it can be difficult to assess complex socio-technical phenomena in experimental circumstances, and the practicalities of running such experiments mean the scenarios on which the experiment is based are limited in scope. In contrast, industry case studies allow evaluation of the method in a real-world setting, but the challenges of recruiting participants and analysing large volumes of data gathered during the course of such evaluations limit the number of case studies that can feasibly be carried out. Furthermore, it cannot be assumed that the success of a method in a limited number of case studies will generalise to other RE situations. For these reasons, three complementary evaluations were performed with the goal of compensating for the different limitations of each approach:

1. A mixed methods scenario based experimental evaluation working with 3rd year computer science undergraduates (presented in this chapter)
 - + Allows case control comparison.
 - + Reasonable proxy for target audience of novice analysts.
 - + Enables controlled ‘cookbook’ application of the method.
 - + Allows assessment of method comprehensibility and acceptability for novice analysts.
 - Complex social phenomenon difficult to assess via experiment.
 - Scenario can never be as rich or detailed as real life.
 - Participants have limited time to learn the method and immerse themselves in the material.
2. Website Comprehensibility and Usability evaluation (presented in this chapter)
 - + Focus on website usability and utility.
 - + Feedback on whether content is considered relevant and comprehensible.
 - + Allows consultation with wider group of respondents.
 - Questionnaire limits responses to predefined questions.
3. Case study evaluation with industry analysts (presented in chapter 7)
 - + Real-life setting.
 - + Allows consideration of method utility, usability and adoption.
 - + Method is used over a long period of time.
 - + Provides feedback from industry analysts.
 - Limited scale: only 4 analysts.
 - Limited control over how the method is applied.
 - Dependent on volunteers’ reports.
 - No case control comparison.
 - Not repeatable.

6.3 SCENARIO BASED EXPERIMENTAL EVALUATION

An experimental evaluation was designed in order to assess the utility of the VBRE method and website for novice requirements analysts. Participants answered questions about a fictional RE scenario, half of the volunteers having received training in the VBRE method. The study aimed to discover whether there was a difference between the

abilities of the ‘with method’ and ‘without method’ groups to identify and address VM&E related issues.

6.1 a Participants

Twelve final year undergraduate software engineering students (female = 3, male = 9, age range 20-24), who had recently completed a module in requirements engineering participated in the study. Although none of the students had worked as a requirements analyst, they were within 6 months of completing their degree, and could be considered a reasonable proxy for a novice requirements analyst starting their first job. The students were recruited via a course mailing list, the email explained that the experiment was investigating requirements elicitation techniques and that students would be asked to analyse a case study. The students were given no further indication at this point that they would be asked to consider the values, motivations or emotions of the case study characters. Six of the participants were given training in the VBRE method and website before attempting the analysis while the remaining six worked without any support, but were given an introduction to the website for a post-test evaluation after they had completed the experiment.

6.1 b Case Study and Tasks

The scenario described requirements elicitation work carried out in support of the development of a sales reporting system for a Building Society. The case study was fictional, but reviewed by the author’s supervisor for realism and consistency. The full text of the case study and experiment can be found in appendix E.

Participants were provided with a narrative scenario giving the background to a software project based at a Building Society and transcripts of interviews with Building Society employees. The scenario described the approaches to capturing and projecting sales figures adopted by the managers of regional sales teams, with interview transcripts illustrating different managers’ attitudes to the proposed development. Participants were asked to evaluate these interviews, and then answer questions about the stakeholders’ VM&Es, and concerns about the new system. These questions consisted of short answer and multiple choice questions. The short answer questions consisted of four open format questions on the issues raised in the interview transcripts, the concerns of the principal characters and potential actions the requirements analyst might undertake to address

problems. Responses from all the subjects were collated and categorised into themes, e.g. ‘concerns about deskilling’ or ‘need for training’, allowing comparison between the answers provided by the ‘with’ and ‘without’ method groups.

The multiple choice questions asked participants to identify motivations and emotions of two of the principal characters in the case study; answers were scored against a ‘gold standard’ answer developed with input from expert requirements analysts (the author’s supervisor and a second Professor of Requirements Engineering).

The design of the experiment aimed to reconcile the tension between providing sufficient structure to the evaluation to allow reasonable comparisons to be drawn between the ‘with’ and ‘without’ groups, whilst avoiding prompting the ‘without’ group to consider the users’ values, motivations and emotions, in a manner that would differ significantly from standard RE practices discussed in chapter two’s literature survey: analysts are reminded to consider ‘soft issues’ but do not receive more detailed guidance. To this end a combination of semi-structured interview questions and multiple choice questions were used, with the experiment ordered in such a way as to attempt to avoid ‘prompting’. In particular, the use of multiple choice questions allows comparison with an expert answer, but does reduce the realism of the ‘without method’ task as participants are being prompted to consider motivations and emotions. Consequently participants were given the short answer questions first, which did not contain any indications as to the goal of the experiment or the types of data of interest. Table 6-1 provides the ordering of the various tasks for the ‘with’ and ‘without’ method cohorts.

Table 6-1 Ordering of experimental tasks for the With and Without groups.

With Method	Without Method
1. Consent form and information sheet	1. Consent form and information sheet
2. Pre-study questionnaire	2. Pre-study questionnaire
3. VBRE website demonstration	3. Participant given the case study to read
4. Participant given opportunity to explore the VBRE website.	4. Participant given short answer scenario analysis questions
5. Participant given the case study to read	5. Participant given multiple choice questions
6. Participant given the short answer scenario analysis questions and asked to use the VBRE website to help them answer the questions	6. Post-study questionnaire
7. Participant given multiple choice questions and asked to use the site to help them answer the questions	7. VBRE website demonstration
8. Website evaluation questionnaire	8. Participant given opportunity to explore the site.
9. Post-study questionnaire	9. Website evaluation questionnaire

6.2 RESULTS

6.2 a Short Answer Questions

Participants were asked four open ended questions about the case study to identify requirements issues and suggest ways they might address these issues:

1. What do you think the main issues in the development of the reporting software will be?
2. What do you think Patrick's main concerns about implementation of the system are?
3. What do you think Lucy's main concerns about implementation of the system are?
4. How might you address their concerns?

Chapter 6 – Experimental Evaluations

The students' answers were reviewed and comparable responses were grouped to allow comparison between With and Without method participants. Tables 6-2 to 6-5 below summarise the participants' responses to each question.

Table 6-2 Summary of Responses to Q1 “What do you think the main issues in the development of the reporting software will be?”

Issue	With Method (n=6)	Without Method (n=6)
Reconciling stakeholder viewpoints	4	1
Need for a configurable system to suit different users	1	0
Consistent procedures	1	0
Data accuracy of financial reports	1	2
Ease of use	1	1
Training	1	1
Problems in motivating participants to use new system	0	2
Totals	9	7

Table 6-3 Summary of Participant Responses to Q2: “What do you think Patrick's main concerns about the implementation of the system are?”

Patrick's concerns	With Method	Without Method
Loss of access to detailed statistics	4	5
Data will not be kept up to date	3	1
Management Disinterest	2	1
Lack of statistical understanding in the rest of the company.	1	2
New system will be less accurate than his current work.	1	0
More pressure on his staff	1	0
Change to way of working	1	0
Deskilling	1	0
His team will lose recognition	1	1
Thinks everyone should switch to his way of doing things.	1	0
System will not meet his requirements.	1	0
Totals	17	10

Table 6-4 Summary of Participant Responses to Q3: “What do you think Lucy's main concerns about the implementation of the system are?”

Lucy's concerns	With Method	Without Method
Doesn't want to force change to new system.	2	1
Team already effective	2	0
Team will be unhappy	2	0
Team won't like new system.	1	1
She's nervous about using computers	1	2
Staff don't like producing reports	1	0
Team won't want change	1	2
Team won't want to keep data current.	1	1
System will be too difficult to use	1	1
Loss of communication	1	0
Recording lost leads may be demoralising	1	0
Shifts focus away from their main priority (selling)	1	0
Pressure on team to collect data	1	0
Time saving	0	1
Will keep her up to date	0	1
Team will be worried about checking up on them.	0	1
Totals	16	11

Table 6-5 Summary of Participant Responses to Q4: “How might you address their concerns?”

Suggestion	With Method	Without Method
Training course	3	4
Team meetings to address concerns	2	0
Explain long term benefits	2	1
Suggest Patrick's reward plan to rest of company	1	1
Compliment Patrick on effort, but challenge need for all the details	1	0
Provide automated system for data collection	1	1
Make raw data available to team leaders in addition to reports	1	0
Test system with the staff before the final rollout	1	0
Allow staff to customise system	1	1
Allow managers to monitor employees' sales.	1	0
Involve Patrick and Lucy in the design process	1	0
Consider which aspects of the work might be left un-automated.	1	0
Find project representatives from staff	1	0
Find compromise between Lucy and Patrick's approaches.	1	0
Enforce Patrick's approach	0	1
Extra training for managers	0	1
Hold a meeting between Anita, managers and IT department	0	1
Link departments through a centralised system.	0	1
Standardise working practice	0	1
Make system simple	0	1
Totals	18	14

The responses to the open format questions can be assessed in a number of ways:

- Quantity of responses made by participants
- Diversity of responses
- Degree of awareness of values, motivations and emotions within the responses

Table 6-6 provides a summary of the number and diversity of responses given by the two groups.

In terms of the quantity of responses, while for each question the ‘with method’ participants made more suggestions, for questions one and four the differences between the groups are small, with greater variation in the number of responses given to questions 2 and 3.

A greater diversity of responses was observed in the ‘with method’ participants’ responses to questions 2 and 3. Given that questions 2 and 3 focus on identifying the

concerns of individual participants this may suggest that the use of the method enables the user to consider a wider range of potential concerns than they might otherwise do.

Table 6-6 Summary of Responses to Open Format Questions

	Total number of responses		Diversity of responses (number of different responses)	
	With Method	Without Method	With Method	Without Method
Question 1: What do you think the main issues in the development of the reporting software will be?	9	7	6	5
Question 2: What do you think Patrick's main concerns about the implementation of the system are?	17	10	11	5
Question 3: What do you think Lucy's main concerns about the implementation of the system are?	16	11	13	9
Question 4: How might you address their concerns?	18	14	14	11
TOTALS	60	42	44	30

Assessing the degree of awareness of values, motivations and emotions within the responses is a more subjective task but there are differences in the answers between the With and Without Method groups. In question 1 when asked about the main issues in the development of the reporting software, ‘reconciling stakeholder viewpoints’ was the most frequently cited concern of the With Method group, followed by one person each reporting the need for a configurable system, consistent procedures, data accuracy, ease of use, and training needs. In comparison the control Without Method group cited motivational problems (2), data accuracy (2), then single responses on stakeholder viewpoints, ease of use and training. Questions 2 and 3 asked the respondents about the concerns of individual managers involved in the project. The ‘without’ group focus on process issues for Patrick: the loss of access to statistics, and poor statistical knowledge in the rest of the company. These concerns were identified by the ‘with’ group, but other issues around values, motivations and emotions were also identified: pressure on staff, Patrick’s wish to enforce his way of doing things, risks around deskilling. Similarly the ‘with method’ group identified emotional concerns for Lucy: team unhappiness, demoralised staff, increased pressure, that were not proposed by the ‘without’ group.

Question four asked the respondents to identify requirements and organisational actions that might be undertaken to address users' concerns. Here the control group's recommendations were more biased towards imposing a solution (e.g. 'Enforce Patricks' approach', 'Link departments through a centralised system', 'Standardise working practice', compared to the method group where more responses considered consensus building (e.g. 'Find compromise between approaches', 'Find project representatives from staff', 'Involve Lucy and Patrick in the design process'. Given the variation in the number and types of responses, it is plausible that the method helped analysts to consider more user focussed approaches.

6.2 b Multiple Choice Questions – Identification of Motivations and Emotions

Participants were asked to select motivations and emotions relevant to the two case study interviews from a pick list, e.g.:

What do you think Patrick's motivations are? (Tick as many as you feel are applicable)

<i>Peer-esteem</i>	<i>Power</i>
<i>Achievement</i>	<i>Sociability</i>
<i>Altruism</i>	<i>Challenge</i>
<i>Curiosity</i>	<i>Pleasure</i>
<i>Ownership</i>	

Participants were able to select as many items as they wished from the list and were therefore assessed on the number of both matches and mismatches against the gold standard answer, rather than simply the number of correct answers. The results of the post-test questionnaire are shown in tables 6-7 to 6-9 as % true positive and % false positive answers assessed against the expert 'gold' standard solution. A detailed set of answers, including the experts' gold-standard answers are provided in appendix F.

Table 6-7 Percentage of true positives (% matches against expert gold standard to total answers given) for the motivations and emotions.

	% True positives with method	% True positives without method
Motivations P	61.9%	40.7%
Motivations L	38.9	50
Emotions P	55.5	47.05
Emotions L	33.3	14.3
Total	45.3	38.8

Table 6-8 Errors or incorrect answers (% mismatches against gold standard to total answers given) for the motivations and emotions.

	With method	Without
Motivations P	38.1	59.3
Motivations L	61.1	50
Emotions P	44.4	52.9
Emotions L	66.7	85.7
Total	54.7	60.1

Table 6-9 Summary of Correct and False Positive Results

	Correct Positives (as a percentage of total number of selections)		False Positives (as a percentage of total number of selections)	
	With method	Without method	With method	Without Method
Motivations P	61.9%	40.7%	38.1%	59.3%
Motivations L	38.9	50	61.1	50
Emotions P	55.5	47.05	44.4	52.9
Emotions L	33.3	14.3	66.7	85.7

The results of the two groups were compared using a binomial test on the total true and false positives. Performance was better with the method than without, but the differences were not statistically significant (see appendix F for details), possibly because of the small sample. Subjects with the method performed better than without in both emotion questions; however, motivations analysis for one character was worse in the With group. Detailed examination of this result showed that the expert answer was more parsimonious than the student selections, selecting only ‘achievement’ and ‘peer esteem’ as opposed to many of the students who also selected ‘sociability’. This difference led to an increased false positive rate but it could be argued that the students had reasonably identified two closely related concerns.

Discussion

Whilst sections of the multiple choice results do not show a significant difference in performance between the ‘with’ and ‘without method’ groups, there is a general trend

towards the ‘with’ group showing a greater diversity of responses, and an increased consideration of ‘soft issues’. In particular the responses to the short answer questions from the With Method group were more numerous, more varied and more user centred, whilst the responses to the multiple choice questions showed improved (though not statistically significant) performance by the With Method participants in three of the four questions. It might be expected that there is less variation between the two groups during the multiple-choice questions, given that all participants are prompted by selecting from a given set of answers. Whilst some sections of the results do not show a conclusive difference between groups the results of the evaluation are broadly supportive of the use of the method.

6.4 VBRE WEBSITE EVALUATION

A web based questionnaire was developed to gather feedback from industry analysts and undergraduate computer science students on the VBRE website for utility and usability. The goal of the evaluation was to answer the following questions:

1. Was the content of the website comprehensible?
2. Did the respondents consider the content useful and relevant to RE?

6.3 METHOD

A questionnaire based approach was adopted in order to provide a simple, quick means of gathering participant feedback. The structured nature of the questionnaire allowed for comparison between the student and expert groups, and was suitable for asking straightforward questions about the site’s usability and comprehensibility.

Respondents were asked to explore the website and then answer questions about website utility and comprehensibility on a 7 point Likert scale. Respondents were also asked to rate all the values, motivations and emotions listed within the website on a scale of 1(irrelevant) to 7 (highly relevant) in terms of their relevance to requirements engineering problems, and then given the opportunity to add free text comments on the website. Table 6-10 below includes the wording of the questions.

6.3 a Participants

The first group of respondents were the final year undergraduate students (n=12, 9 male, 3 female, age range 20-24) who participated in the method evaluation study outlined

above. The students were given an introduction to the website and time to explore the system, before being asked to complete the online questionnaire while the author was present. The second group were professional requirements engineers recruited by a ‘snowball’ approach ($n=6$, 4 male, 2 female), via email to an RE mailing list. Respondents were provided with a short description of the purpose of the website, and links to the website and the questionnaire; in these cases the questionnaire was completed remotely.

6.4 RESULTS

Website Evaluation

Both the students and RE experts rated all aspects of the website positively, see table 6-10, and felt the site had the potential to be a useful aid to requirements elicitation. Both the students and the analysts felt that the scenarios and associated lists of related values, motivations and emotions were very useful. The experts were slightly more critical of comprehension of the concepts and design advice, which is not surprising given their more extensive experience; however even these lower ratings were above the halfway point of the measurement scale.

Table 6-10 Students and Experts’ rating of the method support website on a 7 point Likert scale.

Questions On a scale of 1 to 7:	Students Mean (SD)	Experts Mean (SD)
Did you find the content of the website: (1 – boring, 7- very interesting)	5.5 (0.85)	6.33 (0.85)
Did you find the content of the site clear? (1 – very confusing, 7 easy to understand)	6.45 (0.52)	5.66 (0.85)
Did you find the site easy to understand? (1-very confusing, 7 easy to understand)	6.08 (1.03)	4.5 (1.76)
Did you find the scenarios useful? (1 – not useful, 7 very useful)	6.17 (0.63)	6.17 (0.98)
How useful did you find the design and process advice associated with each term? (1 – not useful, 7 very useful)	5.75 (0.75)	4.83 (1.94)
Do you think the system would be useful to requirements analysts? (1 – not useful, 7, very useful)	6.33 (0.84)	6 (1.26)

The respondents were also asked for their comments on the site in an open format question “Do you have any additional comments you would like to make about the website?” Nine of the twelve students and five of the six experts provided comments. The majority of comments were suggestions for improvements but the comments also included positive and negative feedback on site content and look and feel. Table 6-11

provides a count of the number of comments in each category, and the responses in each category are discussed below.

Table 6-11 Summary counts of the comments on the VBRE website

Category	Students (9 respondents)	Experts (5 respondents)	Totals
Positive comments on site content	3	4	7
Negative comments on site content	0	3	3
Positive comments on site look and feel	2	2	4
Negative comments on site look and feel	2	2	4
Suggestions for improvements	14	6	20

Site content

The students' comments on the site were positive. They felt the site was informative and content rich. The scenarios were felt to be particularly useful and several students commented that having concrete examples provided by the scenarios aided their understanding:

“They were easy to relate to, you don't need special knowledge to understand them.”

“I can understand where they're coming from, everyone's dealt with insurance. It was practical.”

The practicing analysts gave a mixture of positive and negative feedback. Whilst the positive remarks indicated that the content was useful, they found some of the terminology confusing, in particular the site attempted to make distinctions between values, motivations and emotions and this was not well received:

“I think some of the values could be motivations or emotions. I don't really care whether something is a motivation or an emotion, I just need to know if it matters.”

“The different colours on the front page are hard to figure out, and when I'd worked it out it didn't really add anything. It looks cluttered.”

Site look and feel

Student opinion on the site's look and feel was split, two respondents found the site well organised, and two found the volume of information on the site overwhelming and difficult to navigate. It should be noted that many of the student suggestions for

improvement discussed below, whilst not directly critical of site look and feel, did relate to the information architecture and appearance. One of the expert analysts remarked on the value of having multiple routes into the site; however a second industry analyst commented that he found the site confusing, in particular that the front page of the site needed a more obvious starting point for new users:

"A final comment on the usability of first page: It was confusing for me to read "getting started" and then "alternatively...". It took some while till I noticed that the preferred way to get started was behind the link. As I had not understood how to get started, the alternatives were not helpful at this point. I would move them to the getting started page."

Suggestions for Website Improvements

Both the students and experts suggested a variety of improvements; these are detailed in table 6-12.

Table 6-12 Summary of students' and experts' proposed improvements to the VBRE website

Suggested Improvement	Students	Experts
Changes to the colour scheme	4	0
Making it easier to understand how to get started	3	1
Making the pages narrower	1	0
Connecting up related terms	1	1
Making it possible for users to add content	0	1
Targeting the method at project managers as well as requirements analysts	0	1
Adding a search facility	2	0
Adding a section on how to conduct an interview	1	0
Adding more detail to scenarios	1	1
Splitting out project issues and design recommendations	0	1
Spreading the content out over more pages	1	0
Totals	14	6

Relevance of value, motivation and emotion terms

The questionnaire also asked participants to rate each of the VM&Es listed on the site for relevance to RE using a seven point Likert scale (1 – irrelevant to 7 – highly relevant.), table 6-13 contains the top scoring terms (rated 6.0 and above), the full list of terms and ratings can be found in appendix G. There was agreement between the groups on the importance of trust, cooperation and frustration which were the top three responses from both groups. The experts' responses were more variable than the students, which perhaps reflects diversity in the experts who were drawn from different industries, hence an analyst working in a creative media or scientific research environment might consider 'curiosity' a more important issue than an analyst working in the financial domain who might be more concerned with 'responsibility'. The students rated all concepts as relevant (Mean >4.0), with the exception of the term 'Altruism' which was not understood by eight of the 12 students. The expert analysts rated the majority of terms positively but four terms: 'forgiving', 'depression', 'courageous' and 'self-control' were rated at less than 3.5, and could perhaps indicate that these terms might be removed from the site.

Table 6-13 Values, motivations and emotions rated as highly relevant to RE (scoring 6.00 or above) as scored by RE students and RE experts, rating each term between 1-7 for relevance.

Students		Experts	
Trust	6.67	Cooperation	6.83
Cooperation	6.50	Trust	6.83
Achievement	6.50	Frustration	6.83
Frustration	6.50	Absence of Conflict	6.50
Success	6.42	Independent	6.50
Absence of Conflict	6.33	Ownership	6.50
Happiness	6.33	Equality	6.33
Challenge	6.25	Curiosity	6.33
Experience	6.25	Sociability	6.33
Accomplishment	6.17	Experience	6.17
Logical	6.17	Helpful	6.17
Ownership	6.00	Achievement	6.17
Peer-Esteem	6.00	Power	6.17
Pleasure	6.00	Happiness	6.17
Fear	6.00	Friendship	6.00
		Intellectual	6.00
		Responsible	6.00
		Fear	6.00

6.4 a VBRE Website Revisions

The evaluation identified a number of issues with the current site's content, navigation and appearance. Table 6-14 summarises the issues; when the issue was addressed, the Resolution column describes the action taken, when the issue was not addressed, the Resolution column provides the rationale for not taking action.

Table 6-14 Issues identified during the VBRE Website evaluation and their resolution

Issue	Addressed in redesign?	Resolution
The use of different colours to represent VM&Es on the homepage is confusing.	Yes	Removed the distinction between VM&E – feedback from analysts was that they are not concerned with the categories.
Standardise naming conventions for the VM&E terms	No	Opted to continue to use naming conventions as agreed in chapter 5
It's difficult to know where to get started with the website	Yes	Simplified homepage and organised display of VM&E based on those considered most relevant by questionnaire respondents.
Change the colour scheme	Yes	A more harmonious set of colours was selected for the website
Text is too wide	Yes	Fixed text widths of website
Help finding related values, motivations and emotions		Relatedness of different v, m and e is subjective – opted to use scenarios to link related V, M and E so that underneath each scenario a list of all the V, M and E tagged as relevant to that scenario is displayed.
Make it possible for users to add content	No	Outside the scope of this work, but interesting idea for the future.
Target at project managers	No	Outside the scope of this work
It's hard to find content – could a search facility be added?	No	Site is relatively small at present – proposal is to improve layout, and navigation, in particular to improve the layout of the home page rather than to add a search feature.
Add a section on how to conduct an interview	No	Outside the scope of this work
Add more detail to scenarios	No	Adding more detail to the scenarios would be useful, however this was outside the scope of this development.
Split out project issues and design considerations.	No	This could be a valuable improvement to make to the site in the future if the site content is expanded. At present the site contains a relatively small number of project issues and design considerations so this modification would have limited impact.
Spread content out over more pages / make the site smaller	Yes	Two contrasting requests: users finding the 'term' pages too cluttered and others wanting the site content to be condensed. Proposal for the redesign is to improve the appearance of the site including clearer section headings and navigation to try to address these issues.

Chapter 6 –Experimental Evaluations

Figure 6-1 provides a screenshot of the revised VBRE homepage. Changes include modifications to the appearance of the page, including an attempt to create a more obvious ‘starting point’, the removal of the distinctions between values, motivations and emotions and a reduction in the amount of text. The relevance ratings provided by the students and analysts (see table 6-13) were used to create a ‘tag cloud’ on the front page; using larger fonts for the most highly rated VM&Es. Each entry in the tag cloud links to a ‘term page’. Figure 6-2 provides a screen shot of an example ‘term’ page for the value ‘intellectual’. Each page includes example interview questions, scenarios to help the analyst consider how the value might be important to their project and potential design and project considerations. More white space has been added to make term pages easier to read, and the text is no longer presented as a set of tables.

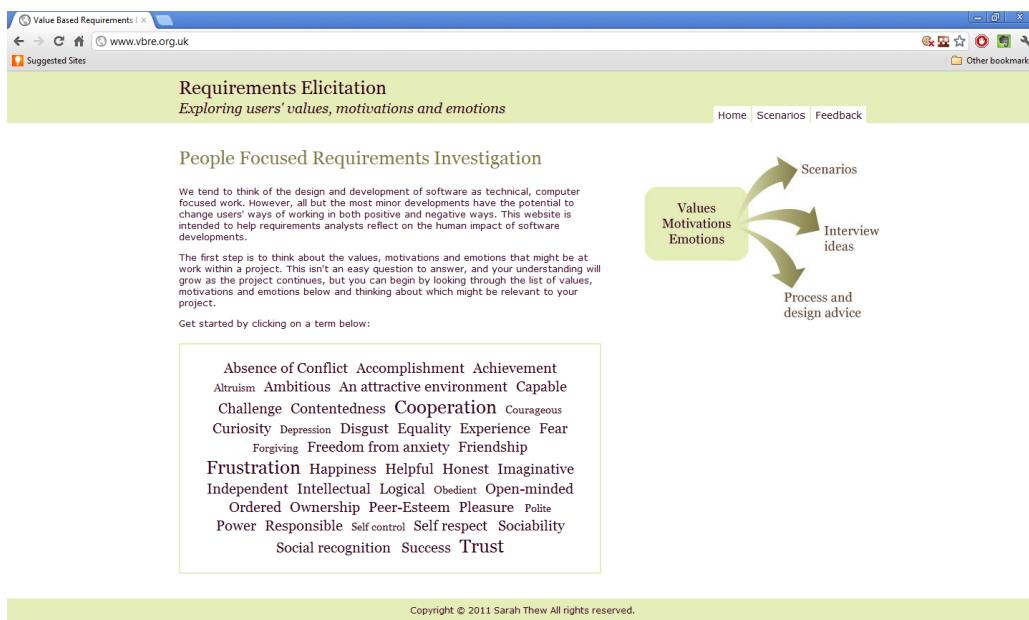


Figure 6-1 Screenshot of the main values, motivations and emotions navigation table from the VBRE website.

Requirements Elicitation
Exploring users' values, motivations and emotions

[Home](#) > [Terms](#) > [Intellectual](#)

Intellectual
Intelligent, reflective

[Interview questions](#)

This section is intended to give you some ideas as to how to explore or identify a particular issue. Not all the questions will always be appropriate or pertinent to your project

- How big a part of your job is problem solving?
- Do you enjoy puzzle solving?
- Do you enjoy learning new skills?
- How creative is your job?
- Have you made changes or improvements to your work processes?
- Are you able to make changes to your work processes?
- Is your job demanding?

[Scenarios](#)

Scenarios are examples of the ways different values, motivations and emotions can play out within software development projects.

- **Data Curation:** A large supermarket company have decided to widen access to an archive of departmental financial performance, which could previously only be accessed via requests to an individual who acted as data curator. The company's management team hope that by allowing heads of the individual departments direct access to the data, they will be better able to monitor costs. [Read more](#)
- **De-skilling:** An insurance company has decided to introduce a system to automate aspects of the claims adjustment process. The system will automate and standardise many aspects of the adjusters' work. [Read more](#)
- **CASE tool introduction:** A software company has decided to introduce Computer aided software engineering (CASE) tools for all developers, to try to standardise their work, and to reduce maintenance costs. [Read more](#)

[Potential design and project considerations](#)

People's values, motivations and emotions can have consequences both for the way you decide to run your requirements gathering proces and for the eventual design of your

Figure 6-2 Screenshot of the ‘Intellectual’ term page

6.5 SUMMARY

Chapter six described two VBRE evaluations. The first experimental evaluation tested the method and website with undergraduate students and showed a small positive impact from the method and site. Using the method students identified more VM&Es and proposed more diverse and user-focussed solutions, although the differences were not significant, potentially due to sample size. The second evaluation focussed on the usability and utility of the website, and was broadly favourable but identified a number of improvements which were made to the website.

Chapter 7 VBRE Industry Case Studies

7.1 INTRODUCTION

The VBRE method was developed in consultation with industry analysts, with the aim of ensuring the method was useful and accessible to working analysts. Whilst results from the website evaluation and controlled, experimental study presented in chapter six were positive, these approaches were unable to assess whether the method is usable and useful in an industrial context. This chapter describes a set of four case studies following practising analysts making use of the VBRE method and website in their own projects. The case studies provide an assessment of the utility and usability of the VBRE method and tools in working practice, and explore if and how the method impacted the software projects under study. The studies also provide a means of investigating how the method is adopted and adapted for use in ‘real-life’ by novice and expert analysts.

The chapter begins with a brief overview of the VBRE method and tool development process, summarising the changes made following each round of evaluation, and provides a summary of the fourth version of the method. This fourth version is then evaluated in the case studies presented in this chapter.

The chapter continues by discussing the case study goals and the rationale for a diary-based approach and revisits the literature around method adoption to aid in developing evaluation criteria. The case study design, recruitment rationale, data collection and analysis processes are described, and actions taken to ameliorate threats to validity are reviewed. The results of the case studies are presented and the findings are discussed.

7.2 VBRE METHOD AND TOOL EVOLUTION

Chapters four to six describe an iterative process of method design, development and testing. Table 7-1 summarises the four iterations of the method and support tools. The basic principle of VBRE: the iterative reflection and review of the outputs of requirements gathering activities, focussing on users’ values, motivations and emotions, has remained central to the method, but has been augmented with a set of support materials to aid the analyst in this reflection and review. The support materials evolved

from taxonomies of values, motivations and emotions, to a website based on the taxonomies. The website was extended to include descriptions and related terms, linked to example interview questions, scenarios and guidelines on their implications for managing the requirements process or defining value sensitive requirements. Figure 7-1 summarises the key steps in the application of the method during one round of requirements elicitation and VBRE analysis, and shows where the website and hunch list are utilised during the process.

Table 7-1 Summary of VBRE Method Versions

Version	Method	Reason for change
1	Cycles of reflection and analysis on users' values, motivations and emotions, integrated into the requirements elicitation process	Initial version based on learning from literature (chapter 2) and analysts interviews (chapter 3)
2	As 1 plus addition of paper taxonomies.	Revised following evaluation by author and a second industry analyst (chapter 4)
3	As 1, plus addition of web based taxonomies, with interview questions, scenarios and process advice	Revised following evaluation by the author and feedback from industry analysts (chapter 5)
4	As 1, plus refined website with usability and content improvements	Revised based on feedback from website content and usability evaluation (chapter 5), and method evaluation (chapter 6)

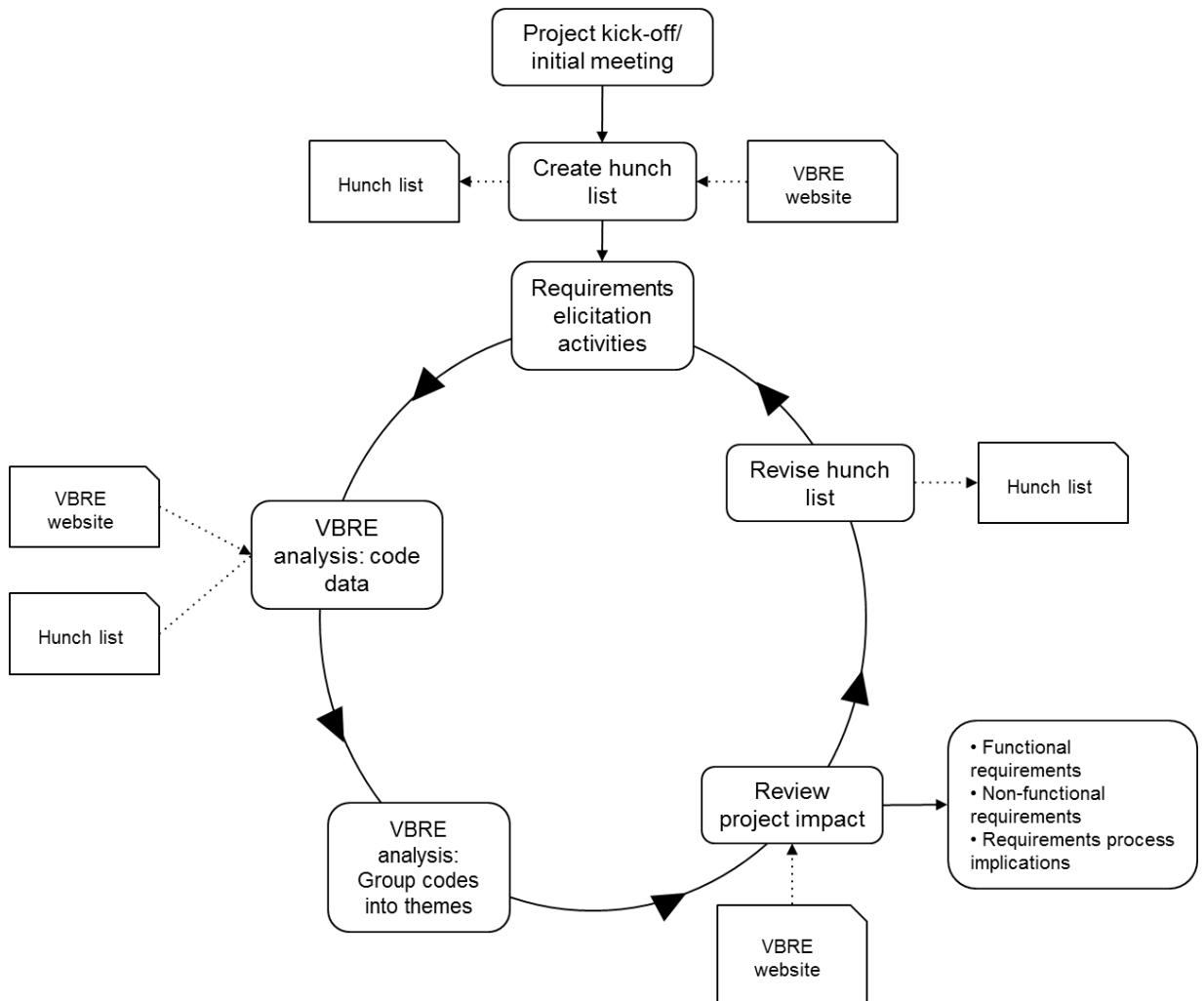


Figure 7-1 Flowchart of the VBRE method version 4

7.3 STUDY APPROACH AND GOALS

The aim of this evaluation was to address the second of the thesis research questions presented in chapter one:

RQ 2: Can a method improve elicitation and effective use of VMEs by requirements analysts?

The case study design aimed to address several sub-questions:

- 2a. What were the analysts' views on the utility and usability of the method and its associated tools, based on their experiences of applying the approach in their own project?

2b. Did the VBRE method have any impact on the projects under study? If so, what?

2c. How was the method adapted for use in ‘real-life’?

Participants were given a tutorial explaining how to apply the fourth version of the method, however given that practitioners usually modify methods to suit their own purposes and to fit in with existing work practices [94, 126, 127] , the analysts were encouraged to apply the method and its tools as they felt most appropriate. In one sense, this approach is problematic, as each case study is likely to vary in the way in which the VBRE method is applied. However, it was hoped that giving practitioners license to adopt and adapt the method as they saw fit would provide a more realistic picture of how the method might be used in the real world. From a pragmatic point of view, it should also be noted that reassuring the participants that they were free to make use of the method and tools as they felt appropriate, encouraged analysts to participate in the study.

The study also asked an additional question. Based on the literature review and the findings of the study reported in Chapter 3 it was anticipated that novice and experienced analysts would use the method in different ways, and therefore the study aimed to recruit analysts with a variety of experience levels in order to ask:

2d. Are the method and website used in the same way by novice and expert analysts?

Case studies are well suited to the study of requirements elicitation techniques in industry, when political and social issues can have as much impact as technical issues [96] and whilst this approach cannot provide statistical measures of cause and effect, it can provide an understanding of the factors influencing method adoption and the reasons for method adaptation. Qualitative investigations of an intervention can provide an understanding of wider influences on outcomes, for example the longitudinal nature of requirements work, demands of multiple projects on attention or influence of existing history in relationships between analysts and users. It may be that the analyst participants have different goals in using the VBRE method as well as different ideas about what ‘success’ looks like; the open ended nature of a qualitative case study allows for unexpected positive and negative outcomes[128].

Frequently cited issues in case study research in software engineering are difficulty in generalising from cases, the lack of control of over confounding variables and problems around alternate interpretations by different people [96]. There are steps that can be

taken in the design of the study to address these issues; in particular the selection of case studies, data collection and analysis process. Section 7.4 Case Study Design, describes the measures adopted to address these problems.

It was anticipated that the analysts would apply the method to pieces of intermittent requirements work spread over several weeks or months (many of the analysts interviewed in chapter three worked across several projects at a time, whilst others carried out multiple roles on their projects, e.g. project manager, user experience expert or software developer.) It was not practical for the researcher to interview the analyst after each application of the method and participants were unlikely to be willing to alert the researcher to every use of the method, therefore diaries were used to collect data about the use of the method. A diary-based case study approach provides a means of longitudinal data capture, and allows for the collection of rich qualitative information necessary to understand the context in which the evaluation is taking place setting [129] [97] [130].

A semi-structured diary format was adopted to allow for some consistency of reporting between case studies, but provide some flexibility for participants to document issues or occurrences. Semi-structured approaches are also recommended as they provide participants with some guidance as to how to complete the diary [98]. However it is inevitable that the degree to which respondents complete the diary will vary and diaries may be incomplete; it can be impossible to know how much information has not been reported. Therefore a wash-up interview allowed for the review of diary content to clarify any ambiguous entries.

Evaluation Criteria

The participants were given the freedom to apply the method as they felt most appropriate to their project, consequently the diary structure was designed to capture information about the ways the method was used as well as project impact, including:

- The frequency of use of the VBRE method.
- The circumstances of use: format of the requirements elicitation activity and the situation.
- VBRE Method components used.
- Analyst's assessment of the impact of the VBRE method.
- Specific values, motivations and emotions identified by the analyst.

- Problems applying the method.

The Data Collection section below provides more detail on the data collection format including an example of a blank diary entry (table 7-1).

In addition to understanding the day-to-day application of the method, the analysts' views on method adoption and adaptation were sought. Chapter two's literature review discussed research into RE method adoption which had identified a number of significant factors, including ease of integration with existing requirements approach, a flexible approach to adoption such that users can cherry pick their use of the method, observable impact, perceived usability, availability of training, peer opinion, and the existence of an organisational mandate [88-90]. There are a number of models which use combinations of these factors to attempt to define the likelihood that a technology or model will be adopted. A review by Riemenschneider et al considered the ability of the Technology Acceptance Model (TAM), TAM2, Method Evaluation Model, Theory of Planned Behaviour and the Mode of Personal Computer Utilisation to predict the adoption of software development methods[131]. The review identified a set of common factors: usefulness, subjective norms, voluntariness and compatibility and generated a set of recommendations around method adoption:

- Mandating use of a method is not sufficient, an individual's perception that adoption is mandatory is no guarantee that they will conform to this mandate.
- Method must be perceived as useful and compatible, the more a method departs from the existing work practices of a developer the less likely it is that the developer will adopt the method.
- Flexibility: 'non vital' aspects of a new method might be adapted or even dropped in order to better fit with existing circumstances.
- Peer influences are significant – people are influenced by co-workers' and supervisors' intention to adopt.

The Method Evaluation Model (MEM) [132] is based on TAM and Rescher's concept of 'Rational Pragmatism': "the efficiency and effectiveness with which a method achieves its objectives". MEM identifies factors influencing the decisions of software developers in adopting or rejecting new methods, and defines two criteria for a method must meet to be considered successful: actual efficacy (does the method actually

improve practice?), and adoption in practice (is the method adopted by practitioners? If the method is not adopted it can have no impact.) MEM focuses on the individuals' perceptions of a method in an attempt to assess the likelihood that a method will be adopted, considering perceived ease of use, perceived usefulness and intention to use. It should be noted that MEM does not consider the significance of factors associated with the wider organisation such as the opinion of a user's peer group or the existence of an organisational mandate to adopt a method. However given the nature of these case studies, neither of these factors can be considered: the VBRE method is new and unknown, therefore participants' peers will not have views on its usefulness or otherwise, and beyond approving participants' participation in the studies, there is no long-term organisational mandate from any of the participants' employers to continue use of the method.

The factors identified by Riemenschneider and MEM were used as a guide in evaluating the outcomes of the four case studies. During wash-up interviews the participants were asked about their perceptions about VBRE's ease of use, usefulness and their intention to use the method in the future.

7.4 CASE STUDY DESIGN

Approach to recruitment

Advice on identifying participants for case study research recommends that the cases should be selected intentionally, for example to find 'typical' cases, or 'edge' cases, rather than at random [96, 133]. For this study, both the findings from chapter three and from the literature suggest that novice and expert analysts might apply the method in different ways. Whilst the ability to find appropriate cases was limited by the resources available to the study and the availability of willing volunteers, this study endeavoured to recruit analyst participants at different stages of their careers.

Data Collection

For each of the case studies the unit of analysis was a single iteration of requirements analysis work carried out by each analyst, incorporating a cycle of requirements elicitation, analysis, documentation and review.

Each case study followed the format shown in figure 7-2. Appendix H contains the case study materials including the initial interview structure, training materials, diary format and wash-up interview script.

An initial interview captured information about analysts' background, their past project experiences and upcoming project work. This was followed by an introductory tutorial explaining the VBRE method and the rationale for its development. The tutorial included an explanation of the method and examples of use, a review of the taxonomies and a demonstration of the website. At the end of the tutorial session the analyst and author discussed forthcoming requirements work and the analyst's perceptions of potential VME issues. During this tutorial the analysts were encouraged to apply the method and website as they felt appropriate to their circumstances. In all but one case the initial interview and tutorial were carried out at the same session (duration: 2 hours).

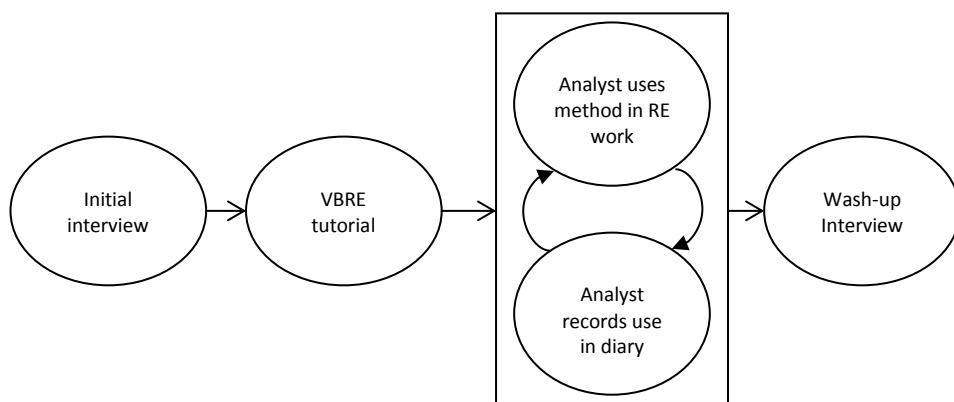


Figure 7-2 Outline of diary study process

The analysts kept a record of their experiences of using the method, using a short structured diary (see table 7-2) whenever they made use of any component of the method or completed requirements analysis activity on their project. The analysts were also given written guidance on the completion of the diary and two example entries. Given that each analyst's work situation was different and that some participants worked across multiple projects, analysts were asked to complete the diary for what they considered to be one phase of their requirements process on one project, covering initial elicitation to requirements definition, rather than to use the method for a set time-period. Analysts were asked to contact the researcher to indicate when they felt they had completed an iteration of their requirements work; however, given the length of the evaluations for two of the analysts (6 and 7 months respectively) the researcher

intermittently emailed these analysts approximately every eight weeks for progress updates.

Wash-up interviews were carried out at the end of each study, during which the content of the diary was reviewed and analysts were asked about their perceptions of the utility and usefulness of the method. Analysts were also asked whether they would use the VBRE approach in future. All interviews were audio-recorded and transcribed.

Table 7-2 Diary Format

Entry Date	
What format did today's requirements work take? Please circle any that apply, or add other techniques as required.	1 to 1 interview (in person/phone/video) Meeting with multiple stakeholders Workshop Work shadowing Other
Did you make use of any VBRE components today?	Method Website Your hunch list None
Please briefly outline the situation and your use of the VBRE tools.	
Did you identify any specific values, motivations or emotions?	
Please describe the impact (if any) of the use of the tools on your requirements identification or project process	
Did you have any problems using the method / website?	

Data Analysis

The diaries were reviewed using a simple content analysis to identify:

- How frequently the method had been applied
- The circumstances in which it was reviewed
- Components of the method used
- Analyst feedback on the impact of the method and any problems experienced.

Case Study Validity

There is an inherent risk in having the diary studies reviewed by the researcher who developed the VBRE method. The researcher's supervisor critiqued the case studies and the conclusions drawn from them in an attempt to ameliorate this. Furthermore, following guidelines on good practice in the design of case studies[96], the wash up interviews provided an opportunity for the participants to review their diaries and to share their views on the method.

A review of the use of case studies to investigate requirements elicitation [55] recommended that case studies should increase their external validity by studying multiple people and/or different contexts. This study works with four analysts based at four different organisations, however it should be noted that all of the projects are developing software for clinical or biological sciences research.

There are two major issues for this study in terms of construct validity. Firstly, do all participants share the same understanding of the method, and secondly, do the analysts and researcher share the same understanding of the diary contents? The first of these issues was addressed by giving a tutorial on the method in advance of the study, and allowing the participants to ask questions about the method both at the tutorial and throughout the duration of the case studies. The wash-up interview held at the end of each case study included a review of the participant's diary entries and provided an opportunity for the researcher to resolve any ambiguities or misunderstandings about the content. This activity proved worthwhile as some of the diary entries were sparse.

7.5 RESULTS

The results section is organised as follows:

1. An overview of the four case studies is provided, describing key characteristics of the four participants and their working environments, and summarising their use of the method.
2. Each of the studies is reviewed:
 - Background contextual detail about the project and stakeholders is provided.
 - Description of the analyst's use of the method.
 - List of the key values, motivations and emotions the analyst identified.
 - Analyst's views on the impact of the method on their requirements elicitation activities and project requirements.
 - Analyst's perceptions of the utility and usability of the method, and their intention to use in future.
3. Discussion of cross-case comparisons and observations.

Overview of the case studies

Four volunteers trialled the method in their workplaces. Three were recruited via personal contacts and advertising within a local requirements and usability forum. The fourth volunteer was then recruited on the recommendation of one of the existing volunteers who found the method sufficiently useful that he encouraged an acquaintance to join the evaluation. All the analysts completed the study and made multiple diary entries. These entries were then reviewed by the participant and author during the final wash-up interview.

Chapter 7 – VBRE Industry Case Studies

Table 7-3 provides an overview of the four studies, describing the requirements elicitation techniques adopted by each analyst, the number of diary entries, components of the method they opted to use and the time period over which the method was trialled.

Table 7-3 Overview of diary study activity

Analyst	A1	A2	A3	A4
Years working as a requirements analyst	1 year	5 years	15 years	2 years
Education	Nursing BSc	Bioinformatics PhD (emphasis on computer science)	Computer Science BSc	Computer Science BSc
Requirements Analysis Training	On the job mentoring, self-study	Self-study	Component of degree, commercially provided short courses, self-study	Self-study
Project Domain	Academic research - biological sciences	EU Research Consortium (academic and industry partners)	Pharmaceutical Industry	Pharmaceutical Industry
Organisation's preferred RE approach	Informal adoption of some Agile practices. Spreadsheet based documentation of requirements (internal format)	Iterative Participatory Design approach, internal format for documentation.	Agile approach to planning and executing RE work – frequent use of UML.	Informal adoption of some Agile practices, no standard format for documentation.
Requirements elicitation techniques adopted	Interviews (in person)	Workshops, prototyping	Interviews (in person, telephone), telephone conferences	Meetings
Number of diary entries	7	5	4	5
Components of VBRE method used	Hunch list, VME Review, Website Components (VME List, interview questions, scenarios)	Hunch list, VME Review, website components: VME list, scenarios	Hunch list, VME Review, Website Components: VME list	Hunch list, VME Review, Website components: VME list, interview questions
Time period trialling the method	4 weeks	7 months	6 months	3 weeks

¹ Analyst 3 made 4 formal diary entries but also reported regularly using the front page of the website as an aide memoire before meetings with stakeholders (approximately 1-3 times a week).

7.6 CASE STUDY REVIEW

The case study review collates information from the initial interview, analysts' diaries and wash-up interview.

Study 1: Inexperienced analyst, Information Management project

A1 has a background in nursing and health informatics, but little formal requirements analysis training and had only worked as an analyst on one previous software project, which was badly received by some users. A1 believed this was due to late and poor stakeholder engagement, and consequently felt anxious about upcoming stakeholder interviews.

Method Use

A1 tested the VBRE method in a project developing web-based software to enable the sharing of information about scientific research projects. This project was financed by an organisation who wished to promote reuse and collaboration in biological research, though A1 and his colleagues in the software development team anticipated that users would not share these goals. The initial requirements elicitation consisted of a series of interviews with 5 research scientists. A1 drew up a list of questions to cover in the interviews; exploring what data they currently hold, how frequently they would be willing to update their own records, what they would like to know about other projects, what search terms they would use. Requirements were collated into a spreadsheet for review and prioritisation with stakeholders and software developers.

A1 followed the VBRE method closely, making an initial hunch list which he updated after reviewing findings from each of his interviews. He used the VBRE website interview questions and scenarios when preparing for interviews.

Key values, motivations and emotions identified by the analyst: privacy, ownership, collaboration, altruism

Method Impact

When drawing up his preliminary VBRE hunch list A1 identified potential issues around the sharing of research data: he anticipated that researchers would not want to share information with researchers they considered to be rivals, that there might be a lack of interest in collaboration, and that the website might increase speculative contacts

requesting data sharing which could be intrusive. He extended his original interview plan to include questions to explore whether these concerns were correct. Over the course of his interviews he explored the question of data sharing and developed a more nuanced understanding about what the scientists were and were not willing to share. In contrast to his original expectations he was surprised to discover that many of the interviewees were happy to share certain details of their research, viewing it as a way to promote collaboration and an altruistic act which would help novice researchers trying to design their first studies.

A1 also identified a clash of views between the project funders and the researchers around the sharing of details about biological samples: the funders considered samples collected during projects they had financed to be publically owned and expected researchers to send samples to a central store, whereas the researchers were concerned that sharing information about such samples might reveal confidential information about their research in advance of publication; publication being a major factor in their career development. This issue was consequently flagged to the project steering committee to develop a policy around sample ownership during the lifecycle of a research project.

Analyst's perceptions of the utility and usability of the method, and their intention to use in future.

A1 commented that the method, in particular the review of interview notes, was time-consuming and that there was a lot to read on the VBRE website but he felt as a consequence of using the method he had attempted to address some issues that he might otherwise have ignored, namely the concerns around sample ownership.

A1 felt the VBRE method was most useful in helping him prepare for interviews, in particular, using the hunch list to prompt him to consider asking questions about users' values and the website interview questions to help him better understand how to broach these subjects. However, he commented that although he felt more confident and better prepared for interviews, he did find the idea of considering users' values and emotions challenging and '*not something that comes naturally.*'

When asked if he would use the method in future work he commented that he would refer to the website and keep a hunch list but might not continue to mark up interview notes.

Study 2. Experienced analyst, Data Management project

A2 has a background in bioinformatics and has worked as a requirements analyst for 5 years on a series of European research projects. She tested the VBRE method within one of these projects. The project was developing data management software for an EU consortium and had faced substantial problems related to trust when first initiated but A2 had worked to develop and refine software requirements with the same set of people for two years and stakeholder relationships had improved. Over the course of this case study, some of the original stakeholders left, and new people joined. A2 was concerned about handling this transition and keeping the stakeholder group running smoothly, this had been her rationale for joining the VBRE study.

A2's development team adopted a Participatory Design approach to their projects and felt this was fundamental to their success. The high level system goals and key requirements were planned and agreed with all stakeholders at workshops held approximately every six months. Requirements were then developed with a sub-group of users, adopting a 'perpetual beta' prototyping approach with new features released quickly to the user group who would act as testers and co-designers.

Method use

A2 used the VBRE method to help prepare for the large stakeholder meetings held every six months, and then to review the outputs of these meetings. The main components of the method used were the hunch list, website front page and the scenarios.

Key VME identified by the analyst: openness, tolerance, trust, anxiety

Method Impact

A2 found that drawing up the hunch list and reviewing meeting notes was useful:

'A way to tie down things that had been buzzing about in my head for a while.'

'It's a reminder to look at things from a different point of view'.

She felt it enabled her to plan the workshops with greater consideration about how to integrate new stakeholders into the existing group. In particular she highlighted openness, trust and collaboration as positive values that were shared by the existing stakeholders. A2 commented that she felt this set of values had developed within the user group over the last two years, and that initially participants had not been willing to

collaborate. She was concerned that new participants joining the group would similarly be initially unwilling to share and felt she needed to promote these values to the new team members. After the first meeting involving the new members of the group she identified a need to change how the meetings were run, realising that although the established members are comfortable with each other and used to being direct, and sometimes confrontational, some of the newer members were anxious and shy. To this end the second workshop was planned with a series of smaller breakout sessions to allow the new and old members to mingle, rather than a large ‘town-hall’ gathering.

She made some use of the website, commenting that she liked the front page as a reminder of things to consider when planning the project, and that the scenarios were a valuable way of making thinking about the consequences of something she considers quite intangible, easier. For example she found the web site scenarios related directly to her current project and highlighted additional values to consider. She remarked that '*the scenarios helped the interviews go better because I anticipated the issues*'.

Analyst’s perceptions of the utility and usability of the method, and their intention to use in future.

A2 did feel that the method was time-consuming, and it felt odd to make notes about users’ values and emotions. When asked whether she had found the method useful she commented:

“Surprisingly useful! But our requirements meetings are very spread out so I kept having to remind myself what to do.”

She observed that she had not followed the VBRE method closely with regard to reflecting on the outcomes of meetings, preferring to use her hunch list and website in advance of workshops to help consider the likely views of different stakeholders and to plan the structure of the days. She commented that the method had an impact on the way in which she ran his requirements workshops but did not think it had impacted the requirements. With regard to future use she did not intend to continue to use VBRE within this project but felt it would be useful to revisit the website at the start of new projects.

Study 3, Experienced Analyst, Clinical data collection project

A3 has a degree in Computer Science and over 10 years requirements analysis experience. He is a contractor working across a variety of industries, and tested the method within a project developing clinical trial analysis software, involving stakeholders from primary (family doctor) and secondary (hospital) care, academic researchers and the pharmaceutical industry. He described this project as '*technically straightforward but intensely political*'. All of the requirements for this project were gathered via workshops and telephone conferences. A3 is confident in running workshops and feels he has good people skills.

Method Use

A3 started using the VBRE method when he was several months into the project and drew up an initial hunch list identifying VM&Es covering all the parties involved in the project, which he regularly reviewed in advance of meetings. He made relatively little use of the VBRE website beyond the VM&E list on the homepage.

Key VME identified by the analyst: innovation, ambition, security, ownership, anxiety, control

Method Impact

A3 began his use of VBRE by drawing up a hunch list. Many of the emotions he identified were negative: resistance to change due to concerns about the consequences of failure, anxiety about job loss or loss of status. A3 tried to address these concerns and to reinforce positive outcomes of the project. He identified shared cross-organisation values: an enthusiasm for innovation for its own sake, as well as ambitions around career progression if the project is a success, and speculated that speaking to these shared values might provide a way to encourage stakeholders to find ways to reach consensus on requirements for the sake of the bigger picture.

A3 also made use of his understanding of users' values of security and control in defining system requirements; building in mechanisms to monitor data access and provide means for users to track queries and work progress. Although the system requirements already addressed all the legal information governance rules, A3 was aware how highly the team members valued control and ownership, and were extremely anxious about accidental release of confidential data, so he felt it was useful to spend

long periods of time covering and reviewing these requirements to secure their confidence.

Analyst's perceptions of the utility and usability of the method, and their intention to use in future.

A3 felt that the most useful part of the method was drawing up a hunch list and reflecting on the VM&Es relevant to his project. He felt that the home page of the website, listing values and emotions was the most important page for an experienced analyst:

“Once I’ve triggered something I can cascade most of what I need but without the front page it slips into the background. There was comparatively little on the website that was new to me, though it was well expressed. I would use it when talking to newer analysts. The main value to me is the reminder list and the intent to leave some time to reflect on this stuff”

A3 commented that he continues to make use of the method in advance of meetings; he finds it useful to carry a paper print out of the homepage with him to refer to during meetings as a prompt to think more widely about stakeholder values and feelings.

“I often have a gut feeling about what I think is happening in a meeting. Looking at the list reminds me to consider other possibilities.”

A3 is occasionally involved in coaching newer analysts and felt that the scenarios could be a useful starting place for teaching analysts to consider social and political issues, but commented that they were short and he would like longer, more complex examples for teaching.

Study 4 Novice analyst, research support tool project

A4 has worked as a commercial software developer for nine years but has only recently been involved in requirements elicitation. His computer science degree did not include any formal RE training, and until his most recent project he had done little requirements analysis. He had recently become responsible for requirements analysis of a web based tool to collect clinical research data. This involved collecting requirements from nurses and from an external research organisation. The requirements for the system were gathered and agreed over the course of three face to face meetings with a small group of stakeholders, covering:

1. Initial requirements scoping
2. Review of proposal and refinement
3. Agreement on final set of requirements

The first of these meetings had already taken place before the initial interview and VBRE tutorial, and A4 expressed surprise at how difficult the early project meetings had been and that he hadn't anticipated this would be the case.

Method use

Creation of hunch list, values taxonomies, lists of interview questions and scenarios, reflection on users' values and, particularly, emotions.

A4 did not make use of the scenarios or the design and project advice, commenting that he was focused on his own project and didn't want to think about anything outside of this.

VME identified by the analyst: ambition, trust, responsibility, peer-esteem, anxiety, inequality

Method Impact

Following the VBRE study kick-off interview and tutorial A4 reviewed his notes from the first stakeholders meeting, drew up a hunch list and reflected on the different stakeholders' involvement. He felt this activity gave him some insight as to why the first meetings had been tense. He identified: ambition, lack of trust, anxiety, extremely high value placed on accuracy, concerns about being perceived as competent, and inequality among stakeholders as issues for the project. He reviewed interview questions from the VBRE website whilst preparing for his next meeting, and pre-prepared a set of requirements that he felt addressed some of issues. In particular he realised that key sticking points for getting agreement on the requirements were:

- The level of detail requested by researchers versus the data the nurses felt able to supply
- The nurses were anxious that the researchers were asking for data held by very busy GPs and the nurses were concerned the GPs would ignore requests for data, leading to the nurses getting behind with their data collection. The nurses felt they were likely to be held responsible for any delays but lacked control over the process.

Once A4 recognised the nurses' anxieties about the lack of control over other people doing the data entry, he was able to propose a new requirement to let the nurses flag when they were waiting on others to do the data entry, making it clear where the responsibilities lay. This proposal helped address the nurses' concerns about being perceived to be competent in the eyes of their peers and the research team.

Analyst's perceptions of the utility and usability of the method, and their intention to use in future.

A4 reported feeling better prepared for subsequent meetings due to using VBRE to try to anticipate problems, and consequently more confident and in control. However he remarked that he was unlikely to continue to use VBRE as it was not part of his company's usual processes.

7.7 DISCUSSION AND CROSS-CASE COMPARISONS

All the participants reported that their use of the method had prompted them to consider users' values, motivations and emotions. Below each of the research questions set out in the introduction to this chapter are discussed.

Q2a. What were the analysts' views on the utility and usability of the method and its associated tools, based on their experiences of applying the approach in their own project?

Method Utility

All of the analysts were able to give examples when they attributed changes to either their requirements process, or to project requirements as a consequence of applying the method, including:

- Interview and workshop planning.
- Challenging analysts' assumptions about users' VM&Es.
- Reflection on outcomes of meetings.
- The addition of new functionality to a project in order to encourage users to adopt the software.

When asked whether they felt VM&Es were relevant to requirements engineering, many of the analysts interviewed in chapter three primarily focussed on user anxiety, and it is noticeable that anxiety was listed as a relevant VM&E in three of these case studies but

also went on to identify a wide list of VM&Es. It is also noticeable that in three of the four studies, analysts actively identified positive values they wished to promote either within the requirements analysis process, or as qualities of the new system. This contrasts with the findings in Chapter three, when few of the analysts considered making use of knowledge of positive values and suggests that the method may encourage analysts to think more creatively about users' values, for example as a means of creating group cohesion.

Method Usability

Feedback from three of the analysts was that they found the method time-consuming to apply, though for two of these respondents this was not considered a barrier to reuse. Analyst A3 had not attempted to apply the 'cookbook' version of the method, instead picking and choosing when to visit the website and had not found this particularly time-consuming.

The analysts used a mixture of interviews and workshops as their main requirements elicitation techniques. All of the analysts took an iterative approach to requirements elicitation and analysis; two of the analysts had little formal structure to their RE approach, but described their approach as 'Agile', whilst the two more experienced analysts described more structured approaches to their RE work; one analyst following a more formalised Agile process, the other describing their approach as Participatory Design. In both cases the more experienced analysts used agreed internal documentation formats, one of which made substantial use of UML. Despite the variation in their processes, none of the analysts reported any issues with integrating the VBRE method into their existing RE approach.

None of the analysts reported any issues with understanding the website content or the application of the method.

Intention to reuse

During the wash-up interview participants were asked if they would make use of the method again. Two of the analysts said they would, and A3 commented that he continues to visit the website regularly. A2 does not intend to use VBRE again within her current project but might consider using it when starting a new project if she felt it could be useful. A4 thought that he was unlikely to continue to use the method as it was not part of his company's standard requirements process.

Q2b Did the VBRE method have any impact on the projects under study? If so, what?

Clearly it is not possible to know whether decisions and activities undertaken by the analysts are a consequence of using VBRE, or whether they would have made similar choices without the use of the method, however all of the analysts described using the method to influence their requirements process or understanding of the requirements, for example A1 raised an issue related to clashing motivations around sharing versus career development which was flagged to the project's steering committee for review, whilst A2 described changing her approach to workshops to better support the integration of new team members. A4 felt drawing up the VBRE hunch list enabled him to better understand the causes of conflict within his project, and addressed some of the issues with changes to the system requirements. It is also apparent from the analysts' hunch lists and diary entries that they paid close attention to their users' values, motivations and emotions and acted upon this information.

Q2c How is the method adapted for use in ‘real-life’?

Participants were given the freedom to apply the method as they felt appropriate. All of the participants drew up hunch lists at the start of their case study, and felt this was a worthwhile exercise. Both of the novice analysts, A1 and A4, described reviewing some of their interview notes alongside their hunch list. Whilst all the analysts commented on using the website extensively in preparing for meetings, their use of the site varied, with some making use simply of the home page and the taxonomies ,and others making use of the interview questions and scenarios.

Q2d Are the method and website used in the same way by novice and expert analysts?

Both the novice analysts made use of the interview questions to help them explore VM&Es with stakeholders. Less use was made of the interview questions and requirements advice by more experienced analysts, but all described finding the list of VM&Es on the front page a useful prompt list to help widen their thinking about social issues and stakeholder values.

The processes of reflection and hunch list development were adopted but adapted for use in different ways by different analysts. The two novice analysts followed the method more closely and kept up-to-date written hunch lists, whilst the more experienced analysts both wrote an initial hunch list but subsequent lists were either

held in their heads or incorporated into their standard interview notes. It is notable that both of the experienced analysts commented in the wash-up interviews that they preferred to use the VBRE taxonomy to ensure they didn't forget to consider values, motivations and emotions when planning requirements work, rather than in reflecting on the outcomes, thus it could be argued that encouraging use of a checklist could help make expert practice more consistent.

7.8 SUMMARY

The set of case studies provided insights into the ways industry practitioners can make use of the VBRE method. All four analysts indicated that they felt the method had impacted their approach to requirements elicitation or the software requirements. As predicted by the method adoption literature each analyst trialled the method in the manner they felt best suited their own project. Although the original focus of the VBRE method was on reviewing and reflecting on interview notes in order to identify evidence of VM&Es the experienced analysts in this study did not feel they needed this structured approach, and preferred using the VBRE website in planning their requirements work.

The case studies provided a means of assessing the utility of diary studies in evaluating RE methods, and showed that diaries can be an effective way to capture reactions and events and suit the study of requirements work which often happens over several weeks if not months. Whilst the diary entries were not always particularly detailed, they provided a useful aide memoire for the analyst during the wash up interviews.

Chapter 8 Conclusions

8.1 INTRODUCTION

The goals of this thesis were to investigate the ways in which requirements analysts elicit users' values, motivations and emotions, and to explore means of supporting analysts in identifying this information during the elicitation process. Chapter eight reviews the work and critically assesses the thesis contributions. Section 8.2 provides a summary of the thesis findings, and section 8.3 reviews the extent to which the research questions have been addressed and describes the contributions of the thesis, considering the findings with regard to existing work in this area. Section 8.4 discusses the limitations of the work, and finally 8.5 goes on to consider further research, discussing both ways in which the limitations of this work might be addressed and highlighting questions raised during the course of this research.

8.2 OVERVIEW OF THE RESEARCH

The work presented in this thesis is organised into two stages. The first stage of the work was an investigation of the RE literature and current analyst practice in order to define the nature of the problem. This was covered in chapters one to three. The second stage of the work was the development, refinement and evaluation of the VBRE method in response to the findings of the first phase of the work, covered in chapters four to seven. Figure 8-1 presents an outline of the thesis and below a brief summary of the key findings and contributions from each chapter is provided.

Chapter one discussed the motivations for this research, considering the reasons why users' VM&Es impact the requirements engineering process, and highlighted a number of examples drawn from the RE literature where users' VM&Es had a significant impact on the outcomes of the project. The terms 'values', 'motivations' and 'emotions' were defined, and the research questions to be addressed by this thesis were discussed.

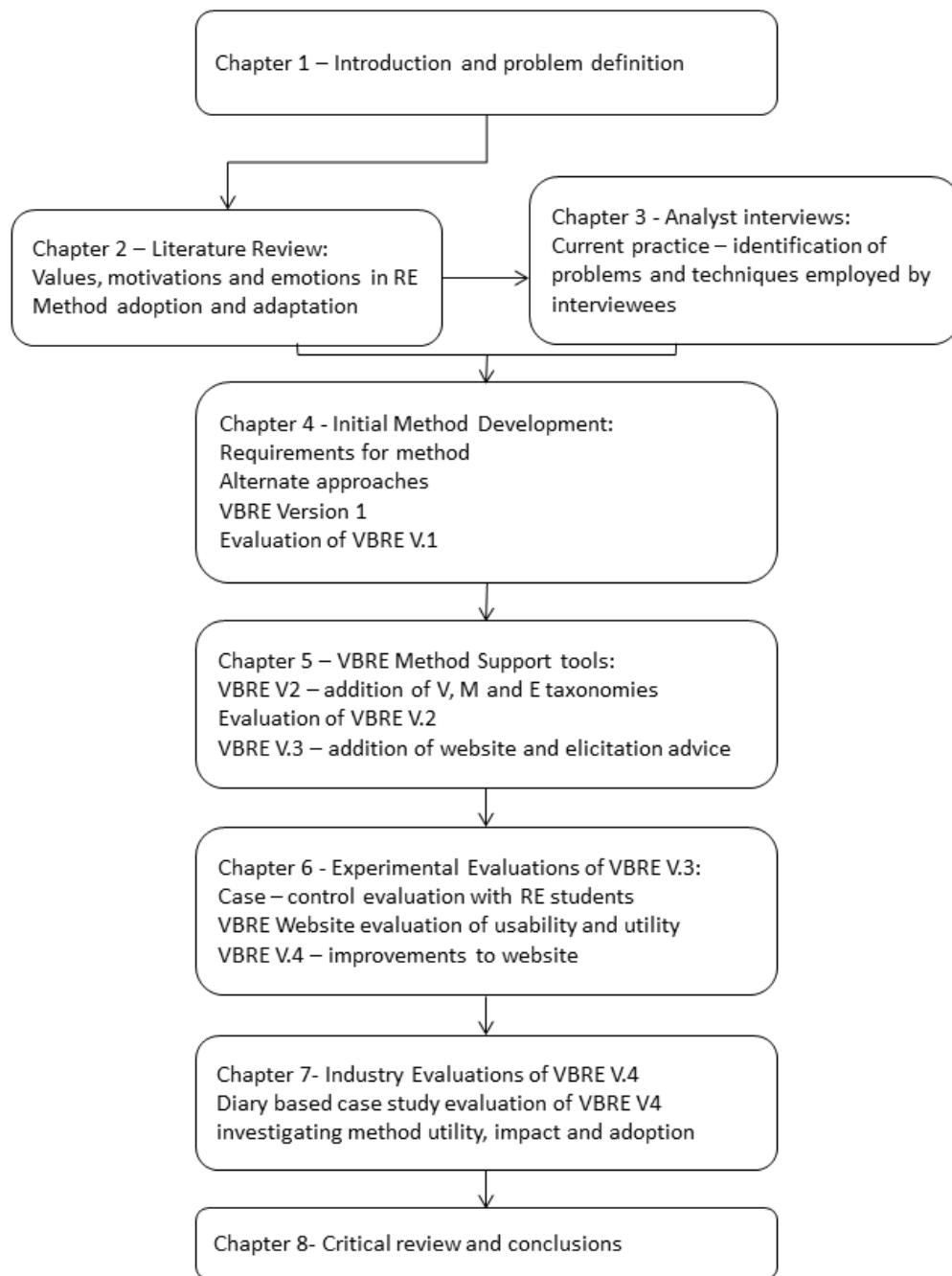


Figure 8-1 Summary of thesis structure

Chapter two investigated the existing literature on the relevance of VM&Es to the RE process. This review indicated that whilst some RE methods direct the analyst in a general sense to consider personal, social and political factors during requirements elicitation, there is little in the way of more specific guidance or techniques.

The literature review also considered the findings and recommendations of research into software method adoption and adaptation. This review identified a number of relevant factors including integration with existing practices, flexibility of use, and appreciation of the wider industry context and environment in which the method is to be applied. Consequently these factors were a consideration in defining the approach taken by this work to both method development and evaluation.

Understanding the current state of affairs is the first step in any attempt to change and improve practice. In **chapter three** the views of industry analysts were investigated. Interviews explored analysts' opinions on the relevance of users' VM&Es, the impact on their requirements work, and their use of techniques to aid in identifying such information. Differences between novice and experienced analysts were identified, both in their attempts to anticipate the impact of users' VM&Es within their RE work, and in the use of techniques to identify this information. The investigation identified expert behaviours that would be useful to promote to novice analysts, plus requirements from analysts around the nature of any method aiming to support the identification of users' VM&Es. This learning was used in the design of the first iteration of the VBRE method, presented in **chapter four**. The method was based on the creation of a 'hunch list' documenting the analyst's thoughts on users' VM&Es, followed by iterative cycles of reflection, integrated into the RE process to enable the analyst to revise and update the hunch list based on their interactions with the user. The method was trialled in two case studies, considering the impact of the method within the case studies and the acceptability and usability of the method. Feedback from this initial evaluation identified the need for taxonomies of VM&E to encourage analysts to think beyond their immediate assumptions and consider a wider range of soft issues which may be relevant to their project.

Chapter five describes the development of RE specific taxonomies of VM&Es to support the analyst in using the VBRE method. These taxonomies were derived by reviewing existing theories and frameworks of values, motivations and emotions with practicing analysts. Chapter five then describes the experiences of the author in making use of the taxonomies in her requirements work and reviews the opinions of industry analysts assessing the method and taxonomies during an RE training course. The taxonomies were considered useful but the review highlighted the need for further support materials to aid analysts in identifying and understanding the impact of soft

issues on their projects. Furthermore, the presentation of the taxonomies as documents was cumbersome. Consequently, the taxonomies were further extended with additional support materials, such as interview questions and illustrative scenarios, and these were developed into a website.

Chapter six presents two evaluations of the VBRE method and website. An experimental evaluation of the VBRE method and website was carried out with final-year RE students, which investigated whether the use of the technique would impact their ability to detect VM&Es. This evaluation showed that the students using the VBRE method provided more diverse and more user-centred responses to requirements issues. Secondly the results from a survey-based evaluation of website content, usability and utility were presented. The survey consulted RE students and industry analysts on the content and usability of the VBRE website, and identified improvements to the site's navigation, subject matter and appearance. The VBRE website was revised based on this feedback.

Chapter seven detailed a series of case studies working with practising analysts who used the VBRE method and website in their own projects. The case studies enabled the investigation of the utility and usability of the method and its associated tools, as well as the impact of the method in the projects under study. The design of the case study also allowed the investigation of the ways the analysts chose to adopt and adapt the method, according to their circumstances and levels of experience. It was apparent that the more novice analysts chose to follow the method in a ‘by the book’ manner, whilst the more experienced analysts made use of the hunch list and a high-level summary of the taxonomies provided by the front page of the website but were less inclined to use the detailed advice on the rest of the website. It was clear that including the method as a part of their requirements work inevitably meant some additional work for all the analysts, however, all four participants credited the method with a positive impact on their project, in particular the two novice analysts described feeling more confident in their ability to address soft issues in their projects.

Finally **chapter eight** critically assesses the contributions and limitations of this work and identifies potential future work.

8.3 CONTRIBUTIONS AND RESEARCH QUESTIONS

The contributions of this thesis are of two types: firstly there are the contributions directly associated with the development of the VBRE method and its content, secondly the contributions based on the study of method development, adoption and adaptation:

1. An exploration of the views of practising requirements analysts as to the relevance and impact of VM&Es within their RE work.
2. Development of an analysis method and taxonomies to aid analysts in identifying users' VM&Es.
3. A demonstration of the utility of adopting a Participatory Design approach to the development of RE methods
4. An evaluation of the use of the method in industry, exploring the use of case studies to understand how analysts adopt and adapt the VBRE approach.

This section reviews the extent to which the contributions have addressed the three research questions set out in chapter one, and considers the contributions in the context of the existing literature. In addition, the VBRE method is reviewed alongside existing methods for eliciting ‘soft issues’, comparing the methods against the industry analysts’ requirements as identified in chapter three.

8.3 a Research Question 1: Do practising requirements analysts consider users' values, motivations and emotions when analysing system requirements?

Much of the research into VM&Es and their relevance to requirements engineering has focussed on investigations of individual software projects, frequently looking at failed or troubled projects, for example studies of the London Ambulance Service dispatch system which did not account for users' values or motivations [2, 9], Ramos and Berry's study of the influence of users' VM&Es on the RE process at a Portuguese automotive factory [7] or an under-utilised knowledge sharing tool for healthcare workers which ignored users' values of privacy and cooperation [5]. However, to date, industry analysts had not been asked their views on the relevance of users VM&Es, or asked if they make any attempt to elicit or use this information. Chapter three presents the first set of interviews with practicing analysts establishing that analysts recognise the impact of users' VM&Es within their projects. This set of interviews showed that whilst novice and expert analysts were agreed on the relevance of VM&Es, the degree

to which they actively attempt to elicit this information varied. Some analysts found identifying users' VM&Es in advance of conflict or problems difficult, whilst the majority of interviewees commented that they identified users VM&Es accidentally or sporadically, and were not always clear as to how to act on any information. A small number of experienced analysts described more systematic approaches: attempting to elicit this information in advance of problems within their projects, and or making use of such knowledge within their work. These experienced analysts discussed their approaches to eliciting and processing this information, and their views informed the development of the VBRE method. In addition to identifying differences between expert and novice analysts the interviews also provided a set of requirements from the analysts for any method aiming to support analysts in identifying users' VM&Es.

8.3 b Research Question 2: Can a method improve elicitation and effective use of VM&Es by requirements analysts?

Chapters four and five describe a Participatory Design approach to developing a method to improve elicitation and effective use of VM&Es. The method and its tools were repeatedly tested and refined by the author and other analysts during the course of developing the method, providing early feedback on the aspects of the method that worked well, and identifying problems. The experimental study in chapter six provides further evidence of the utility of the method in encouraging novice analysts to widen their thinking about VM&Es beyond their immediate assumptions. The case studies in chapter seven provide the strongest evidence for the utility and usability of the method; each participant was able to use the VBRE method to identify VM&Es relevant to their project, and gave examples of the positive impact that use of the method had upon their requirements work.

The case studies also investigated the ways in which the method was used in practice, recognizing that methods are not generally adopted in a formulaic manner, but are adapted by their users who will select the method components they feel are relevant, appropriate to their needs and will integrate with their existing practices. The method allows for flexibility in its adoption, and the case study protocol was designed to allow participants to apply the method as they saw fit, and to capture variations in application by novice and more expert analysts. These experiences fit with research on method

adoption and adaptation, which suggest that lightweight influences are more acceptable to industry analysts[134, 135].

8.3 c Research Question 3: Is Participatory Design an effective way to develop new RE methods?

Requirements Engineering researchers have previously been criticised for failing to test new methods in industry or testing against ‘toy’ problems [89]. Davis and Hickey asked whether “requirements researchers practice what we preach?” [46], observing that, as RE researchers, we should treat industry practitioners as our customers. Research on RE method adoption highlights the need for industry involvement during method development [88] and this work has demonstrated the utility of Participatory Design as means of involving industry analysts in the development and evaluation of a requirements elicitation method. The PD approach consists of iterative cycles of design, development and evaluation and requires the involvement of users (in this case, requirements analysts) throughout the process. The involvement of requirements analysts in the evolution of the method took several forms:

- Testing the method during requirements analysis work.
- Reviewing the method, taxonomies and website.
- Participating in survey based evaluations.
- Participating in case study evaluations.

Testing methods in conjunction with industry partners facilitates identification of issues that might otherwise not have been considered and helps in understanding the practicalities of using a method. Karlsson et al.’s partnership with Ericsson Radio Systems AB identified practical issues around scaling up pair-wise evaluation of requirements to meet the needs of an industrial project[136], whilst the analysts testing Sommerville et al.’s PREview method liked its flexibility and were content to use the aspects of the method that suited their purposes, disregarding some features entirely [126]. Similarly, incorporating regular feedback from analysts into VBRE method development provided an understanding of how the method would be used in practice from early in the study. This steered the design away from more esoteric or impractical ideas, for example the analysis of transcribed text is common in academic studies but was strongly rejected as overly time-consuming by the industry analysts. The first iteration of the website attempted to make distinctions between values, motivations and

emotions, however the analysts preferred a single comprehensive list and felt they did not need to know if a term was a value, motivation or emotion, they simply wished to be reminded of the need to consider each item. Equally, evaluating the VBRE method with industry analysts identified the different ways the novice and expert participants chose to adapt the method to suit their own purposes and circumstances.

Working with industry analysts also provides an appreciation of sensitivities in the relationship between an analyst and stakeholders that may be less significant or not at all present, in the more neutral relationship between an academic researcher and research study volunteers. Whilst there are a number of academic RE studies which have investigated personal values, motivations and emotions using direct questioning or questionnaires, it became clear during the analyst interviews presented in Chapter three that any method that required directly asking users about VM&Es would be unacceptable to industry analysts. Analysts and stakeholders may have worked together previously, or may need to again in the future, there may be a power imbalance, supplier and customer financial relationship or expectations about ‘appropriate’ activities for a requirements analyst; any of which might make the analyst feel unable to directly question a user about VM&Es.

It should be noted that this thesis used a PD approach in combination with theory-led researcher input, for example Chapter five included a review of existing taxonomies as a starting point for developing the VBRE taxonomies, whilst the experimental scenario-based evaluation presented in chapter six allowed the researcher to understand how students, acting as a proxy for novice analysts, might make use of the method, and enabled a ‘cookbook’ assessment of the method’s application. However, the PD contributions to method development and refinement were critical to ensuring acceptability and fit with industry practices, and were an effective way to include analysts in the development process. The PD approach to RE method development has practical advantages: it enabled industry input into the thesis without demanding large time or resource commitments from analysts, and it enabled consultation with analysts from a wide variety of industries and viewpoints. Alternative approaches to PD which might also be used to develop RE methods in conjunction with industry representatives include Action Research or Co-realisation[137] though these approaches would generally require longer time commitments from individual industry partners than the voluntary assistance available to this work. A comparison of Action Research and

Participatory Design highlighted the complementary nature of the approaches: Action Research providing a deep understanding of the requirements and problem, whilst Participatory Research provides a means for end users to shape the response to those requirements [107]. Indeed an Action Research based study of current analyst practices around the elicitation and use of VM&Es would likely enrich the findings of the interview study presented in Chapter three.

Within the RE community a variety of other approaches have been taken to incorporate industry views into method development,. The Volere method was developed by a group of expert RE consultants [6], whilst methods such as GORE and i* were developed by academics, and refined based on testing involving industry partners [138]. If industry uptake is a marker of success in method development all these methods can be considered successful, however these approaches require significant time investment from individual industry partners, making them unsuitable for this thesis.

8.3 d Comparison of VBRE and other VM&E Elicitation Methods

A variety of methods aiming to support requirements analysts in the identification of such soft issues have been published: Value Sensitive Design[68], the use of discourse analysis[64], Mumford’s ETHICS approach [71], Soft Systems Methodology[54], Ramos and Berry’s guidelines[7] and the application of ethnography to the requirements elicitation process [62, 63]. Some of these methods also look at how values, once identified can influence the design of system requirements, for example Value Sensitive Design and ETHICS. Below, these methods, plus the VBRE method are evaluated against the set of analysts’ requirements identified in Chapter three, see table 8-1 for a summary.

Table 8-1 Comparison of VM&E Elicitation Methods against the requirements identified by Chapter three's interview study

Analyst requirements (based on Chapter 3 interviews)	Ethnography	Soft Systems Methodology	Value Sensitive Design	Ramos and Berry	ETHICS	VBRE
Culturally acceptable to analysts	Y	Y	N	Y	N	Y
Minimal demands on time	N	Y	N	Y	N	Y
Compatible with existing requirements approach	Y	Y	Y	Y	Y	Y
Make use of material gathered during the course of existing requirements approach	N	Y	N	Y	N	Y
Not require any specialist expertise	N	Y	N	Y	N	Y
Provide guidance on identification of V, M and E	N	N	Y	N	Y	Y

Ethnography has been used to good effect in studies of the requirements analysis process and has aided researchers in better understanding the sociotechnical context in which systems operate, e.g. in the development of air traffic control systems[62], or the use of breast scanning technology [63]. Ethnography depends on the analyst spending long periods of time in the users' workplace, observing and perhaps participating in the work. The method does not require the analyst to directly ask users about values, motivations or emotions, and could conceivably be integrated into more traditional RE activities such as interviews or workshops. However, the technique is time-consuming to apply and very general, there is no guidance for analysts about the identification of users' values, motivations or emotions. This is in contrast to VBRE which provides a set of taxonomies to prompt and guide the analyst.

Soft Systems Methodology[54] was designed to support analysts in understanding the wider context in which systems are developed, and highlights the need for analysts to consider issues such as the likely beneficiaries or losers from the implementation of a system, however, again, the method does not provide any guidance as to the specifics of how to identify VM&Es.

Value Sensitive Design's main focus is on building values into software, rather than eliciting them from users[112]. Consequently the method focuses on a pre-defined set of moral values, using a set of value cards to identify positive values the stakeholders believe the new system should embody. This approach has been used successfully by Friedman and others in academic research, however, based on the feedback from

industry analysts interviewed in Chapter 3, may not be acceptable to industry analysts given that it requires direct questioning of users about their values, and limits consideration of VM&Es to a small subset of values.

Ramos and Berry provide guidelines for several requirements engineering activities: gathering information about the existing situation, knowledge documentation and the creation of requirements for a new system [7]. The high-level guidelines specify the role of the participants and desired outputs for each RE activity. They also provide two taxonomies to aid in the selection of participants for the requirements analysis process. The guidelines consider structural, social, political and symbolic aspects of the work place, and the human interactions that take place at work. They encourage the analyst to consider information such as processes, regulations and formal job roles: the ‘standard’ inputs to the ‘traditional’ positivist view of requirements analysis, and also recommend that the analyst looks more widely, considering motivational factors, values and expressions of emotions. However, the taxonomies and guidelines are brief and the authors themselves identify the need for more specific advice for analysts. It could be argued that the VBRE method is one such response to this need.

Mumford’s ETHICS method focussed on values and motivations, and of all the methods outside of VBRE, provides the most detailed guidance on identifying values: using a taxonomy of values and a questionnaire-based approach to support analysts in identifying users’ values. This method does provide clear guidance to analysts on the identification of users’ values and emotions but requires that users complete a questionnaire about their values. Based on the requirements identified in Chapter three, analysts may not find this method acceptable on the grounds that they do not want to directly ask users about values, motivations or emotions and the need for specialist expertise to interpret the questionnaire.

VBRE provides specific guidance and, as demonstrated in chapter seven, is flexible enough to fit into existing analyst practices, without demanding excessive effort. The approach encourages the analyst to pre-emptively consider VM&Es before RE activities such as interviews or workshops, followed by review of the outputs, thereby making use of existing materials, and it does not depend on the analyst directly asking the user about their values, motivations or emotions.

8.4 LIMITATIONS: CONCEPTS, METHOD, DATA

This research has elicited regular input and evaluation from industry analysts, including the interviews presented in chapter three, testing and feedback during method development, and industry case studies in chapter seven. Whilst industry input into the design process can help in ensuring the method is fit for purpose and useful to analysts, the numbers of analysts included in the study were limited both by access to volunteers, and the usual budget and resource limitations of PhD research. The inclusion of more analysts, and the ability to support longer periods of investigation into existing analyst practices would likely have revealed further insights into analyst behaviour. Furthermore the involvement of industry analysts devolves a certain amount of control from the researcher to the analyst: it is not always possible for the researcher to be present during testing, e.g. the analyst training course described in chapter five. In this situation the author was dependent on feedback from the industry analyst, and was unable to directly question course participants.

The author also acknowledges the impact of resource limitations on the qualitative analysis presented in this study. The data were coded and themes characterised by the author and the outputs and analysis process then reviewed with her supervisors. Whilst this approach provides uniformity in the interpretation of interview data, there is limited scope for reviewing the validity of the decisions made in coding and classifying data. Furthermore the input of additional researchers into the analysis process could provide alternative perspectives and knowledge.

The taxonomies of values, motivations and emotions, and the content of the VBRE website were developed using a number of sources including the academic literature and contributions from industry analysts. Given the substantial literature on VM&Es in psychology and sociology it is reasonable to ask whether the VBRE method includes the ‘right’ set of VM&Es? The pragmatic viewpoint of the analysts who reviewed the taxonomies and tested the method was that they wanted a broad, inclusive list of VM&Es to inspire them to think beyond their immediate assumptions. However although the taxonomy and website was reviewed and refined with the input of industry analysts (based in central Europe, USA and UK) and RE students, and this captured a certain diversity of opinions, it is likely, given the background of the participants, that this work is culturally specific to the West. Existing work into the values of different

cultures would suggest that the taxonomies in their current form may be of limited utility to other cultures [111, 139].

Two evaluations of the VBRE method were carried out, and can be considered complementary; each approach has its own benefits and limitations. The experimental study reported in Chapter 6 was weighed in the direction of ‘cookbook’ use of the method, and was carried out in a controlled academic setting with student participants. The approach allows for consistent testing of the method using a standard scenario and with method vs. control (without method) participants. However, whilst the students were a reasonable alternative to novice analysts, experimental approaches to studying requirements elicitation methods are inevitably limited. The scenarios provided to participants can never be as rich or immersive as working on a real project and reading transcribed interview text is a poor proxy for being present in actual interviews. Furthermore, designing an experiment which is structured enough to make comparisons between With and Without Method groups, without providing prompts to the Without group was problematic. A longer-term evaluation integrated into a requirements analysis course in the manner of Regev et al. [18], would provide more time for students to learn the method and the opportunity for students to interact with actors playing the parts of stakeholders, and could lead to a more realistic evaluation. In contrast the case studies in chapter seven provide a rich understanding of the method in use over the course of a real requirements elicitation cycle. The analyst participants chose how and when to apply the method, this can be considered both a benefit and an issue: there is no doubt that being given the freedom to apply the method as they felt appropriate encouraged participation and provided a more realistic view of how the method might be used, but consequently there was variation in the ways the method was applied. The studies can be considered complementary; the experimental study provides an understanding of the impact of the method on a population akin to novice analysts. Case studies cannot provide statistical measures of cause and effect, but provide a means of understanding method use in an industrial context, and understanding how the method is adopted and adapted by analysts, and integrates into existing practice. There is a trade-off between the degree of control a researcher has over the application of the method and the degree of realism. By engaging in two different types of evaluation it is hoped that a richer understanding of the utility and usability of the method is provided.

8.5 AREAS FOR FURTHER RESEARCH

There is a need for further work to validate the method. Approaches such as tutorials to RE analysts would provide additional assessment of the method's comprehensibility and utility. In particular, review of the taxonomy content would provide an interesting opportunity to investigate the cultural specificity of this work, and could lead to the extension of these taxonomies or development of alternative content.

Longer-term industry case studies would be the most effective means of assessing the method's acceptability and adoption. Furthermore, given that much of the analyst participation in method development and evaluation was mediated via the author's industry contacts, there is a bias towards the healthcare and life sciences sectors; it would be informative to run additional case studies in other domains. The author continues to discuss use of the method and taxonomies with two of the participants of the case studies presented in Chapter 7, who have found the method sufficiently valuable to continue to make use of it. Sawyer et al. [91] identified the need for cost-benefit analyses to encourage industry practitioners to adopt new methods, and concerns about the impact of adopting VBRE given the limitations of analysts' time have been raised regularly by analysts when reviewing the method. However, given the nature of the method it is difficult to envisage providing effective cost-benefit analyses, and a more effective means of persuading analysts of the value of the method might be sharing the experiences of the analysts who are currently making use of the method.

Additional experimental work would provide further understanding of the impact of the method. In particular, revising the design of the scenario evaluation present in chapter 6 so that the 'Without' group are asked to consider users' VM&Es but are not given training or access to the VBRE method or website, would allow differentiation between the effects of awareness of users' VMEs, versus the effects of using the VBRE method.

Chapter two looked at the literature around NFRs, goals and values, and whilst it is clear that the set of VM&Es generated by this work are not NFRs or goals, there is potential to investigate the use of stakeholder VM&Es in identifying and specifying NFRs and goals, this work expands on the role of soft issues in analysing and specifying requirements. Further extensions to this work might involve extensions of i* modelling with value relationships [28], analysis of values in social networks as suggested by [11] or in value trees[64]; and certainly providing analysts with tools to appreciate the values

or motivations held by different stakeholders could be a powerful way to identify and pre-empt problems based on value or motivation conflicts.

During the course of the analyst interviews presented in chapter three it was apparent that none of the analysts felt their current documentation allowed for the recording of ‘soft information’ about their users, and some analysts were uncomfortable with documenting or sharing this information. Future work could focus on finding effective ways to anonymise and share soft factors, for example, personas [140] are a widely used tool in software development so extending personas with explicit statements of characters’ VM&Es could be an effective way to share such information with the wider software development team. There is scope for further exploration of the impact of VM&Es on the configuration of personal and people-centric systems [72, 121, 141].

There are opportunities to explore ways to better integrate the method and website into the analyst workflow, such as providing analysts with secure, versioned hunch lists that can evolve over the course of a project, allowing the analyst to manage multiple viewpoints, or a mechanism to allow analysts to feedback design or process advice to the VBRE website. Several of the analysts participating in the case studies presented in chapter seven, were keen to see the VBRE website extended to allow analysts to contribute their own expertise, ‘war stories’ and recommendations, and this could become a valuable repository for RE process knowledge.

This thesis did not explore the views of end users on the relevance of their values, motivations and emotions to RE work, and given that some analysts interviewed in Chapter three were uncertain about directly asking users about VM&Es, it would be helpful to explore the acceptability of the VBRE approach with users.

Finally, this work has focussed on analysts eliciting requirements for bespoke software developments. The analyst volunteers participating in the studies presented in chapters 3 and 7, and contributing to the method development work in chapters 4 and 5 were all involved in this type of requirements work. Whilst it is plausible that the techniques and materials of the VBRE method could be applicable to the development of commercial off-the-shelf software this has not been investigated to date.

8.6 CONCLUDING REMARKS

Whilst requirements analysis research [6, 142] has identified soft issues as significant factors, and studies have highlighted the impact of users values, motivations and

emotions, until this work there has been little specific guidance on working with users' values, motivations or emotions. This thesis is unusual in having adopted a Participatory Design approach to investigating and developing a solution for a RE problem: that analysts need to understand users' values, motivations and emotions and their impact on software projects. The VBRE method and website attempt to address this gap, and the positive reception given by the analysts involved in evaluation of the method indicates they see utility in the approach. The VBRE method and website were developed in collaboration with industry requirements analysts and intended to integrate into their existing requirements analysis practice; that several of the industry case study participants commented that they would continue to use the method indicates that the approach functions alongside existing practice and is of utility to the analysts. The success of a requirement analyst's work can be measured in the willingness of stakeholders to adopt a new system, and therefore future work will focus on continuing to collaborate with industry analysts to identify improvements to the method and website, and to gather examples of the method's impact.

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Appendix A Chapter Three: Interview Plan & Initial Coding Schema

This appendix contains the semi-structured interview plan used in the interviews presented in chapter 3.

Interview Plan

Start by introducing myself and my background. Key issues to cover:

My PhD research is concerned with analysts understanding users' emotions, motivations and values during the requirements elicitation process. Consequently I'm carrying out a series of interviews to understand whether analysts are interested in this type of information and if so:

- How do analysts go about gathering such information?
- How do they then make use of this information
- How do they share it with others?

Interview Questions – all questions to be covered during the interview – plus additional questions to explore and clarify as required.

1. Please give a brief overview of your educational background.
2. Please give a brief outline of your employment history and experience in requirements elicitation.
3. Please describe the area(s) of industry and types of software users you work with.
4. Are you aware of users' values, motivations and emotions?
5. Do you have examples from projects when users' values, motivations or emotions have impacted the work – positively or negatively?
6. Do you choose to make use of information such as users' values, motivations and emotions? If so:
 - a. Do you have examples from projects when this knowledge has proved useful?
 - b. How do you gather this information? Do you use any particular techniques?
 - c. Do you document or share these soft 'requirements' with others involved in the project? If so, how?

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7. My thesis is investigating whether a method or tool could support analysts in identifying and working with users' values, motivations and emotions. Would you make use of a method to help identify users' values, motivations and emotions?

Appendix B Chapter Three: Coding Examples

Examples of the coding of analyst interview quotes. Quotes were tagged with codes, e.g. 'Ignoring users' negative emotional reactions'. Like codes were grouped to form sub-themes, sub-themes were then organised into larger themes.

Table B-1: The theme 'Difficulties understanding or acting on users' values, motivations and emotions.' was made up of several sub-themes, including 'Ignoring Users' Negative Emotional Reaction'. The sub-theme was made up of the quotes contained the right-hand column.

Theme: Difficulties understanding or acting on users' values, motivations and emotions.	
Sub-theme: Ignoring Users' Negative Emotional Reactions	I don't pay attention to emotions
	I don't think I was very good at engaging with that response, knowing how to respond to it.
	Some of the users were very angry about the plans, we felt they were being unfair.
	I wasn't aware that what users feel mattered
	The users were creating dissention but I didn't know where to start with it.
	I always tried to deal with it on a factual level.

Table B-1: The theme 'Making Use of Users Values, Motivations and Emotions in requirements definition.' was made up of several sub-themes, including 'Identifying values /motivations the system should support'. The sub-theme was made up of the quotes contained the right-hand column.

Theme: Making Use of Users' Values, Motivations and Emotions in requirements definition	
Sub-theme: Identifying values /motivations the system should support	it just takes a lot of time, I mean, at the moment the system does credit people for putting data in there, and if other people use that data that's good, and people are changing because of that, but outside of the project it's not the same.
	Even <Company name>. has on its site now something that it produces a carbon footprint because processors use less power, and they've actually commissioned studies and they put it on their front page because it makes people feel good, to be green
	it's about changing people's attitudes to the data and being credited for producing data like you're credited for publication, that would help a lot
	Yes in theory it's part of everyone's objectives to record these things but in reality it just doesn't happen. These guys know holding onto that information, it's their power, they're not going to give away the thing that might get them their next win.
	Other people have the view of, "Well if you're using the system, then you should take that responsibility away from me, I don't want to be responsible" and either make the system so big and robust--which will take forever to do and you have to prove that you can't ever falsify data, you can't ever be wrong.
	the senior team wanted the site to be very open, to get everyone sharing and that just went against the younger members of staff, they thought we were being asked to give away their work.
	They like being different to our average users. We were looking at storage

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	management solutions with them and their reasons for rejecting some of the suppliers seemed to come down to not wanting a GUI because that's for normal people.
	the scientists just liked it better because they like to explore the information. I think the first design, which presented it all to them on a plate just felt like they weren't getting their hands dirty or doing any research.
	So we have a bit of that 'not invented here' ownership thing going on when we work with other companies, but it quickly became clear that it was internally too – everyone wants their system and doesn't trust that any other group could have done it better
	Lots of people were nervous about security and sharing, I mean they were supposed to share with each other but we added these extra features so they could track what was going on.
	People like that, like to get credit, individual credit so we had to build that in.

Appendix C Chapter Four: Example Analysis using the VBRE method.

Table C1 shows an example transcript analysed using the reflective practice method. The first two columns of the table are a transcript of a team meeting between two epidemiologists participating in the ADVISES project. The third and fourth columns show the codes given by the analyst. Below the table the codes for each epidemiologist are organised into similar groups and linked to values, motivations and emotions.

Table C1 Meeting transcript marked up with analyst's codes. Please note – this is best viewed in colour.

Epidemiologist 1	Epidemiologist 2	Codes – Epidemiologist 1	Codes – Epidemiologist 2
	Initiates discussion with advert from RAD magazine – Toshiba – leads to conversation about pig models of fetal growth and atherosclerosis.		looking for new ideas
[A] interested in measurement by ultrasound of fat distribution – suggests Epidemiologist 2 follows up with [C] (ISBE)		Developing working relationships in ISBE	
	Initiates discussion about MRI for neonatal research (2 nd magazine article). Research group in Hammersmith – interesting as not aware of another group doing neonatal imaging research (not sure if this is a good or a bad thing?), who else is doing MRI in babies?		Concern about being first in a research area – tension between conservatism vs innovation
Interesting as in a good position to do this kind of work – and would like to develop links with Experimental Medicine given the upcoming rearrangement of schools.		Potential of work – for development of science, positioning of [organisation name]	
	What data is routinely collected in babies?		
[X] next door does intensive care monitor research, [k] does normal neonates, gestation and diabetes, early CV disease signs and metabolic disease in babies. If anyone knows how to get measurements it will be [K].		Internal and external department contacts Comment on [k]'s professional expertise	
	Who is [K]?		

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<p>Gives summary of [K]'s work</p> <p>Important action is to make contact with ___ and ___ and find out about MRI in babies and fat distribution.</p>		<p>Further elaboration on [K]'s expertise</p> <p>Importance of developing contacts</p>	
	Will they be too busy?		
<p>No, this is an important bit of diplomacy, send an email (lists main points for email). Are we missing a trick by not doing this sort of study?</p>		<p>Developing contacts, promotion of collaboration.</p> <p>Expressing concern about [organisation name] direction</p>	
	<p>Moves to new topic</p> <p>How to find out which data is routinely collected in Manchester and NW?</p> <p>Who is the best person to contact about routine morbidity and mortality data?</p>		Request for help
<p>Gives contact details for [H] – and lots of biographical information.</p> <p>Able to get burden of disease area by geographic region – 3 sources – 1. mortality data direct to Primary Care Trusts (PCTs) along with a list of all the causes and contributory factors, 2. Digest of death tapes goes to Office of National Statistics. 3 Hospital Episode Stats (HES) – lead for the country is L.S. in the NHS information centre (ic.nhs.uk). HES are moving from [external supplier] to SUS (secondary users service) – every transaction should be recorded back to '94 for inpatients, outpatient data is not so good.</p> <p>I'm working with [name of external company] on heart bypass data. This is on my agenda so let's just talk about this</p> <p>wants to get a paper on equity measurements.</p> <p>Back to Quality and Outcomes Framework (QOF) – another source of data. Also known as CUPID and NGMS. Data was produced in the last year – deals with pain data for major disease,</p>		<p>Providing evidence for [H]'s expertise</p> <p>Sharing of expertise</p> <p>Development of an external collaboration</p>	

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details are on the BMA website, National Primary Care research and development centre – contacts in Manchester are MR and TD – had a paper in New England Journal based on first wave of QOF data			
	The reason I bring it up is that we should decide now what we need for later. Too much data, depends on usage (some examples given)		Forward planning, ensuring have correct and sufficient data
If you want an inventory of different datasets, have a word with [T]. I can download compendium of health indicators.		Encouraging making contact with external party. Helping Epidemiologist 2 in data collection	
	Focus in on potential sources of information, awareness of where to get data if we need it.		Preparation for potential (as yet, completely unplanned) studies – long term planning
I've never seen anyone answer that question.			
	Do GPs have good BMI measures?		
Not now, but next year?			
	Potential for a new prospective study.		Forward planning
I want you to consult [H] so you know what is available. [H] can map between datasets, a framework exists to do this. [H] is also good at geo-coding, he has multiple datasets with geographic information. Manchester PCTs are better than most areas at doing this – forming Commissioning Business Unit. Creating a population laboratory.		Encouraging collaboration Long term goal	
	Will [H] be familiar with migration patterns in Manchester?		Question about expertise
Yes it's a special interest of his. Moving on to the Equity data – I need time out to do the data analysis, let's talk about it next week when I've done the 1 st pass analysis. I'm waiting on data from CV surgeons.		Work planning	
	Can we go onto the next		

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	thing, MASS?		
That's top of my list.	I'm still in the literature. I want a good understanding of the problem it's tricky.	Priorisation	Thoroughness over speed
Discussion about changes in asthma prevalence over time		Sharing technical expertise	
Does the bias change? Ascertainment bias?		Checking for potential study design issues	
	There are different ways to define asthma, need to understand literature, need literature to give credence to findings.		Thoroughness – checking approach is valid
We need a paper soon to support their interest. You could send them an update.		Concern about maintenance of a relationship Encouraging contact Encouraging speed	
	I'm half way through.		Progress report – not wanting to rush to analysis work without preparation
Can't you just read the abstracts? Are there trends or systematic errors. Psychobehavioural imprinting – how big the variation is based on the mother's personality? Anxious mothers are more likely to overfeed and to over report.		Impatience Suggestion of additional research ideas	
Discussion about bias in studies – Epidemiologist 2 defends need to do literature review		Importance of being thorough	
Make a list of potential confounders.			
	I want this to go to a better journal. I'll have done the literature by the end of this week. I'm looking for other opportunities. The data space is missing breast feeding data – potential confounder. Age groups at which breast feeding is important for BMI.		Professional standing Reassurance to Iain on work progress
Send a message regarding the lack of breast feeding data.			
	Many past stories, want to tie these back to BMI. Not		Research development

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	writing discussion for paper. I want to do at least Thorax.		Waiting to get a good paper
Send a note to _____ re Thorax. Don't want them to think we've lost interest.		Maintenance of external relationships	
Do you want comments?	Next thing – EPIC paper.	Feedback	
	No, not yet. Need to establish a predictive effect to have clinical utility. The table is a problem. Paper planning – pick a story, the best presentation for a journal. I'm trying to finish this week and will send out for comments.		Concern about best way to present information Work planning – reassurance to Iain on timescales
I agree with [S] the message is too complicated for BMJ etc., but you can sanitise.		Information presentation to non-experts	
	I need to explain the importance of different models.		
Need to think about what else can be done, how to present the differences between models.			
	I put the differences into pictures. If you're in obesity, it's probably easy, if not it's difficult.		Use of pictures to communicate a message Concern about presenting to non experts
What if Circulation reject?			
	Other heart journals or obesity.		
If it's BMJ it'll will need a rewrite.			
	I've got the outline of 2 key stories – it's only 2800 words.		
That might make the paper easier.			
	Circulation was the main goal. Leave till next meeting. What are the key things happening in November and December? I have a trip to Finland, I need to		

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	get a visa organised. And I'm working with the London group they're working on sex hormones, something they don't know that much about.		
What comes first, the adiposity then the hormones, or the other way? It's different in men and women.			
	I'm helping the group in London because I'm interested in the fat distribution story. What else is on between November and October, other than your meeting?		Benefits of external collaboration – opportunity to look at other data
For me – loads. For us - I plan to drop some distractions. I'm not going to London for the Foresight reviews – I'm giving but not learning at them. We need to have a big purge on papers. I also have duties with PCT and PhD students. I'm teaching a PhD to analyse for bias. I'm planning to cancel a few other things.		Prioritisation of own workload	
	I'm digressing – re. software projects – can you do a comparison between cleaned and uncleaned data? INADUDIBLE		
National primary care R&D centre regarding use of primary care data.			
	Discussion on adiposity and obesity, changes in physical characteristics, changes over time, study in Hawaiian men.		
National primary care R&D centre will have a handle on omissions and areas/dates of good data.			
	Can also ask them to look at improvements.		
I've got some grant applications.	If I can write a paper in early November I can aim for grant applications.		

Appendix D Chapter Five: Analysts' review of VM&E taxonomies

As described in Chapter 5, a review of the literature on values, motivations and emotions resulted in four lists:

- Mumford's Terminal Values
- Rokeach's Instrumental Values
- Motivations
- Emotions

These were reviewed with three industry analysts for their relevance to requirements elicitation, and the analysts decided whether to keep, remove or rename the terms – these revised lists then formed the basis of the VBRE taxonomies. The tables below record the analysts decisions and comments.

Table D1: Analyst Review of Mumford's Terminal Values

Mumford's Terminal Values	Analyst Review Decision	Analyst comments
An absence of conflict (with individuals, groups)	Keep	Some disagreement as to whether this should be renamed to 'conflict' as conflict was considered to be a significant consideration in working with users, but agreed that for a list of values the more positive 'absence of conflict' was appropriate.
A stimulating life in work (challenging, exciting)	Rename to 'Challenge'	
A sense of accomplishment (making a contribution)	Rename to 'Accomplishment'	
A successful life in work (well-paid, status conferring)	Rename to 'Success'	
An attractive environment	Keep	
Equality of opportunity	Rename to 'Equality'	
Emotional security (support from colleagues and superiors)	Rename to 'Security'	'Emotional security' was considered to be too narrow a definition of 'security' for RE purposes. The analysts discussed two meanings of the term – 'security' in the sense of concerns about unauthorised access to a data source or system, and 'job security', in particular the possibility that stakeholders in a software project might feel their security was threatened by the project.

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Freedom (independence, free choice)	Remove	Felt to overlap with 'Independence' from the list of instrumental values'. Independent preferred as freedom was not considered to be a suitably 'work-appropriate term
Happiness (contentedness)	Rename to 'Contentedness'	Some discussion over the terms 'happiness', 'contentedness', 'pleasure' and 'cheerfulness'. Agreed to keep the first three and remove 'cheerfulness'.
Psychological health (freedom from anxiety)	Rename to 'Freedom from anxiety'	
Good relationships (cooperation, help)	Rename to 'cooperation'	
Pleasure (an enjoyable life in work)	Keep	
Self-respect (self-esteem)	Keep	
Social recognition (respect, admiration)	Keep	
Friendship (close companionship)	Keep	
Wisdom (a mature understanding of life)	Rename to 'Experience'	

Table D2: Analyst Review of Rokeach's Instrumental Values

Instrumental Values	Analyst Review Decision	Analyst comments
Cheerfulness	Remove	See comments on happiness above
Ambition	Rename to 'Ambitious'	
Love	Remove	Inappropriate to a list focused on RE.
Cleanliness	Rename to 'ordered'	Agreed that there is a value around 'orderliness or 'being organised' but felt cleanliness sounded too personal.
Self-Control	Keep	
Capability	Rename to 'Capable'	
Courage	Rename to 'courageous'	
Politeness	Rename to 'polite'	
Honesty	Rename to 'honest'	
Imagination	Rename to 'imaginative'	
Independence	Rename to 'Independent'	See comment on 'freedom' above
Intellect	Rename to 'intellectual'	
Broad-Mindedness	Rename to 'open minded'	'Open minded' preferred to 'broad minded' as a better way of describing someone who would consider other people's views (c.f. 'broad minded' in the sense of being hard to offend)
Logic	Rename to 'logical'	
Obedience	Rename to 'obedient'	

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Helpfulness	Rename to 'helpful'	
Responsibility	Rename to 'responsible'	
Forgiveness	Rename to 'forgiving'	

Table D3: Analyst Review of Motivations

Motivation	Analyst Decision	
Achievement	Keep	
Altruism	Keep	
Curiosity	Keep	
Peer-esteem	Keep	
Possession	Remove	
Power	Keep	
Recognition	Remove	Overlaps with peer esteem' and 'social recognition'
Self-efficacy	Keep	
Self-esteem	Keep	
Sociability	Duplicates 'sociability' as a value	

Table D4: Analyst Review of Emotions

Emotion	Analyst Decision	
Anxiety	Remove	Overlaps with value 'freedom from anxiety', 'distress' and 'fear' – keep 'freedom from anxiety' and 'fear'
Approval	Remove	Overlaps with happiness
Disapproval	Remove	Overlaps with disgust
Disgust	Keep	
Distress	Remove	See comment against Anxiety
Fear	Keep	
Frustration	Keep	
Happiness	Keep	Overlaps with 'happiness' in list of terminal values.
Pleasure	Remove	Duplicates 'pleasure' as a terminal value.

Appendix E Chapter Six: Scenario materials

Appendix E contains the complete set of materials used in the scenario based experimental study presented in chapter 6, including:

1. Pre study Questionnaire
 2. Scenario Background And Interview Text
 3. Short Answer Questions
 4. Multiple-choice Questions
 5. Post-study Questionnaire

1.Pre study questionnaire

Do you have any prior academic experience of requirements engineering?

No Yes – if yes, what?

Have you any experience of working as a requirements analyst?

None

0-1 years

1-3 years

3 or more years

Did you enjoy the requirements engineering aspects of your course?

1 2 3 4 5 6 7

(not
at all) (very
much)

Do you feel confident in your abilities to carry out a requirements engineering task?

1 2 3 4 5 6 7

(not confident)	(very confident)
--------------------	---------------------

2. Scenario Background: Automation of quarterly sales reports

Following declining sales of their insurance and mortgage products, the Littleshire Building Society has recently introduced a new system ‘Sales Leads Manager’ (SLM) to support their sales staff. Users can record their activity, for example, registering new sales leads, successful sales and lost business. As well as helping the sales staff manage their day to day work better, SLM is intended to provide information that could be used in long term planning of sales strategies and help the marketing teams plan advertising campaigns. The Sales department is split into three teams covering different geographic areas:

Scotland and Northern England, managed by Oliver

South East managed by Lucy

South West, Wales and Northern Ireland managed by Patrick

Every three months the three team leaders prepare a report on sales activity in their region, which the Head of the Sales department, Anita uses to track progress and plan future work. The summaries have always been produced manually by the team leaders, and usually take each team leader several days to produce. Worse, each report is in a different format, so that it takes a long time to read them and collate an overall picture. Anita is frustrated by this, surely if everyone is using the new SLM it should be possible to automate the process and produce an identical report for each team plus an overall summary?

Consequently Anita has contacted the IT department to develop an end of quarter reporting system, and as their main requirements analyst, you have been asked to speak to each of the team leaders as well as to Anita.

You met with Anita first who explained how frustrating it is to deal with three different reports. At the moment, each report is in a different format, with the results presented slightly differently, so it takes ages to read all of them and collate the results into the summary she needs to make her forecasts for the future and review staff performances. Of the three, she finds Oliver’s report the easiest to work with, it’s not all that thorough but at least it arrives in the same format every month so it’s easy to find what she wants in it. Patrick’s report is always very detailed with lots of graphs and statistical analyses but he changes the format every month, and she just doesn’t have the time to absorb so much detail. However it’s Lucy’s reports that cause her the most concern. There’s no doubt that Lucy’s team are very productive and generate a lot of sales but her quarterly report is always late, and always a bit jumbled and confused. It’s not unusual for Lucy

to send a revised version a few days later when she's rechecked the figures. Anita thinks Lucy could really benefit from the reports being automated, since she clearly struggles at the moment.

Next you meet with Oliver, team leader for the Scotland and Northern England Sales team. He has already written a small application to automate his team's sales figures, which saves him a lot of time. He's very pleased with his work and keen to give you a demonstration of the application which he thinks could be rolled out to the other teams really quickly.

Your next interview is with Patrick, team leader for South West, Wales and Northern Ireland. A colleague in the IT department who has worked with Patrick before tells you that Patrick helped with the development of the SLM, providing some ideas about the way the system should work and doing some very thorough testing.

Below is a transcript of part of your interview with Patrick.

Patrick	You
	Hello, so, as you know I've come to talk to you about automating the quarterly sales reports.
Hmm.. yes. I think it's quite a good idea, in principle, but it needs to be done right. Have you spoken to Oliver yet? I suppose he's shown you the excel application he wrote?	
	I've been to see him, but we didn't have chance to look at the program, I'm going to go back.
Yes well, no offence to Oliver, but don't hold your breath. The thing is, the other team leaders, and Anita, none of them have much training in statistics. And it was quite a big part of my degree so I understand more about putting together these reports, how you should collate the data, when you can draw conclusions and when you can't, because say, you just haven't got enough data. Oliver's shown me his system, and I just have no confidence that the statistics it produces are correct - Oliver doesn't have any background in statistics at all and I'd have to look through his workings before I'd even consider it. It just doesn't give you enough detail.	
	Can you explain a bit more about the detail you include in your report?
Well for example, it's no good just showing means for sales figures for each person, or new leads or whatever, if you don't have other information like the size of the population, the number of people in the sales team and then your standard deviations and confidence intervals, how can you really know what any of it means? But I don't think the others quite appreciate that. I've tried to explain sometimes and actually, no, I think Oliver does get it and he did agree last time we talked that he should add some more to his report. But Lucy really doesn't have a head for numbers, you're wasting your time there, and well, I just don't think Anita is as interested as she should be. I spend a lot of time on my reports trying to break	

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everything down and make it clear, and I've offered to spend some time going through the report with her, but she's always just like 'Well can you give me a summary? What are the headlines?'.	
	And what is your response to that?
Well I don't think you can work with a summary, you need the detail. It's just not responsible to make approximations from a summary, and make your decisions based on that, important financial decisions about the sales department's performance and future work, but that's what Anita is doing at the moment. She's a very nice woman but it's just not responsible.	
	Ok. Can you take me through one of the reports you put together?
Yes, yes I'd be happy to. The thing is that, whilst it's true that it does take a long time to put the report together.. Well actually it's a bit quicker with the new system because at least all my Sales teams data is in one place, I used to have to ask everyone for it individually, but they're very good about updating the system because I've made it part of their targets that they should update the system once a week.. But anyway, although the report takes a while to produce, you can learn a lot when you take the time to go through your data – see who is converting leads into sales most effectively, which products are becoming more or less popular, making timelines is very interesting for example, for over 3 months and then I do ongoing ones too..	
	I'm interested that you've made keeping the system up to date part of your staffs' targets, I haven't heard anyone else mention that.
No, well it's something I just do within my team. So it's normal that sales staff get a bonus based on their performance, you know, their sales basically.. But we have some control over the bonus and I felt it was so important to have good quality information going into the new system, I decided to make keeping the system up to date a condition of a part of their bonus and make it less dependent on their sales performance. That way they're under a bit less pressure to make sales, and they're more likely to log all the lost sales.	
	So the incentive is more about up to date information than sales?
Exactly. Because what's the point of them only recording successes? And they might do that otherwise. I need to know about lost sales so I can do something about them, so they need to know they won't be penalised for recording them.	
	Yes, that makes sense.
Yes, well how can you do anything if you don't know what's really happening? And that's the other thing that worries me about automating these reports – they are time consuming but I learn a lot by taking the time to explore the sales figures properly, if I just get a report dropped on my desk I haven't done the same amount of exploration, I'll miss out on things. And of	

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<p>course it's very interesting, I do enjoy getting the brain going and using some of my statistics from college, makes a nice change from all the other people stuff we do. Anyway, I'll go and find you some examples of my reports and show you what I mean..</p>	
--	--

Finally, you meet up with Lucy who manages the very successful South East sales team. The same colleague who worked with Patrick on the SLM project couldn't tell you much about Lucy. She was too busy to make it to many of the project meetings, and felt that the new system wasn't really necessary. Her main concern was that her team members wouldn't be forced to use the system if they preferred not to. Below is a transcript of part of your interview with Lucy.

Lucy	You
Hello, come in, you've come from IT, is that right?	Hello
	Yes, I've come to talk to you about how we could automate the quarterly reports.
Oh dear, yes, the dreaded reports. And the sales leads system, nightmare..	Oh dear, you don't like it?
Oh, I suppose I'm being a bit jokey, but no, the team don't really like it, they don't like filling in their figures and I feel like I have to chase them to do it. It's understandable, because they were perfectly happy keeping paper records and notes, and it's much faster to do that in the short term than put everything on the computer. I suppose it's good to have all your numbers and names and so on in one place but you know.. You do what's quickest at the time don't you? And I think they worry that someone is checking up on them, Sales is such a pressurised job anyway, you're judged very quickly on how well you're selling, so it's hard to persuade them that they need to record lost leads. So actually, I suppose their paper records probably weren't any better!!	
	So do you think the information in the system is accurate?
Accurate-ish.. It's good enough I think. The way I look at it, my team are by far the best at actually getting sales, we generate more leads than Oliver and Patrick's teams' put together, and they're very good at turning them into sales. And we're all very happy here so I don't want to start nagging them into worrying about the system or making changes when they can be getting on with selling. After all, that's what they're employed for and they're very good at it!	
	And do you use the numbers in the sales system to do the quarterly sales report?
Mmmm, partially. I send a reminder round my team about having to do the report, urgh I hate doing them! So I remind them all to make sure their files are up to date, and then I do use the numbers in the report, but then of course someone is on holiday, or realises they've made a mistake, so I end up changing the report after I've done it. That's when I do wish they'd keep	

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the numbers up to date!	
	Would it be possible to have a look at one of your reports, maybe you could talk me through what you do?
Urgh ok, well it's just a word document, I'll do my best to take you through it. I suppose it would be good if it was automated because it takes me hours to do, I can never remember from one quarter to the next how I did it. Oliver showed me his automated Excel thing and it's very fancy, he puts all the numbers in different boxes and presses a button and it does it all for you. Have you seen it?	
	Not yet..
Oh well it is very good if you're good at computers. Mine is very simple, I do everything on paper and a calculator then just type it in, I'm quite embarrassed to show you it in comparison.	
	No, no, it'd be very useful.
I'll just go and get last quarter's report. There's probably all kinds of mistakes in there, don't tell Anita if you spot something!	

3. Short Answer Questions

1. What do you think the main issues in the development of the reporting software will be?
2. What do you think Patrick's main concerns about implementation of the system are?
3. What do you think Lucy's main concerns about implementation of the system are?
4. How might you address their concerns?

4. Multiple-Choice Questions

What do you think Patrick's motivations are? (Tick as many as you feel are applicable)

Peer-esteem

Power

Achievement

Sociability

Altruism

Challenge

Curiosity

Pleasure

Ownership

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What do you think Lucy's motivations are? (Tick as many as you feel are applicable)

Peer-esteem	Power
Achievement	Sociability
Altruism	Challenge
Curiosity	Pleasure
Ownership	

Which of these emotions are most apparent from Lucy's interview? (Tick as many as you feel are applicable.)

Fear	Pleasure
Depression	Joy
Frustration	Jealousy
Disgust	

Which of these emotions are most apparent from Patrick's interview? (Tick as many as you feel are applicable.)

Fear	Pleasure
Depression	Joy
Frustration	Jealousy
Disgust	

Please let the experimenter know you have finished.

5. Post study questionnaire

Thinking about the Lowshire Building Society study you have just analysed:

On a scale of 1 to 7 how easy did you find it to analyse the scenario?

1 2 3 4 5 6 7

(difficult) (very easy)

On a scale of 1 to 7 how easy did you find it to think about Lucy and Patrick's values?

1 2 3 4 5 6 7

(difficult) (very easy)

On a scale of 1 to 7 how easy did you find it to think about Lucy and Patrick's emotions?

1 2 3 4 5 6 7

(difficult) (very easy)

On a scale of 1 to 7 how easy did you find it to think about Lucy and Patrick's motivations?

1 2 3 4 5 6 7

(difficult) (very easy)

Please let the experimenter know you have finished.

Appendix F Chapter Six: Experimental Results

This appendix provides the responses to the multiple choice section of chapter 6's experimental study. The Gold Standard answers are provided and highlighted in green, followed by the responses of the student participants.

Table F1. With Method Responses to 'Patrick's motivations' Question

Patrick's motivations	Gold Standard	With Method				
Peer-esteem	1		1			
Achievement		1	1	1	1	1
Altruism						
Curiosity						
Ownership	1			1	1	1
Power	1			1		1
Sociability						
Challenge	1	1		1	1	1
Pleasure			1	1		
Matches against Gold Standard						
	1	1	3	3	2	3
False Positives		1	2	1	1	1
Total no of answers	2	3	5	4	3	4

Table F2. Without Method Responses to 'Patrick's motivations' Question

Patrick's motivations	Gold Standard	Without Method				
Peer-esteem	1		1			1
Achievement		1	1	1	1	1
Altruism						1
Curiosity		1		1	1	
Ownership	1				1	
Power	1	1			1	
Sociability						
Challenge	1		1			1
Pleasure		1	1	1	1	
Matches against Gold Standard		1	2	3	1	2
		1	2	3	1	2
False Positives		3	2	3	3	2
Total no of answers	4	4	6	4	5	4

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Table F3. With Method Responses to ‘Lucy’s motivations’ Question

Lucy's motivations	Gold Standard	With Method					
		1	1	1	1	1	1
Peer-esteem	1						
Achievement	1		1	1			
Altruism				1			
Curiosity							
Ownership		1	1				
Power			1				
Sociability		1		1	1	1	1
Challenge							
Pleasure	1		1	1			
Matches against Gold Standard	1	1	2	2	1	0	
False Positives	1	2	3	3	1	1	
Total no of answers	2	3	5	5	2	1	

Table F4. Without Method Responses to ‘Lucy’s motivations’ Question

Lucy's motivations	Gold Standard	Without Method					
		1	1	1	1	1	1
Peer-esteem	1						
Achievement	1		1	1	1	1	1
Altruism		1	1				
Curiosity							
Ownership							
Power							1
Sociability	1		1	1	1	1	1
Challenge	1			1			
Pleasure	1						
Matches against Gold Standard	2	1	2	2	2	2	2
False Positives	3	1	2	2	1	2	
Total no of answers	5	2	4	4	3	4	

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Table F5. With Method Responses to ‘Lucy’s emotions’ Question

Lucy's emotions	Gold Standard	With Method					
		1	1	1	1	1	1
Fear	1						
Depression	1		1	1	1	1	
Frustration		1	1	1	1		1
Disgust							
Pleasure							
Joy		1					
Jealousy					1	1	
Matches against Gold Standard		1	2	2	2	2	1
False Positives		2	1	1	2	1	1
Total no of answers		3	3	3	4	3	2

Table F6. Without Method Responses to ‘Lucy’s motivations’ Question

Lucy's emotions	Gold Standard	Without Method					
		1		1	1	1	1
Fear	1						
Depression	1			1	1	1	
Frustration		1	1	1	1	1	1
Disgust				1	1		
Pleasure							
Joy							
Jealousy		1					
Matches against Gold Standard		1	0	2	2	2	1
False Positives		2	1	2	2	1	1
Total no of answers		3	1	4	4	3	2

Table F7. With Method Responses to ‘Patrick’s Emotions Question

Patrick's emotions	Gold Standard	With Method					
		1			1	1	
Fear	1						
Depression							
Frustration		1	1	1	1	1	1
Disgust							
Pleasure		1	1	1	1		
Joy				1			
Jealousy	1					1	1
Matches against Gold Standard		1	0	0	1	2	1
False Positives		1	2	3	2	1	1
Total no of answers		2	2	3	3	3	2

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Table F8. Without Method Responses to ‘Patrick’s Emotions Question

Patrick's emotions	Gold Standard	Without Method				
					1	
Fear	1				1	
Depression						
Frustration	1	1		1		1
Disgust				1		1
Pleasure	1	1	1		1	
Joy			1		1	
Jealousy	1			1		
Matches against Gold Standard	0	0	0	2	0	0
False Positives	2	2	2	2	2	2
Total no of answers	2	2	2	4	2	2

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Table F9 Multiple Choice Questions: Binomial comparison of totals

		Totals	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Q1 True Positives	With Method	13	0.54	0.5	0.839
	Without	11	0.46		
	Total	24	1		
Q2 True Positives	With Method	7	0.39	0.5	0.481
	Without	11	0.61		
	Total	18	1		
Q3 True Positives	With Method	10	0.56	0.5	0.815
	Without	8	0.44		
	Total	18	1		
Q4 True Positives	With Method	5	0.71	0.5	0.453
	Without	2	0.29		
	Total	7	1		
Q1 False Positives	With Method	8	0.33	0.5	0.152
	Without	16	0.67		
	Total	24	1		
Q2 False Positives	With Method	11	0.5	0.5	1
	Without	11	0.5		
	Total	22	1		
Q3 False Positives	With Method	8	0.47	0.5	1
	Without	9	0.53		
	Total	17	1		
Q4 False Positives	With Method	10	0.45	0.5	0.832
	Without	12	0.55		
	Total	22	1		

Appendix G Chapter Six: Value, motivation and emotions rated by their relevance to RE by RE students and experts.

Appendix G contains the complete list of scores given to the VBRE value, motivation and emotion terms by the student and expert participants during the website evaluation survey presented in Chapter 6. Each term was rated between 1 (irrelevant to RE) to 7 (highly relevant to RE)

Students		Experts	
Trust	6.67	Cooperation	6.83
Cooperation	6.50	Trust	6.83
Achievement	6.50	Frustration	6.83
Frustration	6.50	Absence of Conflict	6.50
Success	6.42	Independent	6.50
Absence of Conflict	6.33	Ownership	6.50
Happiness	6.33	Equality	6.33
Challenge	6.25	Curiosity	6.33
Experience	6.25	Sociability	6.33
Accomplishment	6.17	Experience	6.17
Logical	6.17	Helpful	6.17
Ownership	6.00	Achievement	6.17
Peer-Esteem	6.00	Power	6.17
Pleasure	6.00	Happiness	6.17
Fear	6.00	Friendship	6.00
Helpful	5.92	Intellectual	6.00
Responsible	5.83	Responsible	6.00
Ambitious	5.75	Fear	6.00
An attractive environment	5.75	Logical	5.83
Freedom from anxiety	5.75	Social recognition	5.83
Social recognition	5.58	An attractive environment	5.67
Power	5.58	Capable	5.67
Capable	5.50	Contentedness	5.67
Honest	5.50	Freedom from anxiety	5.67
Open-minded	5.50	Accomplishment	5.50
Sociability	5.42	Ambitious	5.50
Depression	5.42	Challenge	5.50
Equality	5.33	Imaginative	5.50
Intellectual	5.33	Success	5.50
Ordered	5.33	Open-minded	5.33
Imaginative	5.25	Honest	5.00
Self-control	5.08	Ordered	5.00
Friendship	4.83	Self-respect	5.00
Disgust	4.83	Altruism	5.00
Obedient	4.50	Peer-Esteem	5.00
Self-respect	4.50	Pleasure	5.00

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Curiosity	4.42	Disgust	4.50
Polite	4.00	Polite	4.33
Forgiving	3.92	Obedient	4.17
Independent	3.92	Forgiving	3.00
Courageous	3.75	Depression	3.00
Contentedness	3.67	Courageous	2.83
Altruism	3.67	Self-control	2.83

Appendix H Chapter Seven: Case Study Diary Format

Below is the set of materials used during the Industry Case Studies:

1. Initial interview format
2. Diary guidance and format
3. VBRE Method and Website Slide set
4. Wash-up interview format

1. Initial Interview Format

1. Please give a brief overview of your educational background.
2. Please give a brief outline of your employment history and experience in requirements elicitation.
3. Please describe the area(s) of industry and types of software users you work with.
4. Are you aware of users' values, motivations and emotions?
5. Do you have examples from projects when users' values, motivations or emotions have impacted the work – positively or negatively??
6. Do you choose to make use of information such as users' values, motivations and emotions?
7. If so, you have examples from projects when this knowledge has proved useful?
8. If so, how do you gather this information? Do you use any particular techniques?
9. Do you document or share these soft 'requirements' with others involved in the project? If so, how?

Background on upcoming project (the project they will be working on when testing VBRE)

1. What's the focus of your current RE work?
2. Who are the users?
3. How long has the project been running?
4. Can you give me an outline of your RE process and techniques?

2. VBRE Study Diary Guidance and Format

What is the purpose of the diary?

Its overall purpose is to capture your experiences of using the VBRE method; whether it's helped you better understand your users, whether it has had an impact on your project, how you've used the different VBRE components, and if you've had any problems or difficulties using the method.

How often should I fill it in?

Please fill in your diary every day – even if it's just simply to note that you didn't do any requirements analysis today.

What format can I use?

You can fill in the form electronically, just cutting and pasting a blank form for a new day, or you can print the form out and fill it in by hand. Alternatively, if it's easier for you, you can make audio recordings of your diary – just running through each of the questions in the template.

What should I include?

Please work through the questions in the template below – you can see some worked examples on the next page – if you're not sure if something is relevant, please make a note of it and contact me to ask.

What should I leave out?

You should leave out anything that's confidential to your work or company. I will also take out the names of any people or companies before analysing the data, and won't include any real names in the analyses or publications.

What will happen to the completed diaries?

We will work together to review the diaries, discussing your experiences as you work through the evaluation, and at the end of the process.

At the end of the process the raw data of the diaries will only be available to yourself, me and my PhD supervisor, and will remain confidential.

Blank diary template

Entry Date	
Were you involved in any requirements analysis activities today?	Yes / No (if 'no' stop here!)
What format did the requirements work take? Please circle any that apply, or add other techniques as required.	1 to 1 interview Workshop Work shadowing Other
Did you make use of any VBRE components today?	Method Website Your hunch list
Please briefly outline the situation and your use of the VBRE tools.	
Did you identify any specific values, motivations or emotions?	
Please describe the impact (if any) of the use of the tools on your requirements identification or project process	
Did you have any problems using the method / website?	

Some example entries

Entry Date	3 rd June 2010
Were you involved in any requirements analysis activities today?	Yes
What format did the requirements work take?	1 to 1 interview
Did you make use of any VBRE components today?	Method
Please briefly outline the situation and your use of the VBRE tools.	I used the VBRE method to mark up and reflect on an interview I carried out yesterday, and noticed that there might be an issue about trust with one particular department – consequently I've arranged an interview with a team member from that department. I also noticed that whilst the person I interviewed was happy to let other departments have access to some of his data, there was some anxiety over maintaining ownership and control once these records are available on the intranet.
Did you identify any specific values, motivations or emotions?	Trust, Anxiety
Please describe the impact (if any) of the use of the tools on your requirements identification or project process	There might be a need to ensure the system provides a way for data owners to see who has accessed their data, and keep their names

Appendices

	associated with files. I'm going to explore this new potential requirement with other users.
Did you have any problems using the method / website?	No

Entry Date	4th June 2010
Were you involved in any requirements analysis activities today?	Yes
What format did the requirements work take?	1 to 1 interview
Did you make use of any VBRE components today?	Website
Please briefly outline the situation and your use of the VBRE tools.	Following on from yesterday, I've arranged an interview with the other department where trust seems to be a potential issue
Did you identify any specific values, motivations or emotions?	Trust
Please describe the impact (if any) of the use of the tools on your requirements identification or project process	I used the 'Trust' page of the website to prepare some interview questions to help me explore this.
Did you have any problems using the method / website?	No

If you have questions about filling in the template or anything else to do with the study please contact Sarah (sarah.thew@manchester.ac.uk).

3. VBRE Method and Website Slide set

As described in Chapter 7, the case study participants received a tutorial explaining the VBRE method and website. The slide set below was used during this tutorial.

<p>An Introduction to Value Based Requirements Analysis</p> <p>Exploring users' values, motivations and emotions</p>	<p>Content</p> <ul style="list-style-type: none">• Values, Motivations and Emotions<ul style="list-style-type: none">– Why do users' values, motivations and emotions matter?– What are values, motivations and emotions?– How do they relate to requirements analysis?• An introduction to Value Based Requirements Analysis<ul style="list-style-type: none">– The Method– The Website– Linking the method into your existing requirements analysis process– A worked example
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<p>Why do users' values, motivations and emotions matter?</p> <ul style="list-style-type: none">• Users' values, motivations and emotional reactions can be pivotal to the success, or failure of IT projects.<ul style="list-style-type: none">– US tax office laptop rollout– Health workers' WIKI	<p>How can values, motivations and emotions help us?</p> <ul style="list-style-type: none">• Developing a deep understanding of users' long term goals, working practice, problems and values• Making design decisions• Building a rapport with users• Anticipating user wants and needs
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<p>Values</p> <ul style="list-style-type: none">• Many different definitions• A long-term, widely applicable attitude• Personal, group, role, organisation• One value label – means different things to different people• Values influence emotions and behaviour	<p>Motivations</p> <ul style="list-style-type: none">• Long-lasting goals, high-level drives which shape our behaviour and attitudes.• Motivations are important for understanding stakeholder groups and for individual-level requirements, especially when systems can be customised or configured.• Understanding how committed people may be to a particular solution or project (i.e. how can it help them)
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Emotions

- A mental state that arises spontaneously rather than through conscious effort and is often accompanied by physiological changes
- Emotions generated by experiences with technology generally transient and not extreme
 - Pleasure using creative software
 - Frustration attempting to use badly designed websites
 - Excitement playing computer games
- Experiences with software development – potentially more strongly felt and persistent
 - Fear at the prospect of changes to work processes, relationships, status
 - Anxiety about describing work activities

Values, motivations and emotions in requirements analysis

- Understanding peoples' values and motivations helps in interpreting their requirements and their acceptance of system requirements.
- Assessing emotions gives insight into the force by which they hold values and possible reasons for response to requirements issues and socio-technical systems designs.
- However analysts aren't usually trained to consider these "soft" issues .

It's hard to directly articulate values, motivations and emotions - easier to explore with stories and examples.



Knowing that someone considers a value, e.g. 'greeness' doesn't tell us much about what they consider greeness to be.
Two people may both believe 'greeness' to be important, and we can expect some overlap, but there may well be some differences too.

Exploring Values, Motivations and Emotions

- Expressed through preferences, goals and desires.
 - Users' likes and dislikes
 - Their job
 - Working relationships
 - Environment
 - Reactions to recent events
 - Descriptions of themselves and their jobs

Identifying Emotions



Reactions:

- Facial expressions
- Body language
- Tone of voice
- Choice of language

Attributed photo from: <https://www.flickr.com/photos/22387427@N00/>

An Introduction to VBRE

- Value Based Requirements Engineering
- Reflection on the ways people talk about their work to understand their values, motivations and emotions
- Analysis of values, motivations and emotions as they relate to requirements engineering - developed into a set of guidelines
- A simple method and website to help analysts reflect on their own projects

VBRE Taxonomies

- Lists of the major values, motivations and emotions relevant to RE
- Guidelines to help in identification, understanding implications and process advice.

Review of the taxonomies

- There are separate taxonomies for Values, motivations and emotions.

Value concept	Related terms	Potential sources	Process implications
Trust	Openness, integrity, loyalty, responsibility, reliability	Relationship with other individuals, organisational policies	Less control, more trust, less concern
Collaboration	Cooperation, teamwork, sympathy, alignment, see also Personal characteristics	Relationship with others, Restorations, awareness of others – Office politics	Improved team cooperation, shared awareness

First three lines of the Values taxonomy

The Method

- Structured analysis guided by a framework looking for patterns
- Makes use of data normally gathered during the course of a requirements investigation – interviews, meetings, observations
- Review this data ‘wearing another hat’

Linking VBRE into your own requirements analysis process

```

graph TD
    A[User needs and requirements] --> B[Project team A/B - Owner of the artifact]
    B --> C[Requirements elicitation]
    B --> D[Requirements analysis]
    C --> E[Requirements management]
    D --> F[Requirements validation]
    E --> G[Requirements traceability]
    F --> H[Requirements validation]
    G --> I[Requirements validation]
    H --> I
  
```

The VBRE Website

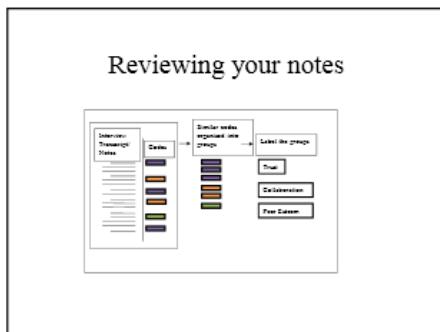
- The website captures information from the taxonomies, along with:
- Questions and advice to help you explore these issues during interviews with stakeholders.
- Example scenarios with discussion points to help you consider the ways different values, motivations and emotions might play out within a project
- Advice about potential impacts on both the design of the software and the way you run your requirements process.

VBRE home page – a tag cloud of values, motivations and emotions



A worked example

- Analysing scientists' differing research priorities
- Exploring how those priorities impact our requirements analysis



4. Diary Review & Wash-up Meeting format

A semi-structured interview completed at the end of each analyst's case study.

1. Overall, how have you found the experience of using the method and website?
2. Diary Review:

Which components of the method were used?

Examples of use

Critical incident review (based on diary content)

Fit with existing RE work?

3. Do you think your use of the method had any impact on requirements elicitation process?
4. Do you think your use of the method had any impact on requirements for the project?
5. Do you think your use of the method had any impact on your understanding of your users?
6. Would you use the VBRE method on future projects?
7. Overall, how have you found the experience of using the method and website?