

Reflective Report

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Large Scale Requirements Engineering (PA2521)

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I. Article Selection:

The articles which I have selected to perform this assignment are:

- Gorschek, Tony, and Claes Wohlin. "Requirements abstraction model." [1]
- Karlsson, Joachim, and Kevin Ryan. "A cost-value approach for prioritizing requirements." *Software, IEEE* 14.5 (1997): 67-74.

These are the two articles which are chosen. The first article was chosen because it is a model which is used in abstracting the requirements. The requirements are categorized into different levels in this model. By categorizing the requirements into the four different levels it is easy to understand the requirements to the development team. This also helps in prioritizing, release planning and roadmapping. This type of technique is not present in the past, so the authors developed RAM model and evaluated it in the industry which results a positive output. This model is useful in large scale requirements to break them into different levels and to make an abstraction model. It also helps in tracking the requirements. This method deals with all the key concepts which are required in the requirements engineering. This is the reason I have selected this paper.

The second article was chosen because to prioritize the requirements by performing a Cost-Value approach. Using this technique the requirements can be ranked by considering two dimensions, they are Customer value and Cost of implementation. While dealing with this technique we also come across with the concepts of Analytical Hierarchy Process (AHP). AHP is the core part of this technique. To implement this technique five steps are to be followed to prioritizing the requirements. They are Inspection of the requirement, AHP is useful in finding the relative value of the requirement, calculation of relative values and implementation costs, Formulating the costs and placing them in the cost-value graph and in the final step the requirements are prioritized using the graph.

II. Implementation Plan:

In the implementation plan for the first article I have taken twenty (20) requirements for developing a course management system (like its learning). The main motive for choosing this goal is I have an experience on this type of development system. In this article a guide is provided to arrange the requirements in four different levels. The requirements are listed and the different levels are identified and listed.

In the implementation plan for the second article I have taken eight (8) requirements for developing a website. The main motive for choosing this goal is I worked with a team in developing this type of website. In this, the requirements will be prioritized by the stakeholders based on the cost-value graph obtained after performing some calculations (relative value and

implementation cost). The requirements are listed. The relative value and the implementation costs are calculated.

III. Execution:

Article 1:

The number of requirements which are taken by me are twenty (20) and these twenty are having different levels, and a total of eighty (80) requirements are obtained.

The requirements are gathered for developing a course management system. An excel sheet is created with the four levels of the requirements. The first step is to place the requirements in the suitable levels. Based upon the requirements in each level the requirements for remaining level are assigned in step two.

The guidelines are provided in the article [1] to place the requirements into a particular level in the first step. The second step is to identify the remaining level requirements. Let us consider an example to explain this in a clear way, for the requirement that the system should have an e-library is a product level requirement. Based on this the feature level – Databases/E-resources, functional level – List of data bases and component level – redirecting to a particular database which is selected.

Article 2:

The number of requirements which are taken by are eight (8). Only 8 requirements are taken because for the following approach the 8 requirements are enough to know its functionality and its difficulty, so taking more number of requirements does not give more importance as the difficulty level just increase more but the functionality is same. The requirements are gathered for developing a second hand website. The requirements are gathered in the user perspective. The requirements are

R1: The system should allow the user to login.

R2: The interface of the system should be attractive, to attract the users.

R3: The items should be listed so that the students (users) can view the items.

R4: The items should be categorized so the users can browse them easily.

R5: The list of items should be saved that the user want to buy.

R6: The system should maintain a session data to maintain the user data secured.

R7: The description of the items should be explained so that the user can decide to buy based upon the condition of the product.

R8: The user should be able to register for using the second hand store system.

By considering these requirements I execute the cost value analysis where the detailed process is mentioned in the proof of concept.

IV. Proof of Concept

Article 1:

In this section the description of the method is described. First a requirement is selected and based upon the guidelines provided in the article [1], the requirement is placed to its suitable level. If the requirement is in the product level then it is breakdown into the feature level, functional level and component level. The requirements are selected to a particular level based upon guidelines. This is the main part in placing the requirements in a correct level. The entire process is carried out in two steps in the first step the requirement is selected for a particular level and in the next step the remaining levels are identified by breaking down the requirement. The work is performed in a excel sheet. Hereby I am attaching the link of the excel sheet in which all the requirements can be viewed. The requirements are which are taken by considering a goal to develop a course management system.

The following link provides the Excel sheet,

https://drive.google.com/file/d/0B-XA85JM_5ccclphOHR1UVdEVnc/view?usp=sharing

Article 2:

In this section the method is described. The requirements are selected and prioritized based on the customer value and cost of implementation.

Step 1:

An 8*8 matrix is formed.

A pairwise comparison is performed. The following values are default values which is given in the article, so based on the importance of the requirements by pairwise comparison the values are allocated below.

| R.ID | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|------|------|------|------|------|------|------|------|------|
| R1 | 1 | 3 | 5 | 3 | 7 | 0.33 | 3 | 0.2 |
| R2 | 0.33 | 1 | 3 | 3 | 3 | 0.2 | 3 | 0.33 |
| R3 | 0.2 | 0.33 | 1 | 5 | 5 | 0.33 | 3 | 0.2 |
| R4 | 0.33 | 0.33 | 0.33 | 1 | 3 | 0.33 | 3 | 0.2 |
| R5 | 0.14 | 0.33 | 0.33 | 0.33 | 1 | 0.33 | 3 | 0.14 |
| R6 | 3 | 3 | 3 | 3 | 3 | 1 | 0.33 | 0.2 |
| R7 | 1 | 1 | 0.33 | 0.33 | 0.33 | 3 | 1 | 0.2 |

| | | | | | | | | |
|----|---|---|---|---|---|---|---|---|
| R8 | 5 | 3 | 5 | 5 | 7 | 3 | 5 | 1 |
|----|---|---|---|---|---|---|---|---|

Step 2:

For determining the Eigen values of a matrix, we perform the averaging method.

| | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|----|-------|------|-------|------|------|------|-------|------|
| R1 | 0.09 | 0.25 | 0.24 | 0.12 | 0.21 | 0.03 | 0.11 | 0.07 |
| R2 | 0.03 | 0.08 | 0.14 | 0.12 | 0.09 | 0.02 | 0.11 | 0.11 |
| R3 | 0.018 | 0.02 | 0.04 | 0.21 | 0.15 | 0.03 | 0.11 | 0.07 |
| R4 | 0.03 | 0.02 | 0.009 | 0.04 | 0.09 | 0.03 | 0.11 | 0.07 |
| R5 | 0.013 | 0.02 | 0.009 | 0.01 | 0.03 | 0.03 | 0.11 | 0.05 |
| R6 | 0.28 | 0.25 | 0.14 | 0.12 | 0.09 | 0.11 | 0.012 | 0.07 |
| R7 | 0.03 | 0.02 | 0.015 | 0.01 | 0.01 | 0.33 | 0.03 | 0.07 |
| R8 | 0.46 | 0.25 | 0.24 | 0.21 | 0.21 | 0.33 | 0.18 | 0.35 |

Step 3:

The sum of each row of the matrix is calculated and each element of the matrix should be divide by the number of requirements.

| |
|-------|
| 1.12 |
| 0.7 |
| 0.648 |
| 0.399 |
| 0.272 |
| 1.072 |
| 0.515 |

| |
|------|
| 2.23 |
|------|

The above values should be divide by 8

| |
|----------|
| 0.14 |
| 0.0875 |
| 0.081 |
| 0.049875 |
| 0.034 |
| 0.134 |
| 0.064375 |
| 0.27875 |

Step 4:

The requirements are assigned with the relative value based on the obtained Eigen value.

R1 has 14% of entire requirement value.

R2 has 8% of entire requirement value.

R3 has 8% of entire requirement value.

R4 has 5% of entire requirement value.

R5 has 3% of entire requirement value.

R6 has 13% of entire requirement value.

R7 has 6% of entire requirement value.

R8 has 27% of entire requirement value.

We determine the consistency of the results by using the formula

Consistency index (CI) = $(\lambda_{\max} - n)/(n-1)$

To find the value of λ_{\max} we have to multiply both the matrices below.

| | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|----|------|------|------|------|------|------|----|------|
| R1 | 1 | 3 | 5 | 3 | 7 | 0.33 | 3 | 0.2 |
| R2 | 0.33 | 1 | 3 | 3 | 3 | 0.2 | 3 | 0.33 |
| R3 | 0.2 | 0.33 | 1 | 5 | 5 | 0.33 | 3 | 0.2 |
| R4 | 0.33 | 0.33 | 0.33 | 1 | 3 | 0.33 | 3 | 0.2 |
| R5 | 0.14 | 0.33 | 0.33 | 0.33 | 1 | 0.33 | 3 | 0.14 |
| R6 | 1 | 1 | 0.33 | 0.33 | 0.33 | 3 | 1 | 0.2 |
| R7 | 1 | 1 | 0.33 | 0.33 | 0.33 | 3 | 1 | 0.2 |
| R8 | 5 | 3 | 5 | 5 | 7 | 3 | 5 | 1 |

| |
|----------|
| 0.14 |
| 0.0875 |
| 0.081 |
| 0.049875 |
| 0.034 |
| 0.134 |
| 0.064375 |
| 0.27875 |

The multiplication results the below values

| |
|---------|
| 3.1542 |
| 1.21275 |
| 1.21986 |

| |
|----------|
| 0.424935 |
| 0.1904 |
| 2.21502 |
| 0.462856 |
| 9.4775 |

The first element in the resulting vector should be divided by the first element of the primary vector.

| |
|--------|
| 22.53 |
| 13.86 |
| 15.06 |
| 8.52 |
| 5.6 |
| 16.53 |
| 7.1899 |
| 34 |

The value of λ_{\max} can be obtained by

$$\lambda_{\max} = (22.53+13.86+15.06+8.52+5.6+16.53+7.1899+34)/8 = 14.7112$$

Now the CI can be calculated by

$$CI = (\lambda_{\max} - n)/(n-1) = (14.7112-8)/(8-1) = 0.958$$

We have the CI and now we have to find the CR

$$CR = CI / RI$$

The RI indices for the matrix 8 is given as 1.41

$$CR = 0.958/1.41 = 0.679$$

This value can occur in rare conditions. The generic value is 0.1 or less than 0.1.

In the next step to find the relative values we perform the cost implementation technique. This method also consists of the same steps as above. The values are taken by not repeating the entire process.

Relative costs which resulted are:

R1 has 5% of entire requirement cost.

R2 has 14% of entire requirement cost.

R3 has 15% of entire requirement cost.

R4 has 13% of entire requirement cost.

R5 has 27% of entire requirement cost.

R6 has 8% of entire requirement cost.

R7 has 11% of entire requirement cost.

R8 has 7% of entire requirement cost.

By using the obtained values a cost value diagram is designed to prioritize the requirements. In the graph there are three regions named high, medium and low.

The ratio for value to cost for requirements is given below:

R1: 2.8

R2: 0.625

R3: 0.54

R4: 0.375

R5: 0.123

R6: 1.675

R7: 0.574

R8: 3.98

The limit for placing the requirements in the regions according to value-cost ratio are high: above 2, medium: between 2 to 0.5 and low: less than 0.5

The requirements which are classified in this method are:

High: R1 and R8, medium: R2, R3, R6 and R7, low: R4 and R5.

V. Lessons Learned

Article 1:

I implemented the RAM model with taking 20 initial requirements. The requirements are easy to place in the earlier stage. But while placing some requirements I got confused that these

requirements would belong to other level. These confusions got clear by the guide which is provided in the article. So, that the requirements are easily placed in the remaining levels. After placing the requirement in a particular level the requirements should be break down. While some requirements are easily break down and some requirements are bit confusing. Overall the process is easy for abstracting the requirements in a large scale and it provides a keen idea about the complexity of the requirement and helps in prioritizing.

Arranging the requirements in an organized way helps in tracking the requirements. If the number of requirements are more than 3000 then it is a complex task to handle the requirements. By using the RAM model the requirements are having different levels, so that the requirements can be handled easily in a large scale requirements.

Article 2:

I implemented this technique for 8 requirements. The calculations went wrong for many times. It took me a lot of time and concentration to apply this method for 8 requirements. This is a complex task for implementation but can be easily implement with specific tools for calculations. For the large scale requirements this would be a typical task, but if the implementation is done in a process the results would give a positive output. So for these type of approached tool support is more important than manual way of doing. So a lot of time is wasted through manually doing the approach instead by giving the values as in starting table, the tool can calculate and provide the final values.

VI. Reflections:

Article 1:

During implementation of ram model, the model seems need to be more specific as there is a confusion arises during allocating requirements to suitable level, so the guide need to be improved. So that requirements like both functional and nonfunctional can be arranged according to the guide. Also as there is a research regarding quality requirements which is 'QRAM' model [3] quality requirements can be placed with functional requirements. So that even more research related to this model can be more helpful for practitioners to easily arrange their requirements. So finally I felt that there needs to be a model which supports all type of requirements where RAM AND QRAM models are beginning of that, further improvement can lead to more useful and generalized model for requirements management.

Article 2:

While implementing this technique it is a good experience. I understood the complexity of using this technique in the large scale requirements. The method is complex to implement but the concept is easy to understand. This method is implemented in a case study which resulted in a positive output.

References:

- [1] Gorschek, Tony, and Claes Wohlin. "Requirements abstraction model."

- [2] Karlsson, Joachim, and Kevin Ryan. "A cost-value approach for prioritizing requirements." *Software, IEEE* 14.5 (1997): 67-74.
- [3] Mahmood, Farrukh, and Waqas Rasheed. "Quality Requirement Abstraction Model (QRAM)." 2014.