

Understandability of Requirements Artefacts - A Small Survey

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Abstract—Motivational goal modelling has evolved from a method to build agent-oriented software models to be a general method for eliciting requirements for software, products or services. The method has been used for over five years in software engineering units at the University of Melbourne. Increasingly the units have advocated building consistency between software requirements artefacts such as motivational models, lists of user stories and prioritised requirements presented in a MoSCoW table. This paper describes a small survey comparing the understandability of three requirements artefacts: motivational models, user stories and MoSCoW tables.

Index Terms—model-based requirements, motivational modelling, requirements engineering, engineering education

I. INTRODUCTION

Lightweight requirements artefacts are an important aspect of teaching software engineering units using an agile approach. For the past five years at the University of Melbourne, motivational models [1] have played a central role. The models were introduced for teaching both in a dedicated requirements engineering unit and in semester-long and year-long software project units. The models have been used successfully by students for their projects.

As students became more familiar with the models, consistency principles between motivational models and other requirements artefacts have been developed, specifically user stories [2], personas, and more recently MoSCoW tables [3]. Students are shown how to relate motivational models to user stories as per the account in [4]. As the consistency principles have been applied and the quality of motivational models have improved, it became clear that there is a large overlap of information between the motivational model and the user stories. There is also an overlap between user stories written as text, and requirements prioritised within a MoSCoW table.

We wondered whether it was easier to understand information in the form of a motivational model, or in the form of a list of user stories. We conducted a small experiment in January 2023 to see if there was any difference between the comprehensibility of the information presented in the user stories and motivational models. The experiment was run by three students doing an internship with the company Queue

Solutions which maintains software for building motivational models. The experiment also included MoSCoW tables which are a different format for user stories with priorities (Must have, Should have, Could have or Won't have) added. We wondered which of the three representations - motivational models, user stories as text, or MoSCoW tables would best be understood by inexperienced users.

The internship was run under the Summertech program sponsored by the Victorian Government. The Summertech program supported two students from Swinburne University of Technology, and we included an undergraduate student from the University of Melbourne seeking a research experience. The internship was hosted by Queue Solution (<https://www.leonsterling.com/about-queue-solutions>). Ethics were handled by Queue Solutions, and user consent agreements and plain language statements were prepared. Each of the three students involved in the internship conducted a small survey comparing the ease of understanding of the requirements artefacts.

This brief paper is organised as follows. In the next section we describe the artefacts that were used in the study and where they came from. We illustrate the artefacts using models that were chosen from student projects developed by undergraduate and masters students undertaking software projects at The University of Melbourne. The third section contains three subsections, where each of the three students involved in the experiment students describe their individual surveys. The final section concludes with observations from the surveys.

II. REQUIREMENTS ARTIFACTS

Motivational modelling emerged from agent-oriented goal modelling to describe projects to non-technical stakeholders. It has been applied in diverse contexts, including space planning, brand development and strategic planning for an eCommerce platform. The essence is developing a shared understanding between diverse stakeholders in a user-centred manner. The general abstract nature of the models has been useful for software engineering students who sometimes struggle to get a high-level view of a project.

In brief, a motivational model is a high level diagram describing an overall socio-technical system, a software product or a company. The high level diagram is different from early requirements diagrams in more traditional goal-oriented

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requirements engineering [5]. Diagrams produced through motivational modelling are more abstract with more ambiguous semantics than other modelling methods such as i* [6], and with less structure. The model gives all stakeholders a strong voice through the ability to talk about high level goals in terms of emotions and qualities as well as functionalities. A motivational model has some similarity to a business brief as it can be seen as a starting point for a conversation that is able to capture initial objectives and goals of a client.

The intent underlying the creation of a motivational model is to capture a shared understanding of the system, its goals and stakeholders. The diagram captures what the system to be is being designed to do, what qualities the system should have such as security and privacy, and how interactions with the system should feel for key stakeholders.

We describe a motivational model that is a simplification of one of the motivational models used in the survey. The model was developed by undergraduate students at the University of Melbourne undertaking a capstone project unit. The overall project was to create an electronic marketplace for the client, a graduate student at the University of Melbourne. The simplification is for ease of description.

As can be seen, the model contains several shapes, specifically parallelograms for functional goals, people for roles, clouds for quality goals, and hearts for emotional goals. The overall goal is to create an electronic marketplace. There are four main functional goals, expressed in the four parallelograms under the central parallelogram in the top of Figure 1. They are to 'Browse and Search,' 'Buy,' 'Sell,' and 'Manage User Accounts.' The stakeholders are the clients of the electronic marketplace indicated by the person figure next to the main goal. Buyers, sellers, and admin are other stakeholders depicted in the figure. The desired qualities of the electronic marketplace are expressed in the cloud, namely the system needs to be clean, easy-to-use and professional. More specific qualities are that the user should be interested while browsing and searching, buying should be secure and selling should be honest. Note that other qualities may be relevant - these were ones elicited during the student project. The desired emotions while interacting with the electronic marketplace are expressed in the hearts. Overall clients should feel proud, while buyers

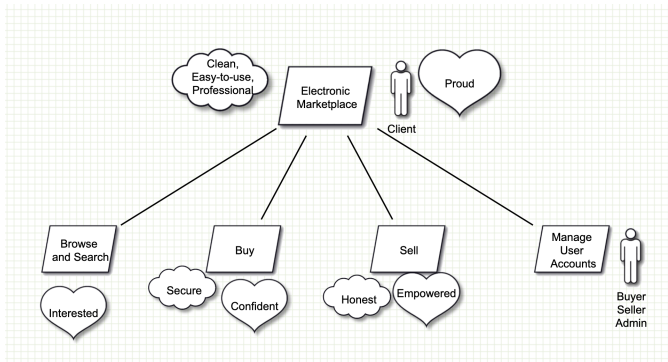


Fig. 1. Example motivational model

should be confident and sellers empowered. These words were generated during an elicitation session, and participants have a sense of what is intended by the terms from the discussion in the session.

A user story is a short, simple description of a feature told from the perspective of the person who desires the new capability, usually a user or customer of the system [7]. User stories typically follow a simple template:

The basic form of a user story is 'As a <user> I want to <do> so that <goal>'.

Historically user stories were deliberately kept informal, written on index cards or sticky notes, stored in a shoe box, and arranged on walls or tables to facilitate planning and discussion. Their impermanence made it easy to tear them up, throw them away, and replace them with new stories as more was learned about the product being developed. Examples of user stories are given in the next section.

The MoSCoW method was developed by software developer Dai Clegg in 1994 [3] in the context of rapid application development. It has been adopted in agile development as a mean of prioritising requirements, as explained for example in [8]. MoSCoW tables are used regularly by software engineering students in their project subjects. MoSCoW tables have the information from the user stories laid out in a table format with an extra column giving the priority information for the particular user story.

III. THREE RELATED SURVEYS

As the internship was a learning experience for the interns, it was decided that the interns would conduct the surveys separately. Each of the student surveys was written by an intern. The results are described in turn.

A. Aishwarya's survey

The client project used for the survey was one of the projects developed by students undertaking the Undergraduate IT capstone project. The high level objective was for the students to build an online marketplace for their client. The motivational model that the team developed is shown in Figure 2 in an Appendix at the end of the paper.

When translated to a user stories list, the requirements look like:

- 1) Epic: Buy, sell, search real estate properties, proudly and in an easy-to-use, clean, professional manner
- 2) As a buyer, I want to be able to browse and search properties, and remain interested through the process. As a buyer, I want to also be able to:
 - a) Look up items using keywords
 - b) Browse listings
 - c) Lookup a seller account
 - d) Contact a seller
- 3) As a Buyer, I want to be able to buy properties confidently and feel secure about the process. As a buyer, I also want to be able to:
 - a) Place an order

- b) Modify an order
 - c) Add listings to cart
 - d) Pay
 - e) Cancel orders
 - f) Get personalized things
 - g) Rate listings
- 4) As a Seller, I want to be able to sell properties while feeling honest and empowered. I also want to be able to:
- a) Create a listing
 - b) View statistics
 - c) Modify a listing
 - d) Decline an order
- 5) As Sellers and Buyers, we want to be able to:
- a) Create an account
 - b) Login and logout
 - c) Edit details
 - d) View orders
- 6) As an admin, I want to be able to moderate the forum, and have authority. I also want to be able to:
- a) Remove malicious accounts

The survey participants were university students in various undergraduate and graduate disciplines. Some had backgrounds in engineering, while some were in academia and the arts. To ensure that participants felt comfortable answering the survey as honestly as possible, the survey was anonymous and details were not collected that would make participants identifiable (such as their names and email IDs).

The participants had varying levels of experience with requirements elicitation, which affected their level of understanding with the different representations of requirements elicitation.

The software developers that were surveyed also had varying levels of experience with requirements elicitation, although this did not seem to affect their perceived understanding of the requirements artifact, perhaps because of the intuitive nature of the motivational modelling diagrams and user stories list.

The survey began by asking participants about their background, including their current industry, educational background, experience with software development, and experience with requirements elicitation.

- 1) What industry do you work in? (If you are a student, what industry do you hope to work in?)
- 2) What did you study in university?
- 3) Have you had any experience in software development?
- 4) If you answered 'yes' to the previous question, what level of experience would you say you are at?
 - a) Beginner (0-1 years)
 - b) Intermediate (1-5 years)
 - c) Skilled (6-10 years)
 - d) Master (more than 10 years)
- 5) What is your level of experience with requirements elicitation?
 - a) Never heard of it before

- b) Familiar with it, but haven't done it myself before
- c) I've done it once or twice/ a few times
- d) I do it on a regular basis, and am well-versed with it
- e) I've learnt it at university/ in the workplace, and have had to use it on projects

The survey then asked participants to study a motivational model, extract information from it, and comment on the experience of conveying information with a motivational model. Similar questions were then asked about the user stories list.

The questions asked about the motivational model (the same one pictured in *Figure 2*) include:

- 1) What is the overall goal of the system?
- 2) What are 8 functionalities needed for a buyer?
- 3) What might a buyer feel when browsing and searching?
- 4) Which role will "view statistics"?

The questions asked about the user stories list (as described above) include:

- 1) What is the overall goal of the system?
- 2) What are 8 functionalities needed for a buyer?
- 3) What is something an admin might feel when interacting with the system?
- 4) Which role will "view statistics"?

Once the participants extracted information from the two types of representation, they were asked about their experience through the following questions:

- 1) How well do you feel you understood the model?
- 2) How well do you feel you understood the requirements artifact?
- 3) Which representation do you prefer? Which one was easier to understand?

All the participants surveyed were confident in their understanding of the requirements artifact, however there were some mistakes made by the survey participants in identifying quality and emotional goals. Only 28 percent of the people surveyed were able to correctly identify emotional goals with the motivational modelling diagram, whereas 71 percent of the participants were able to correctly identify quality goals in the motivational modelling diagram. When asked for an overview of the requirements artifact, 62.5 percent of participants were able to find a reasonably correct answer, although it was a high-level, slightly vague response, such as "online marketplace" instead of "buying, selling, searching real estate properties".

With the user stories list, the participants, regardless of educational and professional background, were all able to correctly identify specific details, such as the full list of roles that a buyer would need.

There was a higher accuracy rate, in general across all participants, with the user stories list, despite 57 percent of the participants saying they preferred the motivational modelling diagram.

An equal number of participants favoured the motivational modelling diagram and the user stories list. It turns out that people with backgrounds in STEM fields such as Biology

or Engineering preferred the motivational modelling diagram, whereas those with backgrounds in the arts preferred the user stories list. There were some exceptions to this, where an architectural student preferred the motivational modelling diagram.

With the user stories list, it was easier for participants to find more specific information such as quality goals and the number of requirements assigned to specific roles, whereas with the motivational model diagram, participants were able to see the big picture idea more clearly.

Overall there were slight differences in the accuracy achieved and preferences for both forms of requirements elicitation, but each have their merits. The user stories list was where the most accurate information was extracted by students surveyed, whereas they said they preferred to look at diagrams instead. Considering this, it makes sense that using the motivational modelling diagram is ideal in contexts when pitching the high level overview of a project to a manager or a non-technical stakeholder, and then move to using the user stories list when evaluating more specific aspects of the projects' features, or to pass on to software developers so they can break down the task further based on the priority of each specific aspect.

B. Hammad's Survey

The goal of the survey was to gauge participants' familiarity with and comprehension of three requirements artifacts: motivational models, Moscow tables, and do/be/feel/list models. The survey had a total of five participants, representing a variety of fields such network security, business management, and software engineering.

The poll's findings revealed that motivational models were by far the most well-liked model, being selected by four out of every five respondents. This suggests that participants most frequently use and accept motivational models. The study found that a significant majority of respondents (80 percent) were familiar with the term 'requirements elicitation.' The study suggests that clients and organisations are methodically compiling and outlining their motivational needs. The process of eliciting requirements is essential for developing motivational models because it guarantees that the models are tailored to the particular needs of the individual or group. This finding implies that participants are aware of the importance of requirements elicitation in the development of motivational models. The questions asked during survey are as follows:

1) Motivational Model set of questions:

- a) What functions are needed to manage the applications?
- b) How should the applicants feel when they make applications?
- c) What qualities should 'streamline Collaboration applications' from the Investigator's point of view?
- d) Who are the stakeholders for the CCFR Portal?

2) Do/ Be/ Feel List:

- a) Who are the stakeholders for the CCFR Portal?

- b) What functions is the administrator responsible for?
- c) How should the Community Char feel when interacting with the portal?
- d) What qualities should the CCFR portal have from an applicant's point of view?

According to the study, respondents who had never before seen motivational models were able to understand the concepts and models fairly well.

They must be easy to understand, especially for those with little prior knowledge, if they were able to respond to the questions regarding the models in the time provided. The findings revealed that every participant correctly identified the functionalities for managing the applications, and that eighty percent of them had no trouble identifying the emotional goals from the motivational models used to create the applications, while eighty two percent had done the same with the quality goals shown in the diagram. The motivational modelling diagrams made it simple to identify the CCFR portal's stakeholders, and 80 percent of the participants did just that. Nevertheless, two participants forgot to list two of the stakeholders.

While all of the users were able to correctly identify the CCFR portal stake holders from the user stories, the participants were a little perplexed when asked to understand the user stories list because they had missed even the functionalities when the same model was displayed on a motivational modelling diagram. All of the characteristics and feelings were not even mentioned by the participants.

The study's participants said there were several challenges to applying motivational models in practise. The biggest issue raised by participants most frequently was a lack of background information.

The business background student preferred the user stories list since the diagrams were a little perplexing to the participant, however the computer science and engineering students enjoyed using the motivating diagrams because they were accustomed to looking at the diagrams.

The motivational models were viewed as being really helpful by ninety percent of the participants, which further demonstrates their acceptance and worth. This finding suggests that motivational models can help groups and individuals achieve their desired outcomes by providing an organised and systematic approach to motivating. organised and systematic approach to motivating, motivational models can assist groups and individuals in achieving their desired results.

C. Que's survey

The study recruited five participants with diverse backgrounds, including three IT professionals with more than two years of experience and two designers. Of the IT professionals, three had experience working with Agile methods, while the designers were not familiar with Agile. All participants were familiar with drawing and reading graphs and tables, but none had seen the Motivation Model previously

The study addressed the research question, "Which artifact presents requirements best?" Five participants were recruited using personal networks. The participants were asked to answer three sets of questions related to different software requirement artifacts: a "Do/Be/Feel" list table, a Motivation Model, and a MoSCoW Table. The survey was administered using an online survey tool, and participants were given a set amount of time to complete the survey. All responses were recorded, cleaned, and transformed for analysis. Participants were provided with four documents: a consent form, a plain language statement, the model requirement artifacts, and the survey questions.

- 1) Motivational Model set of questions:
 - a) Who is a stakeholder in project allocation?
 - b) How should the coordinator feel when the manager user?
 - c) What general qualities do we expect for the system overall?
 - d) Who are the stakeholders mentioned in the model?
 - e) What functions do a student need?
 - f) How many function(s) are there in Project Creation?
- 2) Do/ Be/ Feel List:
 - a) Who are the stakeholders of the User Management system?
 - b) How should students feel when Registering/Logging in?
 - c) What functions are a supervisor responsible for?
 - d) What quality should the system have from the perspective of the coordinator?
- 3) MoSCoW table:
 - a) What functions of the system concern the supervisor?
 - b) Which stakeholder wants to approve, or take down the project?
 - c) What functions of the system concern an examiner?

The Motivational Model artifact was the easiest for participants to understand and use, with faster and more accurate responses. Around 80 percent of the people surveyed were able to correctly identify six answers. For the Do/Be/Feel List, participants had the most difficulty and made the most mistakes, confusing the quality and feeling columns. Survey respondents only answered 70 percentage for four questions. The MoSCoW Table was new to all participants, but 90 percent were able to quickly understand and answer the questions.

Motivational Model: For the first question, only one experienced developer was able to provide the correct answer. However, for the next two questions, all participants answered correctly. The fourth question confused participants, as they did not distinguish it from the first question. For the last question, all participants found the answer in the Motivation Model. Three participants had better scanning skills and greater understanding of questions with more detail. In total, three out of five questions were answered correctly, but

none of the participants were able to answer questions about stakeholders in this section.

Do/Be/Feel List: Participants had the most difficulty with this artifact, with three people selecting two incorrect options on the first question. When asked the "Feel" question, four participants selected the "Be" column instead. For the third and fourth questions, all participants answered correctly.

MoSCoW Table: This artifact was new to all participants, but they were able to quickly understand and answer the questions.

The Motivation Model was the easiest requirement artifact for participants to understand and use. The Do/Be/Feel List caused the most confusion, while the MoSCoW Table was easy to understand despite being new to all participants. The findings can be used to improve the presentation of software requirements to developers, with the goal of improving the software development process.

IV. FINDINGS AND CONCLUSIONS

All three surveys were successfully conducted. The results were loosely consistent. Furthermore we feel that the responses are representative of what we expected from the survey results.

In conclusion, the surveys provides valuable data about the understandability and ease-of-use of three requirements artefacts: Motivational Models, Moscow Tables, and Do/Be/Feel/List Models. The findings of the survey suggest that Motivational Models are the most widely accepted and used model by participants.

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V. APPENDIX

Below is *Figure 2*, the motivational diagram used for Aishwarya's survey:

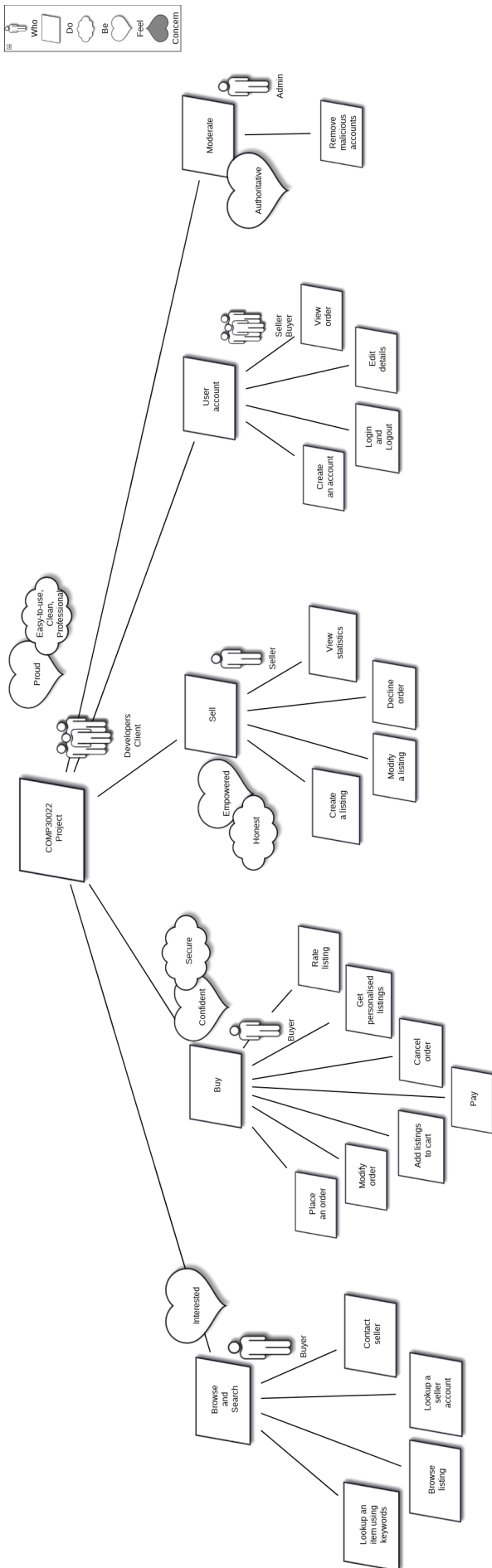


Fig. 2. Motivational Modelling Diagram Used for Aishwarya's Survey